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Foreword

We are proud to present the 23rd Volume of Amsterdam University College's *Undergraduate Journal of Liberal Arts and Sciences*!

At the end of their studies at AUC, students write a thesis exploring a topic of their choice driven by independent research. Students are thus provided with an opportunity to use the skills they have obtained during their undergraduate studies, explore an area of personal and academic interest, and potentially begin their future in academia. This issue contains a diversity of excellent theses by AUC students, the topics of which range from the use of biomarker-precision therapy for treating leukemia to the value of local media in conflict prediction, and from the use of senses like touch and smell in museum exhibitions to the impact of double consciousness among racialised others on Dutch racial discourse.

The issue begins with Vojtech Mazur's paper describing cell assembly detection in various mouse brain areas using Minimally Complex Models (MCMs), and showing them to be a reliable model for neuronal assembly detection. The following paper by Ayden Danchi Teye explores biomarker-precision therapy in the context of Acute Myeloid Leukemia. Ayden examines biomarkers in acute myeloid leukemic stem cells (LSCs) linked to relapse, evaluates their potential as pharmacological targets for precision medicine, and identifies combination therapies with reduced toxicity and improved efficacy to address minimal residual disease and treatment resistance.

Opening the Social Sciences section of this issue is a paper by Chynna Bong A Jan, which explores how Dutch double consciousness historically suppresses racial discourse among racialized individuals in the Netherlands and examines how growing anti-racist activism is challenging these norms, reshaping racial identity, and transforming conversations about race and racism. This work is followed by a paper by Fabien Kuzmič introducing the Feasibility Klima Index (FKI), a multidimensional tool that integrates technical, sociopolitical, and behavioural factors to assess and compare climate mitigation strategies.

The first paper in the Humanities department is Manoela de Salles Freire Rutigliano's thesis analysing several exhibits by Ernesto Neto and Maria Nepomuceno that challenge the privileging of sight in museums. Though a nuanced analysis guided by decolonial and queer theory Manoela explores the implications of exhibitions incorporating touch, sound, and even smell, and the experiences these sensations evoke. Helena Burdzińska's paper follows after, discussing the interiors of the Dutch Rijksmuseum and the National Theatre in Prague, and their relationship to collective cultural memories of their respective nations. Helena's detailed analysis sheds light on the reciprocal relationship between national identity and art, as well as the importance of memory studies as a tool for studying art.

Last but not least is Luuk Boekestein's Interdisciplinary thesis, which explores the use of big data approaches in the field of conflict studies to predict outbreaks of violence and conflict. Luuk provides a detailed account of the current state of the field, before exploring whether local or global news data produces more accurate predictions and discussing the implications of his findings.

Before concluding this foreword, we would like to extend our gratitude to everyone else who made this issue possible. We would like to show a moment of appreciation to everyone on InPrint's administrative team, like Mariin and Zuzia, many of whom took on new responsibilities this year and performed them diligently and consistently. We also thank Julia and Lena, the Heads of departments who guided their editors through various challenges and provided us with invaluable support and advice. We also extend our gratitude to editors who have remained from last year, like Wilma, Natalie, and Fatima for continuing their excellent work. Lastly, we want to thank our new editors for their enthusiasm and contributions to this issue.

Not to be forgotten are the students who signed up as peer reviewers and assisted InPrint's team with editing the Capstones in their final stages - thank you!

Finally, we would also like to extend our gratitude to InPrint's faculty advisors — Luis and Joost. We're grateful for the support and advice you have provided our committee, and the opportunities for collaboration we have explored.

Polina Smirnova and Basia Haber, co-Editor-in-Chiefs

Contents

Sciences

Cell Assembly Detection in Mouse V1, PPC, and CG1 Using Minimally Complex Models

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koto_feja, 2022.

Abstract

Perception involves the cooperation of various brain areas and the processing of information via neuronal assemblies - communities of highly correlated neurons. *Minimally complex models* (MCMs), a subfamily of spin models, have recently been shown to detect higher-order interactions in binary data while avoiding the intensive computational costs typically associated with higher-order pattern detection. In this study, I applied MCMs to detect assemblies of interacting neurons in mouse primary visual cortex (V1), posterior parietal cortex (PPC), and cingulate area 1 (CG1). I used pre-existing neural population recordings from the mouse cortex, obtained with permission from Umberto Olcese's lab at the Swammerdam Institute for Life Sciences. Using Bayesian model selection of MCMs on this data, I detected consistent communities of interacting neurons across time scales and combinations of visual and auditory stimuli. These communities existed within and between the investigated cortical areas, providing evidence for inter-area functional connectivity at the level of cell assemblies. Evaluation with clustering similarity metrics confirmed that MCMs are a reliable model for neuronal assembly detection. Additionally, since MCMs can be applied to any binary dataset, this example illustrates their versatility and utility in various scientific fields.

 Keywords and phrases: *Minimally Complex Models, neuronal assemblies, perception, primary visual area, cingulate area 1, posterior parietal cortex, community detection*

Contents

List of Abbreviations

MCM Minimally Complex Model

V1 Primary Visual Cortex

CG1 Cingulate area 1

PPC Posterior Parietal Cortex

ICC Independent complete component

ARI Adjusted rand score

NMI Normalized mutual information

1 Introduction

Over the past few decades, our understanding of the brain has advanced remarkably, yet many of the intricacies of neural information processing and functioning remain to be fully understood For a long time, it was thought that information processing occurs primarily at the level of individual neurons. However, research in the past decades points toward neuronal communities, called cell assemblies, as being a key information-processing unit in the brain [1-5]. Cell assemblies are typically defined as communities of neurons with highly correlated and co-occurring spiking (firing of action potentials), and they are found both within and across brain areas [1, 2].

One field where cell assemblies have received a lot of attention is perception. Making sense of the world by processing limited and noisy information from the outside world is a complex process. It involves many brain areas and the integration of information from different senses [6, 7]. An increasing amount of evidence shows that perception is not a simple feedforward process, but involves recurrent processing and complex top-down modulation [8, 9]. As assumed by the predictive coding framework, perception is dependent on prior expectations and predictions that interact with the incoming sensory information [9]. Inevitably, this involves complex information processing and functional connections across many cortical areas. Studying these functional connections is crucial to understanding how the brain processes sensory information and turns it into conscious percepts.

Though valuable insights into this topic can be provided by studying the functional connectivity of single neurons and cell assemblies, this approach has a notable limitation. The commonly utilized network-based functional connectivity models encode only pairwise interactions [10]. However, recent experimental evidence suggests that higher-order interactions (i.e. interactions involving three or more neurons) are present and an inherent component of neuronal connectivity [11, 12]. Typically, models encoding higher-order interactions tend to be computationally infeasible because the number of possible interactions scales superexponentially with input size [10, 13]. *Minimally complex models* (MCMs) are a subclass of atomic spin models, a mathematical family of models that can sim-

ulate interactions of binary and non-binary variables. While MCMs can encode higher-order interactions, their log evidence is easy to compute [13]. This means that a best-fit model for data can be found relatively quickly using Bayesian model selection implemented with a greedy search algorithm without having to parse the space of all possible MCMs (which is still very large) [13]. This allows researchers to model higher-order interactions while maintaining reasonable computation time. using Bayesian model selection, allowing researchers to model higher-order interactions while maintaining reasonable computation time. using Bayesian model selection, allowing researchers to model higher-order interactions while maintaining reasonable computation time.

In this paper I apply the Bayesian model selection of MCMs to neural population recording data from a mouse cortex (specifically the primary visual cortex (V1), cingulate area 1 (CG1), and posterior parietal cortex (PPC)) [6]. The aim of this investigation is three-fold. First, I aim to demonstrate and examine the utility of this new modeling approach for analyzing the functional connectivity of neurons. Secondly, I will use the MCMs to detect and investigate the cell assemblies and functional connectivity within and across the aforementioned areas of the mouse cortex. Finally, I aim to investigate the reliability of the MCM community detection results using clustering similarity metrics. Taken together, these aims can be summarized in the following research question:

How effectively and reliably can Minimally Complex Models detect and analyze functional connectivity and cell assemblies within and between the areas V1, CG1, and PPC in the mouse cortex and what information can they reveal about the cell assemblies?

Section 2.1 I will expand on the neuroscientific background of cell assemblies and how they relate to perception, as well as evidence that studying higher-order neuron interactions is necessary. Next, in section 2.2 I will explain what MCMs are and how they can be used for community detection. I will then explain my methodology and examine the data used in my analysis in section 3, after which I will present the main results in section 4 and discuss their implications in section 5.

2 Research context

2.1 Multisensory integration and the role of cell assemblies

Multisensory perception is a complex process, as it is involved not just in the processing of sensory information, but also in attention, decision-making, and responding to external stimuli [1, 14]. As a consequence, numerous cortical and subcortical connections lead to higher sensory cortices and primary sensory areas, including V1, the focus of this study. Functional connectivity is critical to understanding information processing in the brain [1, 14]. Previous research identified extensive connections to mouse V1 that seem to play a role in perception and multisensory integration (MI) [15, 16]. While the main input into V1 is sensory information from the retina, traveling via the optic nerves and thalamus, there are also substantial inputs from the anteromedial cortex [15]. This includes the secondary motor cortex, anterior cingulate cortex, and medial parts of the temporal lobe. Crossmodal connections have been identified with the primary auditory cortex (A1), which was found to influence basal V1 activity with an early onset after the change of a visual or auditory stimulus [16]. In comparison, motor inputs to the V1 tend to have a later onset and have been associated with a longer sustained V1 activation during a decision task that involves multisensory discrimination [6, 16].

Top-down modulation and recurrent processing have gained particular attention in recent years. Information processing in the V1 was shown to be modified by the animal's goals, behavior, and internal state using complex regulatory circuits [6, 15-16]. For instance, multisensory discrimination seems to require a longer sustained duration of V1 activation compared to a unisensory stimulus change [6]. The theory of predictive coding even proposes that percepts are best-guess predictions about external stimuli and are continually updated with incoming sensory evidence [9]. This has been proposed as a key feature of conscious perception [8-9].

In my examination, I will specifically focus on connections of V1 with the PPC and CG1. The PPC is a prominent hub for the integration of sensory information with motor planning, perceptual decision-making, and spatial awareness [17-19]. It has connections with visual, auditory, and somatosensory motor areas, including bidirectional connections to V1 [17-20]. While it appears to be involved in some forms of perceptual decision-making, it is not always causally necessary and its exact role in decision-making is still under scientific scrutiny [19, 20]. Meanwhile, CG1 is also an informational hub involved in a variety of cognitive functions, including attention, motivation, and regulation of emotional responses as a part of the limbic system [21-23]. Just like the PPC, it is bidirectionally connected with V1 and involved in visual perception and attention [22-25]. For example, it modulates selective attention through long-range Gaba projections to V1 [24], and its neurons show selective attenuation in response to a visual discrimination task [25].

Parallel research highlights the key roles of neuronal assemblies (also called cell assemblies): populations of neurons that tend to be correlated and fire in unison [1-5]. These neuronal assemblies can be both localized and spread across multiple brain areas, and communication both within and across cell assemblies is important in perception [1, 2]. It was long known that stimulus-specific cells exist in V1 (such as cells sensitive to a specific line orientation [26]), but there also appear to be distinct stimulus-specific cell assemblies [3]. These can be differentiated from background activity, encode detailed stimulus information, and were shown to be inactivated by anesthesia [3]. Some have even proposed that cell assemblies, as opposed to individual neurons, are the brain's main information-processing unit [4]. Still, it also appears that not all neurons are members of cell assemblies. Evidence suggests that rapidly firing thin spike neurons tend to fire in correlation with each other, while the action potentials of less frequently firing broad spike neurons are more independent [27]. Still, it is undeniable that there is a dynamic interaction of neurons both within and across cell assemblies.

Hence, understanding neuronal cell assemblies and their communication across brain areas is key to understanding information processing during perception of multisensory stimuli. The most common methods of cell assembly detection involve pairwise interactions and correlations [10, 28]. For instance, ref. [28] shows that weak pairwise correlations were sufficient to predict large-scale firing patterns better than an independent random model. However, while many studies focus on pairwise interactions between neurons, higher-

order interactions also play an important role [10-12]. For example, a third-order interaction could be a neuron that is only active if two neighboring neurons are silenced. More complex examples include cortical avalanches or simultaneous silence, a phenomenon where many neurons are not spiking at a given time [11-12]. Often, it is difficult or virtually impossible to explain these features from pairwise interactions. Therefore, searching for higher-order interactions could give us new insights into neuronal information processing patterns that might be unattainable with pairwise approaches.

When studying higher-order interactions, model complexity quickly becomes an issue since the number of possible interactions grows super-exponentially with input size [10, 13]. De Mulatier (ref. [13]) proposes a solution in the form of MCMs, a subclass of spin models. Spin models and MCMs are described in the next section, along with an explanation of why MCMs are the ideal candidates for higher-order community detection using Bayesian model selection.

2.2 Introduction to Minimally Complex Models and Bayesian model selection

MCMs belong to a class of physical models called spin models. While spin models were originally developed to model the magnetic properties of elements, they have found wide applicability in many different contexts [29]. This is because they can model interactions of any order between variables and can infer patterns directly from binary data (without the need for a correlation network) [10, 13]. A famous example is the Ising model, which has been successfully applied to magnetic elements, voting patterns, and more [29]. Given a set of binary data with n variables (called $spins$), $s = (s_1, \ldots, s_n)$, N independent observations $\hat{s} = \left(s^{(1)}, \ldots, s^{(N)} \right)$, we can infer a probability distribution that was most likely to have generated the data. This can be achieved by this by examining the following parametric family of probability distributions:

$$P(s \mid g, M) = \frac{1}{Z_M(g)} \exp \left(\sum_{\mu \in M} g^\mu \phi^\mu(s) \right) \qquad (1)$$

Here, $M = \{\mu_1, \ldots, \mu_K\}$ is a set of K interactions (each μ_i is a binary vector that encodes which

spins partake in a particular interaction). Each vector μ can include an arbitrary order of interactions by involving any number of spins up to n. The vector g includes the parameters g_u that modify the strength of interactions, and normalization is achieved using the partition function $Z_M(g)$. Finally, $\phi^\mu(s)$ are called $spin operators$, and they are the product of the spins participating in each interaction μ:

$$\phi^\mu(s) = \prod_{i=1}^{n} s_i^{\mu_i} \qquad (2)$$

In principle, the model family in Eq. (1) can encode any possible set of spin interactions, but we are only interested in finding the set of interactions that creates the probability distribution of our observed data. In other words, our goal is to find the model M with the largest probability $P(\hat{s} \mid M)$ of generating the data. This probability is called the evidence (or marginal likelihood) and is computed by integrating the probability distribution in Eq. (1) over all possible values of the parameters g:

$$P(\hat{s} \mid M) = \int_{R^M} P(s \mid M, g) P_0(g) \, dg \qquad (3)$$

Here $P_0(g)$ is the prior distribution over parameters g. Evidence represents the overall fit of a model to the given data. The model maximizing the evidence reaches the optimal balance between goodness of fit and complexity of the model. Note that due to the high-dimensional integral, the evidence becomes difficult to compute. Moreover, in a system with n spin variables, the number of plausible interactions is $2^{n\smile}1$, which means there are $2^{2^n} - 1$ plausible spin models – this huge number quickly makes an exhaustive search computationally intractable as n increases. As a solution, ref. [13] proposes applying Bayesian model selection only to $minimally complex models$ (MCMs), a subfamily of spin models.

As a prerequisite for defining MCMs, we must first discuss $independent complete components$ (ICCs). As its name suggests, an ICC is a set of spin interactions M_a that satisfies two properties. Firstly, it is $complete$, meaning that for any two interactions $\mu, \nu \in M^a$, the interaction $\mu \oplus \nu$ is also an element of M_a. Secondly, it is $independent$ of other ICCs. This means that for a set of ICCs $M^a, a \in A$, the operators of any model M_a in the set cannot be derived by multiplication of any operators of any other model in A. An MCM is simply a spin model

whose interactions are solely composed of ICCs:

$$M = \bigcup_{a \in A} M_a \qquad (4)$$

Figure 1 gives some examples of MCMs. Note that by definition, every ICC is also an MCM. Each ICC (and every MCM) can be expressed in terms of a basis $b = (\phi_1, \ldots, \phi_r)$, where each basis element ϕ_i is a single spin operator and any interaction in the ICC can be expressed as a product of these operators. In the default case, the basis simply consists of the original first-order spin variables (in our case individual neurons). This allows us to interpret the ICC as a community of spin variables, enabling us to detect assemblies of interacting neurons by finding the set of ICCs with the maximum evidence.
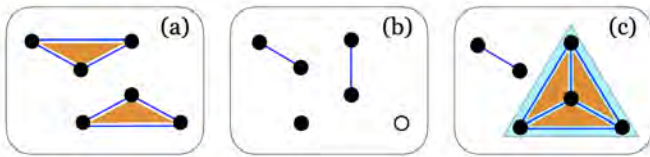

Figure 1: Examples of MCMs in a system of six variables, represented by the dots. First-order interactions are indicated by blackened-out dots, second-order by a blue line (between two variables), third-order by an orange triangle, and fourth-order by a light blue triangle. The models respectively have (a) two, (b) three, and (c) two ICCs. Reproduced from [13] with author permission.

As shown in ref. [13], the evidence of each MCM is relatively straightforward to compute as the ICCs greatly simplify the evidence formula in eq. 3. to the following form:

$$P(\hat{s} \mid M) = \frac{1}{2^{N(n-r)}} \prod_{a \in A} \frac{\Gamma\left(2^{r_a-1}\right)}{\Gamma\left(N + 2^{r_a-1}\right)} \prod_{b_a} \frac{\Gamma\left(k_{b_a} + \frac{1}{2}\right)}{\sqrt{\pi}}$$

$$(5)$$

where N corresponds to the number of observations in $\hat{s}$ and Γ denotes the gamma function. The rank r_a of an ICC M_a is the total number of basis variables in the ICC, $r = \sum_a r_a$ is the total rank of model M and denotes its cardinality. Finally, k_{b_a} is the number of instances in the dataset where the basis operators of M_a take the value b_a. The process of finding the model that maximizes the (log)-evidence (which as we recall is equivalent to finding the model with the best probability distribution for the data) is termed Bayesian model selection. Both the reduction in the number of possible mod-

els and the relatively easy computation of evidence mean that MCMs are ideal candidates for applying Bayesian model selection to our data. The process of finding the model that maximizes the (log)-evidence (which as we recall is equivalent to finding the model with the best probability distribution for the data) is termed Bayesian model selection. Both the reduction in the number of possible models and the relatively easy computation of evidence mean that MCMs are ideal candidates for applying Bayesian model selection to our data.

2.2.1 MCM and best basis search algorithms

Even if we employ Bayesian model selection on MCMs, the space of searching for the best MCM remains very large. An exhaustive search for the best MCM becomes computationally infeasible for $n \geq 15$ due to the large number of possible MCMs, so a different approach is needed [13]. Therefore, ref. [13] develops a greedy algorithm to find the best MCM. First, each spin operator in the basis is assigned into its own ICC. Then, it attempts to merge all of the pairs of existing operators into new ICCs and selects the merger with the largest corresponding increase in log-evidence. This step is repeated as long as there is an increase in log evidence from the merger, or until all operators are merged into the same ICC. The code for this algorithm, developed by de Mulatier, is available at ref. [30]. In Section 4, I will implement this algorithm to find the best MCMs in the dataset of neuron spikes in the mouse cortex for different choices of stimuli and time windows (see Sections 3.1 and 3.2 for details).

Recall that any spin model M has a basis ḅ, a minimal set of independent operators from which any operator of the model M can be constructed. The basis is said to have a rank r, which is the number of spin operators in the basis. Using a basis of the original spin variables has the advantage of easy interpretation; the ICCs are simply communities of spin variables. However, a given basis also limits the MCMs that can be generated from its basis vectors, which means that the original basis might not be optimal for finding the best MCM. To resolve this issue, de Mulatier proposes a best basis (also called "preferred basis") in which the operators in b directly correspond to the partitions of the ICCs [13]. In other words, the new basis variables in the preferred basis can correspond to prod-

ucts of the original variables. For instance, in neural recording data, each original variable corresponds to one neuron. Then in the best basis, the new variables might correspond to highly (anti-)correlated pairs or triplets of neurons that capture more information in the data observations than the original division into neurons.

Given binary data in the original basis, de Mulatier presents a separate algorithm to transform the data into the best basis [31]. This algorithm searches the best basis for possible all operators up to an order k, choosing the operators with the highest bias (where bias is the deviation from probability based on random chance). Similar to the search for the best MCM, an exhaustive search over all operators would be infeasible for the large numbers of variables in the data presented in this paper. The basis search algorithm returns the new basis along with a mapping to the original basis so that the two can be compared. Later in my analysis, I will attempt to use this algorithm to find additional neurons interactions beyond what we can detect with the MCMs alone (section 4.4).

3 Experimental data and methods

My study used data obtained by ref. [6]. In separate recording sessions, mice were simultaneously presented with visual stimuli (line gratings with a certain orientation) and auditory stimuli (a constant note playing at a certain frequency). During each trial, either one or both of the stimuli (the angle of the line gratings or the frequency of the sound note) changed. The cohort relevant to the present study was trained to respond to either stimulus with a lick on one of two sensitive pads, depending on whether the stimulus change was visual or auditory. Throughout the trials, the activity of single neurons was recorded in vivo using silicon probes in the mouse's V1, CG1, and PPC. CG1 was not included in the recording sessions 3 and 4. The resulting data is a time series of neuron spikes for each recorded neuron. For more details on the data collection, please refer to Lohuis et al. [6]. All of my subsequent analysis was done in Python 3, with the code available in ref. [32].

The data was recorded in 20-40 minute sessions from the same animal, with new probes used in each session. Additionally, each session had mul-

tiple combinations of grating angles and sound frequencies that varied from trial to trial. Since such stimulus combinations inherently alter the activity of cells in the primary visual cortices [3, 17], I will group trials into combinations with a similar line orientation ($\pm$ 2.5°) and sound frequency ($\pm$ 15Hz). This will ensure enough data to find the best MCM for each stimulus combination while also not pooling activity under different conditions. The data for the initial analysis consisted of four recording sessions from a single mouse (Table 1).

3.1 Data preprocessing and format

Since the MCMs can only be fitted to binary data, the time series spiking data was first binarized. In other words, the time interval before and after stimulus change in each trial was cut into discrete time bins of constant size. Each time bin contained a 1 if the neuron fired in this interval, 0 otherwise. While this is necessary for MCM analysis, it also means that occasionally the neuron can spike multiple times during a time interval, thus leading to a loss of information. The probability of multiple neuron spikes in a time bin increases proportionally to the time bin size (Table 2). However, the neuron firings appeared to be rather sparse, with most neurons staying silent most of the time and only firing occasionally (Table 2; Fig. 2). Hence, it occurred rather infrequently that more than 1 spike occurred during a time bin. Since the MCMs can only be fitted to binary data, the time series spiking data was first binarized. In other words, the time interval before and after stimulus change in each trial was cut into discrete time bins of constant size. Each time bin contained a 1 if the neuron fired in this interval, 0 otherwise. While this is necessary for MCM analysis, it also means that occasionally the neuron can spike multiple times during a time interval, thus leading to a loss of information. The probability of multiple neuron spikes in a time bin increases proportionally to the time bin size (Table 2). However, the neuron firings appeared to be rather sparse, with most neurons staying silent most of the time and only firing occasionally (Table 2; Fig. 2). Hence, it occurred rather infrequently that more than 1 spike occurred during a time bin.

Only two seconds of recordings before the stimulus change were used per trial (see above). This ensured that the neuron activity had a chance to return to a baseline level after the previous trial's

Table 1: A summary of the recording sessions used in the analysis.

Session number	Brain areas recorded	No. of neurons (equal to no. of spin variables)	Duration	No. of trials	No. of different stimulus combinations
1	CG1, PPC, V1	86	41 min 47 s	330	4
2	CG1, PPC, V1	68	44 min 46 s	373	4
3	V1, PPC	37	33 min 13 s	272	4
4	V1, PPC	31	22 min 48 s	170	4

Table 2: The average number of neuron spikes in time bins.

Time bin size (bf)	Average no. of spikes in all bins	Average no. of spikes in bins with at least one spike	Frequency of bins with more than 1 spike out of all bins with a spike
5	0.0309	1.2948	0.06353
10	0.0618	1.3392	0.1064
15	0.0927	1.3822	0.1447
20	0.1235	1.4223	0.1785
25	0.1543	1.4588	0.2084
30	0.1851	1.4957	0.2356

stimulus change. After each stimulus change, response-relevant activity lasted only up to 500ms [6], which would not provide enough data for MCM analysis and would require the concatenation of too many trials (see next section). To get a perspective of the time scale at which we can find distinct neuronal communities, multiple binarizations were done for each trial with a bin size ranging from 5 to 30 ms, at 5 ms intervals. Based on previous research, these are reasonable time scales for identifying assemblies of interacting neurons [6, 16].

3.2 MCM analysis steps

The main goal was to analyze neuronal assemblies across different brain areas and potentially gather information about their functional connectivity. The first analysis step was to concatenate a number of trials with the same stimulus combination since even two seconds of data per trial was not enough to find strong communities. To find enough large components and higher-order interactions, at least 1000 data observations are required as a rule of thumb, and more observations would be better [13]. The two seconds of recording yield from 66 (for 30ms time bins) to 200 (for
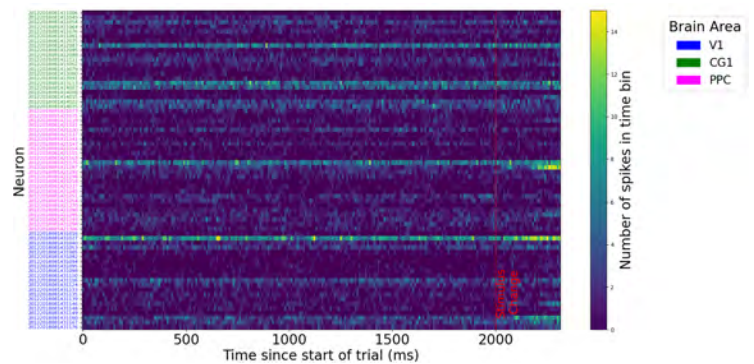
Figure 2: An example superimposed Raster plot, showing the binarized neuron firings for 41 superimposed trials with the stimulus combination of 225-230°line gratings and a sound frequency of 13000-13020 Hz before stimulus change. This plot was created by superimposing Raster plots of individual trials (Fig. S1; see Appendix for supplementary figures)

5ms time bins) data observations per trial. To ensure enough data for an MCM to find higher-order patterns, the data was combined from multiple trials randomly sampled with replacement from each stimulus (the number of trials was chosen so that

there were at least 1500 data observations available for each MCM). This was repeated thirty times for each stimulus combination and time bin size.

Secondly, the greedy algorithm from de Mulatier [30] was used to find the best MCM for each trial concatenation and a co-occurrence matrix was generated. This is a matrix where each row and column correspond to one variable, with each entry being set to 1 if the two variables are found in the same component, and 0 otherwise. All 30 of the matrices for each trial combination were summed and displayed as a heatmap, with darker colors indicating a higher frequency of co-occurrence. To further analyze this cross-connectivity, hierarchical clustering was utilized to group frequently connected neurons. This was done by first converting the superimposed co-occurrence matrix into a similarity and then a distance matrix. From this, the hierarchical clusters were identified using the Scipy clustering module for Python 3 [33]. The hierarchical clusters provided quantitative information on the distance within and between the clusters, thus allowing a better understanding of cluster separability. Moreover, hierarchical clustering was subsequently utilized to reorder the superimposed co-occurrence heat maps to group neurons from different communities together. Finally, clustering similarity metrics and log-evidence were used to evaluate the community detection results and provide additional comparisons of communities across time scales and stimulus combinations.
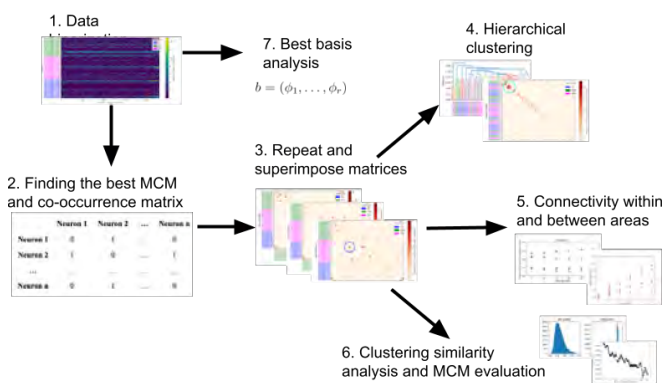
Figure 3: A graphical summary of the data analysis steps

In the results section, I will use the terms "components," "clusters," and "communities" to refer to detected cell assemblies. By "components" I will refer to neuron groupings within the MCMs, while I will use the term "clusters" to strictly refer to the groupings created with hierarchical clustering. I will use the term "communities" more interchangeably to refer to any grouping of interacting neurons. The term "connection" simply refers to two neurons being found in the same component.

4 Analyzing functional connectivity between areas

4.1 Effect of time bin size: community structure at different time scales

As described before, the data was binarized into discrete time bins, ranging from 5 to 30 ms. Analysis of MCMs created using different time bin sizes revealed distinct patterns at varying time scales. At the 5-ms time scale, most components were rather sparse (meaning that most components were found in a relatively small proportion of the MCMs; Fig. 4a). Notably, the connections were rather equally distributed within and between different brain areas. Similarly, the hierarchical clustering revealed small clusters, mostly containing between two to four neurons (Fig. 4b). With 10 ms time bins, there was a larger number of neurons in different components, particularly within the same brain areas (Fig. 4c). At this time scale, hierarchical clustering typically revealed fewer clusters of varying sizes, mostly ranging from around two to six neurons but some having over ten neurons (Fig. 4d). These clusters can be seen more clearly if we reorder the neurons on the heatmap of the superimposed co-occurrence matrix according to their hierarchical cluster membership (Fig. 6).

With time bins of 15-30ms, we see distinct components with high occurrence that are stable throughout these time scales (Fig. 4e-h; Fig. S2). These strong connections tend to form both within and across brain areas. For an initial visual validation, we can identify connected pairs of neurons that are present at all time bin sizes. For instance, the neurons 1421155 and 1414008 co-occur consistently from 5ms to 30ms time bins in session 2 (Fig. 4). A quantitative analysis of how stable the clusters are across stimuli and time scales is presented later in section 4.3.

The component size grows with increasing time
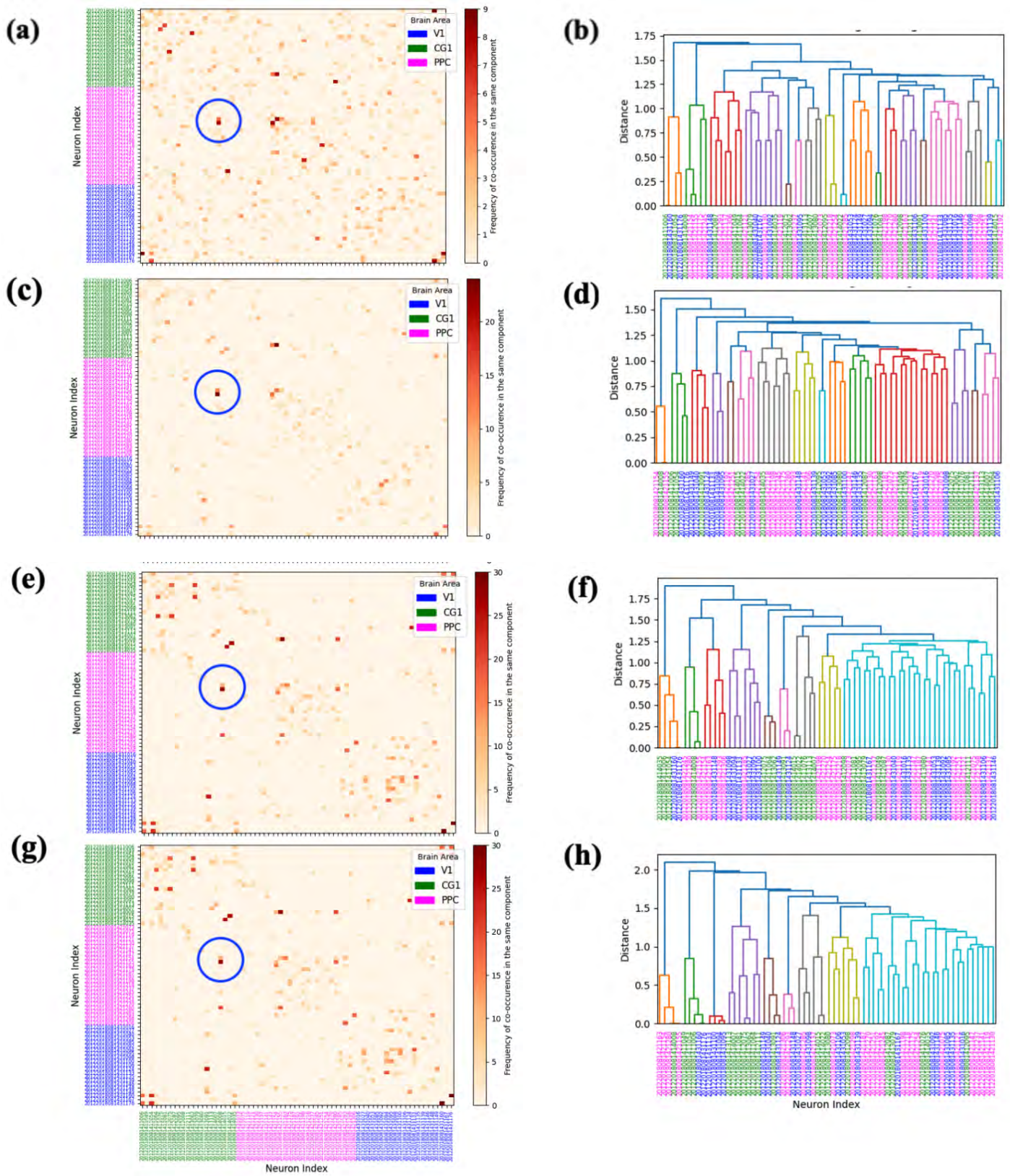
Figure 4: Representative superimposed co-occurrence matrices and hierarchical clustering dendrograms, made from concatenated trial data from the same stimulus combination at varying time bin sizes: (a-b) 5ms, (c-d) 10ms, (e-f) 20ms, and (g-h) 30ms; the blue circle indicates the connection between the neurons 1421155 and 1414008, an example connection that is stable across all time bins
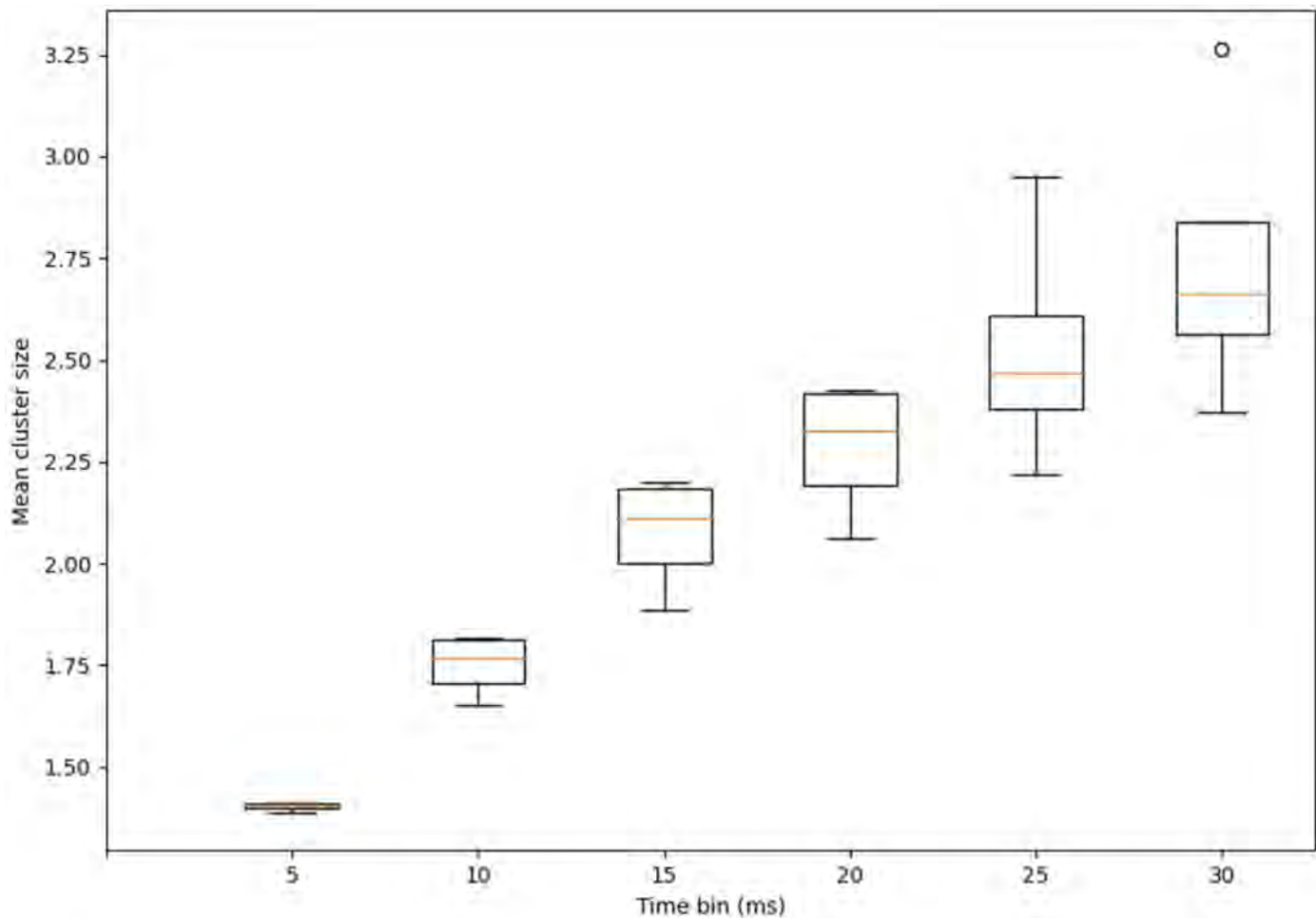
Figure 5: Box plots showing the changes in the sizes of ICCs across different time bin sizes

bin size (Fig. 5). Although this result could be partly explained by a greater overlap in the time bins (which would mean more neurons simultaneously active just by chance), the hierarchical clustering shows that the results are more nuanced. In most dendrograms at these time scales, we typically have one large cluster of distantly related neurons dominating the diagram with multiple smaller clusters that range from two to six neurons and tend to have smaller distances in between (Fig. 4f,h). This implies that with the 20-30ms time bin sizes, the smaller clusters contain more closely interacting neurons than the large clusters with 10 or more neurons. Even among the more closely connected clusters, there is considerable variation in distance between nearest neighbors, with a distance less than 0.5 in some clusters and greater than 1 in others (Fig. 4f,h). Together with the increasing component size in larger time bins, these results indicate that even within the community, some neurons interact with one another more frequently than others.

Reordering the superimposed heatmap to bring together clusters shows that the smaller clusters correspond to clusters of strongly interacting neurons both within and between brain areas (Fig. 6). Meanwhile, the large clusters appear to be congregations of small communities of two or three interacting neurons, with occasional weaker interactions with more neurons (Fig. 6). This gives new insights into functional neuronal communities in sensory areas. While many neurons seem to be involved in pairwise or three-neuron interactions at short time scales (5 ms), some tend to interact in larger communities at larger time scales (15-30 ms).

Moreover, after visual inspection, the most highly connected clusters tend to show up on the superimposed plots even across time bins. One example is a cluster containing the previously mentioned neurons 1421155 and 1414008. Interestingly, the size of the cluster increases from 3 neu-

rons to 4 neurons as the time bin increases from 15ms to 20ms, which suggests that one neuron only seems to interact with the others at a longer time scale. Conversely, neurons that are not part of a distinct cluster or are only in a weakly connected cluster on the superimposed plots show a more varied firing pattern as the time bin size varies (Fig. 6).

4.2 Functional connections between and within brain areas

As a reminder, I am using the term "connection" to mean two neurons being in the same ICC–in other words, the two neurons are involved in an interaction. Sensory processing is a complex process that involves multiple brain areas, and studying interactions between neurons in different areas is crucial to understanding this processing [6, 7, 15-17]. The superimposed co-occurrence matrices reveal connections both within and between brain areas. Hence, the next logical step is to quantify the relative amounts of these connections by calculating the relative proportions of the two types of connections.

The proportion of connections found within a brain area increases as the time bin size increases, and it seems to plateau between 15-20ms (Fig. 7a-d). In the first two sessions, there are significantly more connections between areas than in sessions 3 and 4 (Fig. 7a-d). One reason seems to be that only two brain areas were recorded in sessions 3 and 4, while three areas were recorded in sessions 1 and 2. Figure 7a/b indicates that the numbers of connections between each pair of areas are roughly equal; therefore, excluding one area from the recording meant excluding $\frac{2}{3}$ of the potential inter-area connections from the recordings. Still, the number of V1-PPC connections observed in the later time bins of sessions 3 and 4 seems to be even lower than expected by this reasoning. A possible reason is that fewer neurons were recorded in sessions 3 and 4, which would reduce the probability of finding inter-area connections.

Moreover, across all time bins in sessions 1 and 2, the components that contained connections between areas tended to be larger on average; in these sessions, the size of inter-area components increased faster with increasing time bin size (Fig. 8). In sessions 3 and 4, we see the exact opposite trend – the within-area components are larger and increase faster as time bin size increases (Fig. 8).

A reasonable explanation of these results could be the decreased number of connections between areas observed in sessions 3 and 4 (Fig. 7c-d). No components containing neurons from all 3 regions have been found.

4.3 Robustness and similarity analysis

Previous analysis reveals numerous interesting patterns regarding communities and connectivity. Stability analysis (i.e. comparing the similarity of community allocation results across different clustering attempts) is important to ensure the robustness of these results (i.e. their generalizability). Moreover, comparing the similarity of communities both within and across different time scales and stimulus combinations could reveal how different the clustering is across these conditions. In the following section, I will first compare the stability of clusters of different runs within the sessions and stimulus combinations

4.3.1 Stability of MCM clustering within sessions

At 20 ms, the average component size of the MCMs appears to stabilize (Fig. 5), and it offers a good trade-off between showing distinct communities and not showing spurious patterns due to overlapping spiking. Moreover, the patterns observed were nearly identical at the 10, 20, and 30 ms time bins analyzed for this section. Hence, I will only include plots with 20ms time bins as they are most representative of the overall pattern.

To validate the clustering stability, the Adjusted Rand Index (ARI) and Normalized Mutual Information (NMI) were computed for clusters across stimulus combinations and time bins [34, 35]. Both are metrics that compare the similarity of clustering results of different clustering attempts of the same data. ARI quantifies the number of pairs that were assigned to the same cluster in two clustering attempts, and its scale ranges from -1 (perfect mismatch) to 1 (perfect match). An ARI score of 0 indicates that the similarity of the clusterings is no better than random [34]. Meanwhile, NMI measures the degree of shared information between two clustering attempts, ranging from 0 (no shared information) to 1 (maximum shared information) [35]. In this section, I will use these metrics to compare only the clustering of the ICCs.
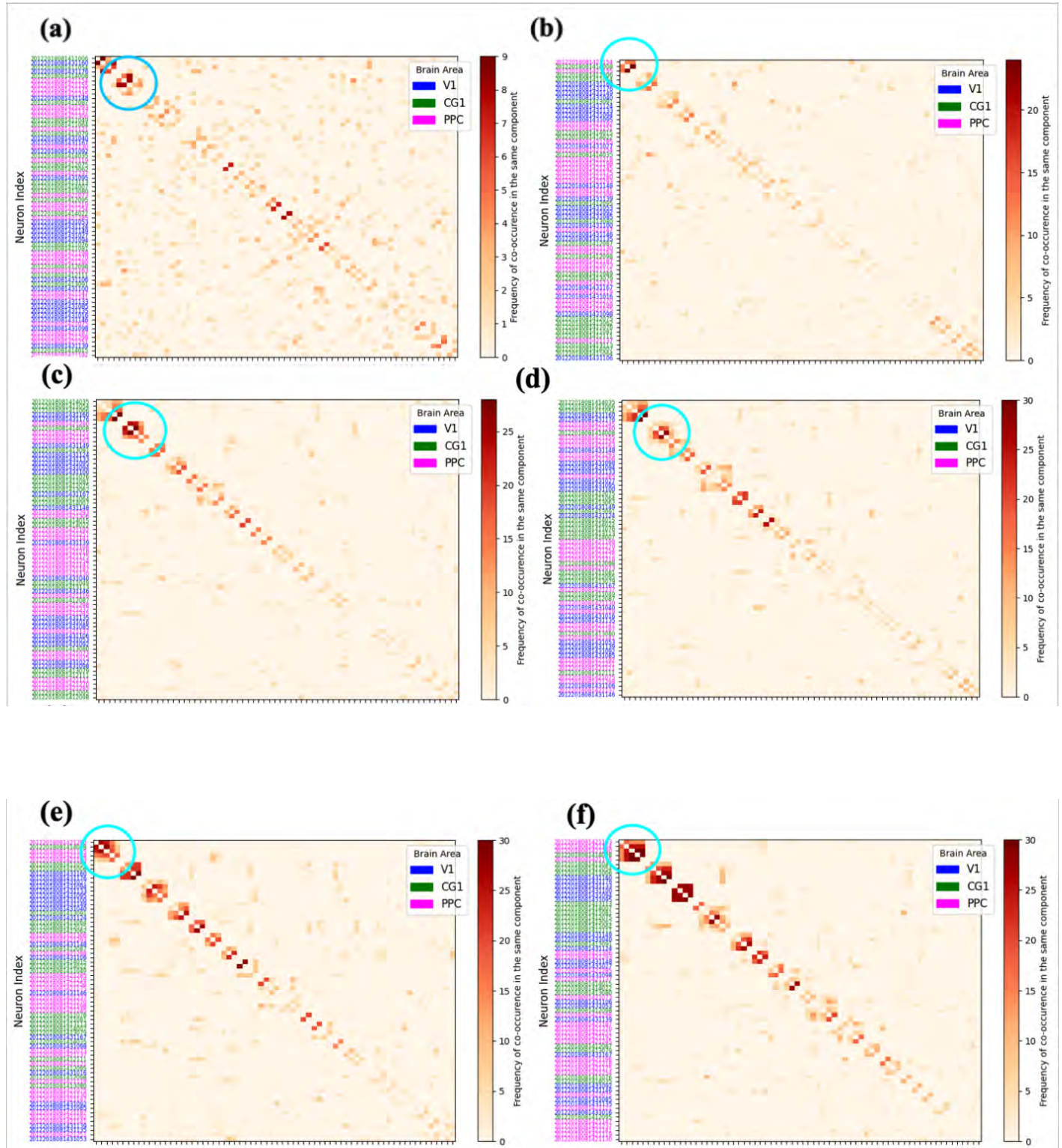
Figure 6: Superimposed matrices reordered to show the clusters, showing the results of MCMs from the same stimulus combination as Fig. 5. The time bin sizes are (a) 5ms, (b) 10ms, (c) 15ms, (d) 20ms, (e) 25ms, (f) 30ms. One cluster that appears in all 6 time scales is circled in blue; note that its position in the plot varies because the neurons were ordered according to their hierarchical clustering distance, which varies from bin to bin.
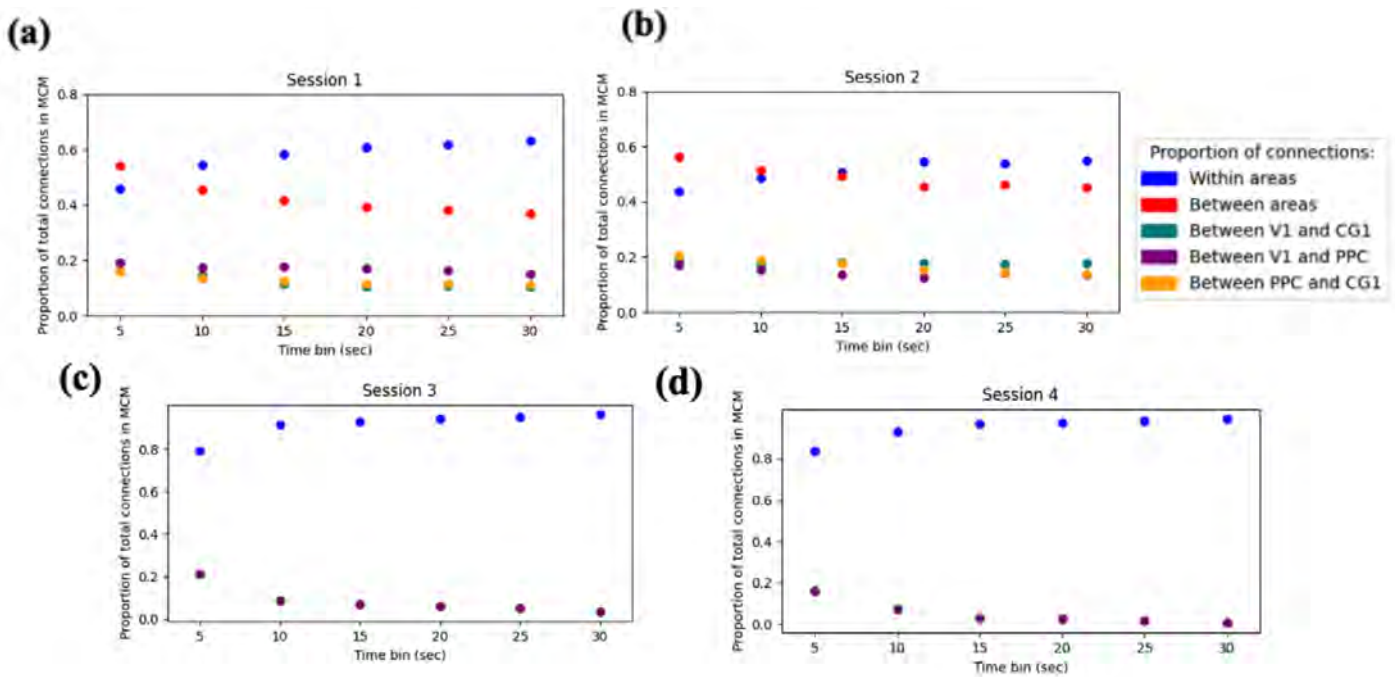
Figure 7: Scatter plots showing the proportion of connections within and between different brain areas; (a-b) in sessions 1 and 2 we can see the total connections between brain areas and connections between specific brain areas, while in (c-d) sessions 3 and 4 we can only see connections between V1 and PPC
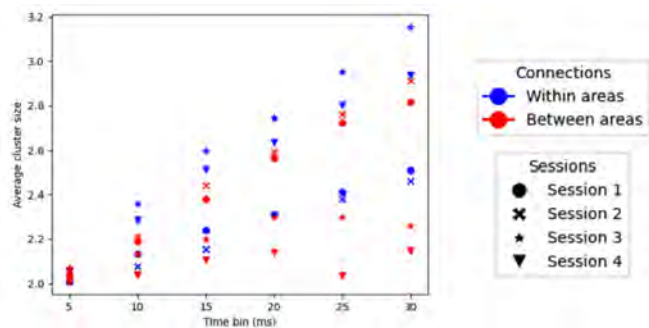
Figure 8: A scatter plot of the average ICC size of components that contained connections solely within areas and components with connections across areas; components of size 1 were excluded as they contained no connections.

To analyze clustering stability, I compared the similarity of MCM components within the same stimulus combination and time bin. For each stimulus combination, I used random sampling with replacement to create 60 different concatenations of the trials, resulting in 60 MCMs per stimulus combination per time bin. Then, I calculated the pairwise ARI and NMI scores for each pair of the 60 MCMs, plotting the resulting ARI and NMI distributions in a histogram (Fig. 9).

A first key observation is that the NMI scores are on average much higher than the ARI scores, with their means being 0.8466 and 0.3355 respectively. The distribution of the NMI scores is also narrower, spread between 0.75 and 0.95, while the ARI scores range from 0.05 to around 0.90 with a right-skewed distribution. The low mean and peak of the ARI scores indicate that the average match in assignment into clusters is only marginally better than random. While this could indicate poor clustering quality, the ARI score can also be heavily affected by a difference in the number of components and label permutations (i.e. labeling the same component differently in separate clustering attempts) [34]. Indeed, the high NMI score suggests that a significant proportion of the information is shared between the two clustering attempts. This means that individual neurons tend to be grouped with the same neurons across different MCM runs. Hence, the clustering attempts by fitting an MCM were quite consistent and the low ARI scores can probably be attributed to differences in component labeling and sizes.
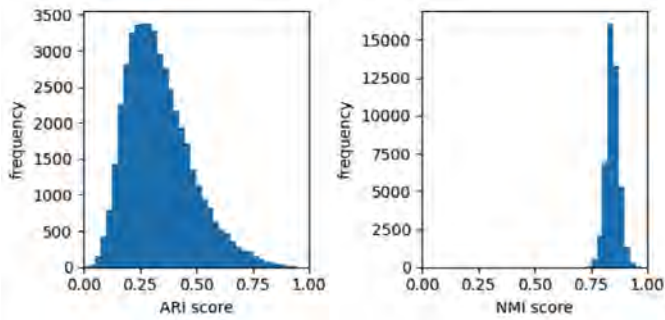
Figure 9: Histograms showing the distribution of the ARI and NMI scores

4.3.2 Stability and similarity of MCMs across time bins and stimulus combinations

In the previous section, ARI and NMI scores were used to compare the similarity of ICCs between different trial concatenations with the same time bin size and stimulus combination. However, these scores can also be compared across time bins, to quantify how variable the components were across different time scales. Strikingly, the mean NMI score comparing mutual information between pairs of neurons across time bin sizes was 0.8583, - approximately the same amount as the NMI score for MCMs within the same time bin (Fig. 10a). This suggests that the clustering was very consistent across time bins and provides further proof of the reliability of this technique. Just as before, the ARI scores were rather low (mean = 0.3669), indicating that the specific assignments and permutations of the clusters differed.

Similarly, we can compare the cluster scoring metrics of trials within the same time bin but with different visual and auditory stimuli (line orientations and sound frequencies). Such a comparison yields a mean ARI score of 0.2526 and a mean NMI score of 0.8608 (Fig. 10b). Therefore, the component assignments seem to be rather consistent across stimulus combinations, which would imply that the detected cell assemblies are not stimulus-specific. To further investigate this possibility, I performed the MCM analysis on the entire session and then reordered the superimposed matrices of individual stimulus combinations based on the whole-session clustering.
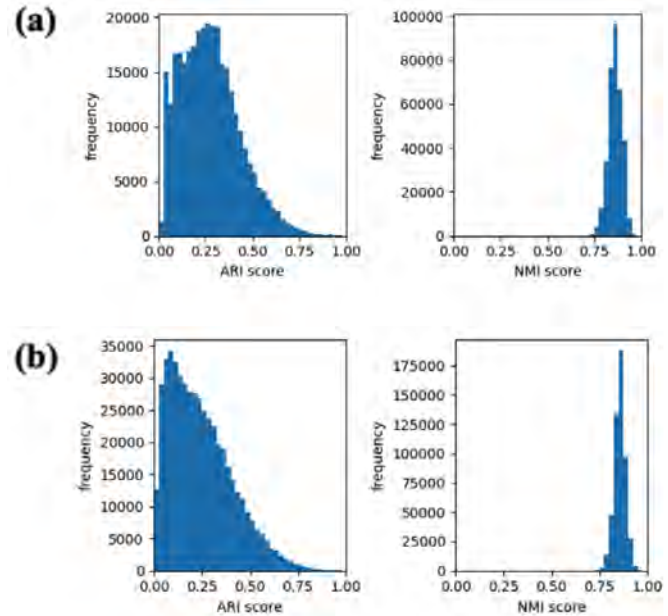
Figure 10: Histograms showing the distribution of the ARI and NMI scores (a) across different stimulus combinations and (b) across different time bins

4.3.3 Examining log-evidence of MCMs

In Bayesian model selection, log-evidence is defined as the logarithm of the probability that a given dataset was generated by a particular model [13]. In section 2.2, we explored how the log evidence can be computed for spin models and MCMs; higher log-evidence indicates that the neuron spiking patterns are farther from an independent model and better explained by the MCM's components [13]. To analyze whether the average log-evidence changes as a session progresses, I concatenated the trials with a sliding window approach. The first concatenation contained the first 15 trials of the session, while the second concatenation excluded the first trial, but included the 16th trial, and so on until the last concatenation contained the last 15 trials. The best MCM (i.e. the one with the highest log-evidence) for each concatenation was computed, and its log-evidence was computed and plotted as a function of the first trial in that session (Fig. 11).

We would expect the log-evidence to stay constant across the session since apart from the changing stimuli, the mouse's environment remained constant. However, instead we observe high fluctuations in log-evidence over time, as well as an overall downward trend in sessions 1 and 2 (Fig. 11a-b). In other words, the separability of the neurons into communities appears to have de-

creased over time as each session progressed. Sessions 3 and 4 also appear to have somewhat of a downward trend, but the results are less clear (Fig. 11c-d). The tall peak in session 3 between trials 200 and 240 is especially strange (11c).)
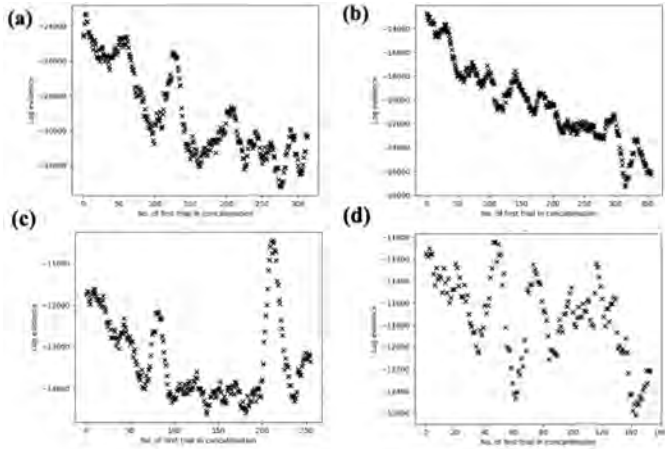
Figure 11: Scatter plots of log-evidence plotted against the number of the first concatenated trial (out of 15 trials) used in the MCM, plotted for individual sessions: (a) session 1, (b) session 2, (c) session 3, and (d) session 4

A plausible explanation is the fluctuation of the mouse's arousal, which has been linked to altered cortical activity and changes in visual encoding [36, 37]. Specifically, arousal was found to modulate depolarization and hyperpolarization of neurons in primary sensory cortices [36] and change the population activity patterns [37]. Both of these factors could contribute to altering the firing patterns and discriminability of cell assemblies, thus leading to changes in MCM log-evidence over time. Therefore, I calculated the Pearson correlation of pupil size (which is a measure of arousal and was also measured Lohuis et al. [6]) with log-evidence over the session duration. However, as it turned out, there was no correlation of MCM log-evidence for concatenations of trials with pupil size (Table 3). I attempted a similar analysis for MCMs from individual trials, correlating the log-evidence with the average pupil size during the trial. As before, the correlation was close to 0 in all sessions (Table 3). Moreover, the pupil size was very variable throughout the trials, indicating that arousal levels varied within individual trials (Fig. S3).

4.4 Preferred basis analysis

As explained in section 2.1, transforming the data into the preferred basis can give us more information about the interactions between neurons by transforming the neurons into new basis variables [13]. I performed the following section of the analysis for entire recording sessions, pooling together data from all stimulus combinations. This is reasonable since the ICCs in different stimulus combinations are the same. Importantly, this pooling makes the analysis more efficient as the algorithm for finding the best basis is computationally time-consuming and it also means that there is more data available for finding the best basis. I applied the best basis search algorithm to the data in the original basis for each session and analyzed the results. Just like the previous section, this analysis was performed on the 20ms time bin data.

First, I ran the algorithm with k = 3, meaning it only considered interactions up to an order of three in each step. Even in the best basis, nearly all basis variables in all sessions remained as individual neurons with a few exceptions. Four of the new basis variables were a product of two neurons. A basis operator consisting of two neurons suggests that the spiking of the two neurons was mutually exclusive. Three new variables were triplets, which might indicate a three-neuron interaction (such as two neurons silencing a third neuron or vice versa). However, these combinations all had a low bias (≤ 0.38773), which would indicate that these interactions are only observable in a small fraction of the observations and not much more probable than what would be expected at random [13, 31]. Moreover, all of the triplets had either only neurons with low spiking frequencies (they spiked in <10% of time bins), or one neuron with a high spiking frequency combined with two neurons with a low spiking frequency. Therefore, it is difficult to determine whether these observations were due to spurious correlation or true interactions.

Surprisingly, in sessions 1 and 4 the algorithm found variables consisting of six, seven, and nine neurons, all with a bias near zero. Therefore, I decided to run the algorithm with $k = 4$ to see whether these clusters would be broken down by further iterations of the algorithm. Indeed, the previously large groupings broke up into quartets, triplets, and pairs of neurons, confirming that the results at $k = 3$ were an artifact. $k = 3$ persisted

Table 3: Pearson correlation coefficients of MCM log-evidence and pupil size averaged over the trial duration

Session	Log-evidence and mean pupil size Pearson correlation coefficients	
	15 trial concatenations	Individual trials
1	-0.0226	0.0674
2	-0.2059	-0.0330
3	0.0088	0.0057
4	0.4492	-0.0734

with $k = 4$, which suggests that they could in fact result from actual interactions. However, the pairs and triplets were still infrequent compared to individual neurons in the new basis. Moreover, all of the new operators both at $k = 3$ and $k = 4$ had a very low probability, $P(\phi_i = 1)$[1], indicating that they were not frequently observed in the data.

5 Discussion

The chief aim of this study was to see if MCMs can be used to distinguish assemblies of firing neurons within and across brain areas by considering higher-order neuronal interactions. Secondarily, the study assessed the reliability of using this novel class of models for neural assembly detection. To this end, the MCM modeling approach was applied to single-cell neural recordings in mouse V1, CG1, and PPC. The study was successful in showing that MCMs can be used to identify distinct neuronal communities, demarcated by the models' ICCs. These communities were detected both between and within areas, were stable across trial concatenations and time scales, and their size varied with the size of time bins used.

Previous research on neuronal cell assemblies identified distinct assemblies within and across brain areas [1-5]. Accordingly, I was able to detect both ICCs with neurons from a single area, and ICCs spanning across different brain areas (Figs. 4, 6, 7). These neuronal communities were stable both within time bins and stimulus combinations, as indicated by the high NMI scores (Fig. 10). By considering higher-order interactions within groups of neurons, this approach can discern patterns in neural connectivity that cannot be detected with networks and other pairwise approaches [10, 13]. Note that the ICCs by themselves do not indicate the nature

of the neuronal interactions - whether they are excitatory or inhibitory, unidirectional or bidirectional. They simply indicate that an interaction is there.

Although a bidirectional flow of information has been previously identified between V1 and other cortical areas [6, 15, 16], including PPC and CG1 [19, 20, 24, 25], it is remarkable that this interaction is visible at the level of individual neuronal assemblies. This further provides evidence for direct neuronal connections between these areas and is in line with previous research. For instance, it was found that neuronal firing patterns in the mouse CG1 attenuate in response to changes in visual stimulus [25]. Interestingly, the disparity between clustering results of different stimulus combinations (NMI mean = 0.8608) was highly comparable to the disparity between different clustering runs within the same combination (NMI mean = 0.8466). Hence, the assignment of neurons into assemblies was similar across the different stimulus combinations. Previous research revealed stimulus-specific neuronal assemblies in the mouse auditory cortex [3]. Given the parallels between the primary sensory cortices, it is interesting we do not observe such stimulus-specific cell assemblies in the V1. This could be possibly attributed to different methods of cell assembly detection, notably to the fact that, unlike other methods, MCMs encode higher order rather than pairwise interactions.

Nevertheless, my findings further support the notion that neuronal assemblies are key information-encoding units in the brain [1-5]. They also hint at the importance of cell assemblies in multisensory integration, top-down modulation, and recurrent processing (such as in perceptual decision-making and selective attention modulation [19, 20, 24, 25]). While the detected community sizes tended to be quite small (around two to six neurons), it is difficult to draw conclusions on the actual size of cell assemblies due to the limited number of neurons recorded. Investigations with

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[1]Recall that the operator ϕ_i is the product of binary spin variables. Therefore, the probability $P(\phi_i = 1)$ is the probability that the product of the spin variables is equal to 1.

higher recording density could give more indication about the size of these assemblies.

The investigation of using different time bin sizes for spike binarization revealed the effect of time bin size on the MCM community detection. As expected, increasing time bin size led to increased average component size (Fig. 5) and higher consistency of components across different runs (Fig. 6). This ranged from near-independent spiking patterns at 5ms to communities of two to six neurons at 15-30ms. This pattern can be partially attributed to the increased probability that spikes of two randomly selected neurons co-occur in a given time interval as the interval size increases. Nevertheless, we would expect the size of the components to cap off at a certain time bin size, assuming cell assemblies of a static size. This was not observed with the time bin sizes used (up to 30ms). Previous research has indicated that a neuron can attenuate the action potential threshold of a neighboring neuron for up to 50ms [39]. In future analysis, it would be interesting to see if the size of the detected cell assemblies does indeed cap off at a certain time bin threshold. Nevertheless, various properties of the MCMs, including log-evidence and neuron clustering as measured by the NMI score, remained consistent across the time scales.

Another notable result was the detection of both distinct components and near-independent neurons that did not appear to belong to distinct components (Fig. 6). It is possible that these "unclustered" neurons also belong to cell assemblies, but the other neurons in these assemblies were not recorded due to chance. However, previous research has also hinted at the existence of so-called soloists, neurons that fire rather independently from synchronous neural assemblies [27]. Investigation with a greater neural recording density could shed more light on the frequency of occurrence and possible function of these posited independently firing neurons.

A rather curious finding was the continuously changing log-evidence over session duration (Fig. 9). The fact that the log-evidence change was continuous and somewhat oscillatory indicates that it could be related to fluctuations in brain activity over time. These oscillations occur in the range of minutes and could be linked to the level of arousal or attentiveness [34, 35]. However, no significant correlation was found with pupil size, a standard measure of arousals. Future research could inves-

tigate possible explanations for this strange behavior of the log-evidence.

Finally, an analysis of the best basis did indicate a few potential two-neuron and three-neuron interactions. However, it is unclear whether these were the result of biological neuronal interactions or spurious findings, and unexpectedly few pairs and triplets were observed. A probable reason is the low average spiking frequency of the neurons at 20ms time bins (only 12.35% of time bins across all sessions and neurons contain a spike). The calculation of bias in the best basis search algorithm calculates the bias as a deviation of an operator ϕ_i from pure chance (where $P(\phi_i = 1) = 0.5$). Hence, the low firing frequencies skew the bias toward higher values and $P(\phi_i = 1)$ toward zero. This makes the identification of interacting pairs and triplets more difficult, and could explain their low occurrence in the best basis. Future research applying the best basis could circumvent this issue by transforming the original binary data to make the frequencies of $P(\phi_i = 1)$ close to 0.5 by normalizing the data.

Overall, the MCMs are a promising modeling technique for investigating single-cell spike data and detecting interacting neuron communities. The MCM approach detected distinct and robust communities in the neuronal data, including components that were consistent across trials and time bin sizes. The ICCs identified in my analysis were consistent across different random clustering concatenations, as shown by the high NMI scores. Moreover, we can track individual connections and components that are consistent across different time bin sizes, further supporting the results. The continuous change of log-evidence over time, albeit mysterious, provides further confirmation that the MCMs reveal actual patterns in the data as opposed to noise (which could be the case if the log-evidence varied erratically). These results were visible even given the relatively small amount of data available: most MCMs in this study were fitted using 1500 data observations. Normally, several thousand observations would be ideal for MCM analysis with the large number of variables involved (ranging from 31 to 86) in order to identify larger components [13]. The fact that the results were still quite robust and consistent despite this limitation further supports the reliability of the MCM technique.

Apart from the general strengths of the MCM approach, my investigation had several strengths

as well. Notable was the inclusion of different time bin sizes when binarizing the data, which allowed the investigation of MCMs at different time scales. Moreover, the use of different concatenations of trials with the same stimulus combination for finding the MCMs allowed me to evaluate the community detection consistency and apply hierarchical clustering to further analyze the quality of the communities.

Nevertheless, the application of MCMs has limitations relevant to the results. As mentioned previously, the MCM groups together neurons that interact with one another, but provides less clear insights into the nature of the interactions - excitatory, inhibitory, and more complex higher-order interactions are all grouped into ICCs without providing a clear way to distinguish between them. The MCM analysis can only be done on binary data. This feature does allow the investigation of neural activity at various time scales but also leads to the loss of information if a neuron fires multiple times during an interval. Furthermore, the MCMs assume that the data is stationary, and can only extract stationary patterns that are constant across data observations. Neural activity is dynamic and can change over time, and these dynamics cannot be captured by MCMs. Moreover, the log-evidence plots clearly show that the discernibility of interactions fluctuates and changes throughout a recording session. This might affect the quality of the MCM analysis, especially during longer recording sessions.

A particular limitation of my study was that due to the frequent stimulus changes in the session, I had to discard a large amount of data from my analysis when the mouse's cortex was attenuating after a stimulus change. Recordings of neural activity with a constant stimulus could provide more data for fitting the MCMs, allowing the MCM to find larger communities and better fit. I also did not investigate how the MCM approach compares to different methods of community detection, such as community detection from correlation networks or the Ising model. Such comparative exploration would shed more light on the capabilities, strengths, and weaknesses of MCMs in comparison to other approaches. When finding best-fitting MCMs on concatenations of trials, I used sampling with replacement to randomly sample the trials from within a stimulus combination. This meant that there was some overlap of trials in different concatenations,

which could lead to an increase in the similarity metrics such as the NMI score.

5.1 Concluding remarks

In summary, my investigation demonstrates the utility and potential of the MCM approach in the detection of assemblies of interacting neurons within and across brain areas. While this modeling approach does have some limitations, it nonetheless provides a reliable technique for community detection using higher-order patterns in binary data. This model family can serve as a novel tool for investigating functional connectivity, cell assemblies, and their relation to cognitive processes. By accounting for higher-order interactions, it can provide new insights into the nature of information processing during perception and cognition. Moreover, just like other spin models, it can be applied to any binary dataset. Hence, MCMs have wide applicability in neuroscience; other biological networks; and outside of the life sciences such as in analyzing voting patterns, magnetism, and digit classification. This makes them a highly versatile tool for the study of higher-order interactions and communities in the biological, physical, and social sciences.

In neuroscience, this opens many avenues for future research. In this study, I used data from mice that were performing a behavioral task in response to a stimulus change. Applying MCMs to recordings of spontaneous activity with a constant stimulus or the absence of a stimulus would provide much better community detection results due to the increased amount of data available for MCM fitting. Moreover, it would allow us to observe spontaneous neural assemblies involved in perception. Using higher-density recordings would increase the number of variables, potentially allowing us to detect larger components. We could also measure other areas of the brain to see if such functional connections can be observed between them as well. Finally, MCMs can be explicitly compared with other community detection methods to get a better understanding of their strengths and limitations to ensure proper interpretation of results. In summary, the MCM approach has a lot of potential in exploring neuronal assemblies and can provide us with a better understanding of neuron interactions as well as the neural processes that these interactions underlie.

Acknowledgments

6 References

1. Peyrache A, Benchenane K, Khamassi M, Wiener SI, Battaglia F. Principal component analysis of ensemble recordings reveals cell assemblies at high temporal resolution. *Journal of Computational Neuroscience*. 2009 Jun 16;29(1-2):309–25.

2. Pulvermüller F, Mohr B. The Concept of Transcortical Cell Assemblies: a Key to the Understanding of Cortical Lateralization and Interhemispheric Interaction. *Neuroscience & Biobehavioral Reviews.* 1996 Jan;20(4):557–66.

3. Filipchuk A, Schwenkgrub J, Alain Destexhe, Bathellier B. Awake perception is associated with dedicated neuronal assemblies in the cerebral cortex. *Nature Neuroscience.* 2022 Sep 28;25(10):1327–38.

4. Bharmauria V, Bachatène L, Cattan S, Brodeur S, Chanauria N, Rouat J, et al. Network-selectivity and stimulus-discrimination in the primary visual cortex: cell-assembly dynamics.*European Journal of Neuroscience.* 2015 Nov 19;43(2):204–19.

5. Sakurai Y. How do cell assemblies encode information in the brain? *Neuroscience & Biobehavioral Reviews.* 1999 Oct;23(6):785–96.

6. Pulvermüller, F., Mohr, B. The Concept of Transcortical Cell Assemblies: a Key to the Understanding of Cortical Lateralization and Interhemispheric Interaction.*Neuroscience & Biobehavioral Reviews.* 1996 Jan;20(4):557–66.

7. Oude Lohuis MN, Pie JL, Marchesi P, Montijn JS, de Kock CPJ, Pennartz CMA, et al. Multisensory task demands temporally extend the causal requirement for visual cortex in perception. *NatureCommunications.* 2022 May 23;13(1).

8. Steinmetz NA, Zatka-Haas P, Carandini M, Harris KD. Distributed coding of choice, action and engagement across the mouse brain. *Nature.* 2019 Nov 27;576(7786):266–73.

9. Pennartz CMA, Dora S, Muckli L, Lorteije JAM. Towards a Unified View on Pathways and Functions of Neural Recurrent Processing. *Trends in Neurosciences.* 2019 Sep;42(9):589–603.

10. Huang Y, Rao RPN. Predictive coding. *Wiley Interdisciplinary Reviews: Cognitive Science.* 2011 Mar 24;2(5):580–93.

11. Kamphof S. Community detection on binary data with higher-order patterns using Minimally Complex Models [Masters Thesis]. *[University of Amsterdam]*; 2022.

12. Yu SP, Yang H, Nakahara H, Santos GS, Nikolić D, Plenz D. Higher-Order Interactions Characterized in Cortical Activity.*The Journal of Neuroscience.* 2011 Nov 30;31(48):17514–26.

13. Shimazaki H, Sadeghi K, Ishikawa T, Ikegaya Y, Toyoizumi T. Simultaneous silence organizes structured higher-order interactions in neural populations. *Scientific Reports [Internet].* 2015 Apr 28 [cited 2024 Apr 21];5(1):9821. Available from: https://www.nature.com/articles/srep09821

14. de Mulatier C, Mazza PP, Marsili M. Statistical Inference of Minimally Complex Models. arXiv *(Cornell University)* 2020 Aug 2;

15. Thomas Yeo BT, Krienen FM, Sepulcre J, Sabuncu MR, Lashkari D, Hollinshead M, et al. The organization of the human cerebral cortex estimated by intrinsic functional connectivity. *Journal of Neurophysiology.* 2011 Sep;106(3):1125–65.

16. Froudarakis E, Fahey PG, Reimer J, Smirnakis SM, Tehovnik EJ, Tolias AS. The Visual Cortex in Context. *Annual Review of Vision Science.* 2019 Sep 15;5(1):317–39.

17. Oude Lohuis MN, Marchesi P, Olcese U, Pennartz CMA. Triple dissociation of visual, auditory and motor processing in mouse primary visual cortex. *Nature Neuroscience [Internet].* 2024 Feb 2 [cited 2024 Mar 21];1–14. Available from: https://www.nature.com/articles/s41593-023-01564-5

18. Wallace MT, Ramachandran R, Stein BE. A revised view of sensory cortical parcellation. *Proceedings of the National Academy of Sciences.* 2004 Feb 6;101(7):2167–72.

19. Olcese U, Iurilli G, Medini P. Cellular and Synaptic Architecture of Multisensory Integration in the Mouse Neocortex. *Neuron.* 2013 Aug;79(3):579–93.

20. Zhou Y, Freedman DJ. Posterior parietal cortex plays a causal role in perceptual and categorical decisions. *Science* 2019 Jul 12;365(6449):180–5.

21. Oude Lohuis MN, Marchesi P, Pennartz CMA, Olcese U. Functional (ir)Relevance of Posterior Parietal Cortex during Audiovisual Change Detection. *The Journal of Neuroscience.* 2022 May 31;42(26):5229–45.

22. Pardo JV, Pardo PJ, Janer KW, Raichle ME. The anterior cingulate cortex mediates processing selection in the Stroop attentional conflict paradigm. *Proceedings of the National Academy of Sciences.* 1990 Jan 1;87(1):256–9.

23. Bush G, Luu P, Posner MI. Cognitive and emotional influences in anterior cingulate cortex. *Trends in Cognitive Sciences [Internet].* 2000 Jun;4(6):215–22. Available from: http://www.georgebushmd.com/GBMD-Website/Research_&_Publications_files/Bush_2000_TICS_CingReview.pdf

24. Weissman DH, Gopalakrishnan A, Hazlett CJ, Woldorff MG. Dorsal Anterior Cingulate Cortex Resolves Conflict from Distracting Stimuli by Boosting Attention toward Relevant Events. *Cerebral Cortex.* 2004 Jul 6;15(2):229–37.

25. Zhang S, Xu M, Kamigaki T, Hoang Do JP, Chang WC, Jenvay S, et al. Long-range and local circuits for top-down modulation of visual cortex processing. *Science.* 2014 Aug 8;345(6197):660–5.

26. Wal A, Klein FJ, Born G, Busse L, Katzner S. Evaluating Visual Cues Modulates Their Representation in Mouse Visual and Cingulate Cortex. *The Journal of Neuroscience.* 2021 Mar 9;41(15):3531–44.

27. Niell CM. Cell Types, Circuits, and Receptive Fields in the Mouse Visual Cortex. *Annual Review of Neuroscience.* 2015 Jul 8;38(1):413–31.

28. Bachatene L, Bharmauria V, Cattan S, Chanauria N, Rouat J, Molotchnikoff S. Electrophysiological and firing properties of neurons: Categorizing soloists and choristers in primary visual cortex. *Neuroscience letters.* 2015 Sep 1;604:103–8.

29. Schneidman E, Berry MJ, Segev R, Bialek W. Weak pairwise correlations imply strongly correlated network states in a neural population. *Nature [Internet].* 2006 Apr 1 [cited 2020 Jun 22];440(7087):1007–12. Available from: https://www.nature.com/articles/nature04701.pdf

30. Hopfield JJ. Neural networks and physical systems with emergent collective computational abilities. *Proceedings of the National Academy of Sciences [Internet].* 1982 Apr 1;79(8):2554–8. Available from: https://www.pnas.org/content/79/8/2554

31. de Mulatier C. Greedy algorithm for detecting community structure in binary data [Internet]. *GitHub.* 2024 [cited 2024 Mar 20]. Available from: https://github.com/clelidm/MinCompSpin_Greedy

32. de Mulatier C. Search for the Best Independent Minimally Complex Models (MCM) [Internet]. *GitHub.* 2024 [cited 2024 May 28]. Available from: https://github.com/clelidm/MinCompSpin_BasisSearch128

33. Mazur, V. Code used for analysis in Vojtech 's Bachelor's thesis [Internet]. *GitHub.* 2024 [cited 2024 May 27]. Available from: https://github.com/[Author]/[Author]BachelorThesis

34. Virtanen P, Gommers R, Oliphant TE, Haberland M, Reddy T, Cournapeau D, et al. Author Correction: SciPy 1.0: fundamental algorithms for scientific computing in Python. *Nature Methods.* 2020 Feb 24;

35. Hubert L, Arabie P. Comparing partitions. Journal of Classification [Internet]. 1985 Dec 1;2(1):193–218. Available from: https://link.springer.com/article/10.1007%2FBF01908075

36. Vinh NX, Epps J, Bailey J. Information Theoretic Measures for Clusterings Comparison: Variants, Properties, Normalization and Correction for Chance. 2010 Mar 1;11(95):2837–54.

37. Shimaoka D, Harris KD, Carandini M. Effects of Arousal on Mouse Sensory Cortex Depend on Modality. *Cell Reports [Internet].* 2018 Mar 20 [cited 2023 Jun 20];22(12):3160–7. Available from: https://pubmed.ncbi.nlm. nih.gov/29562173/

38. Vinck M, Batista-Brito R, Knoblich U, Cardin JA. Arousal and Locomotion Make Distinct Contributions to Cortical Activity Patterns and Visual Encoding. *Neuron [Internet].* 2015 May 6 [cited 2020 Nov 8];86(3):740–54. Available from: https://www.scie ncedirect.com/science/article/pi i/S0896627315002524

39. Bharmauria V, Bachatene L, Cattan S, Rouat J, Molotchnikoff S. Synergistic activity between primary visual neurons. *Neuroscience.* 2014 May 1;268:255–64.

A Supplementary Plots
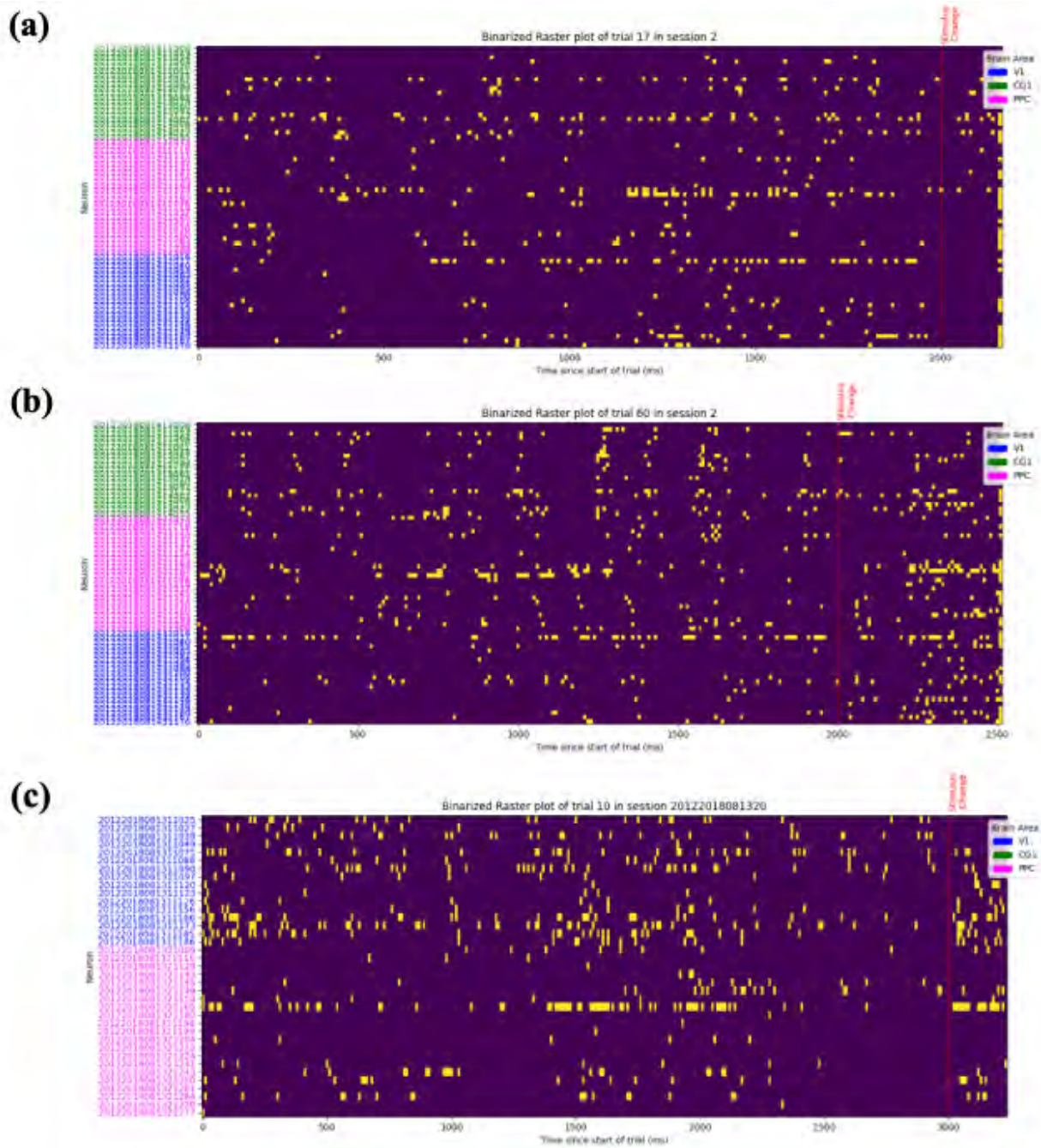
Supplementary Figure 1: example Raster plots showing neuron spiking in individual trials using 10ms time bins, where yellow tick indicates a spike in the given time bin; (a, b) example plots are from session 2; (c) plot from session 3
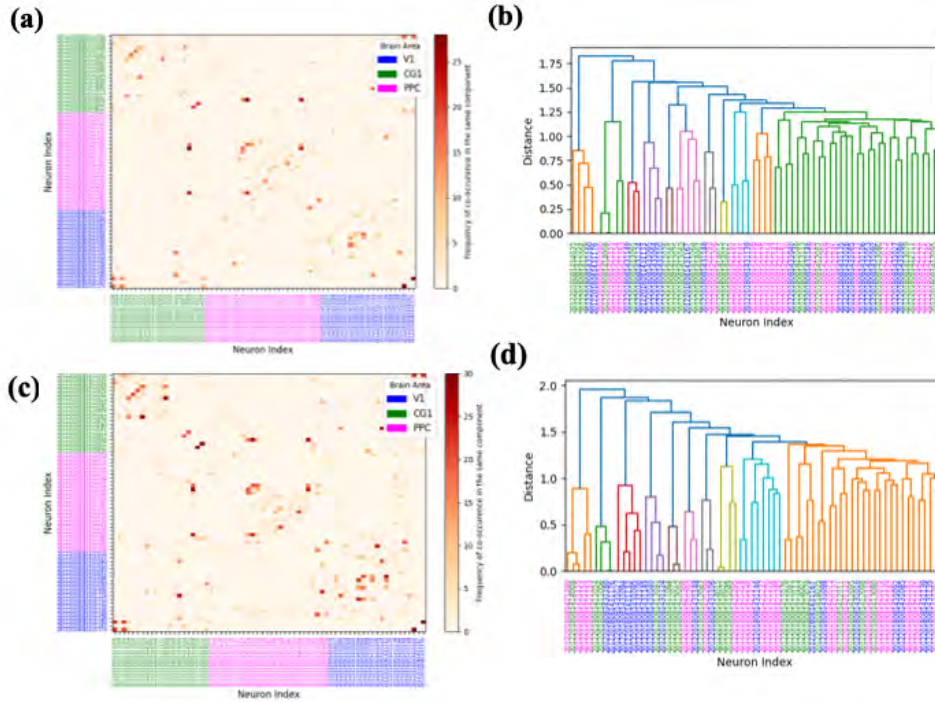
Supplementary Figure 2: Representative superimposed co-occurrence matrices and hierarchical clustering dendrograms, made from concatenated trial data from the same stimulus combination at varying time bin sizes: (a-b) 15ms, (c-d) 25ms
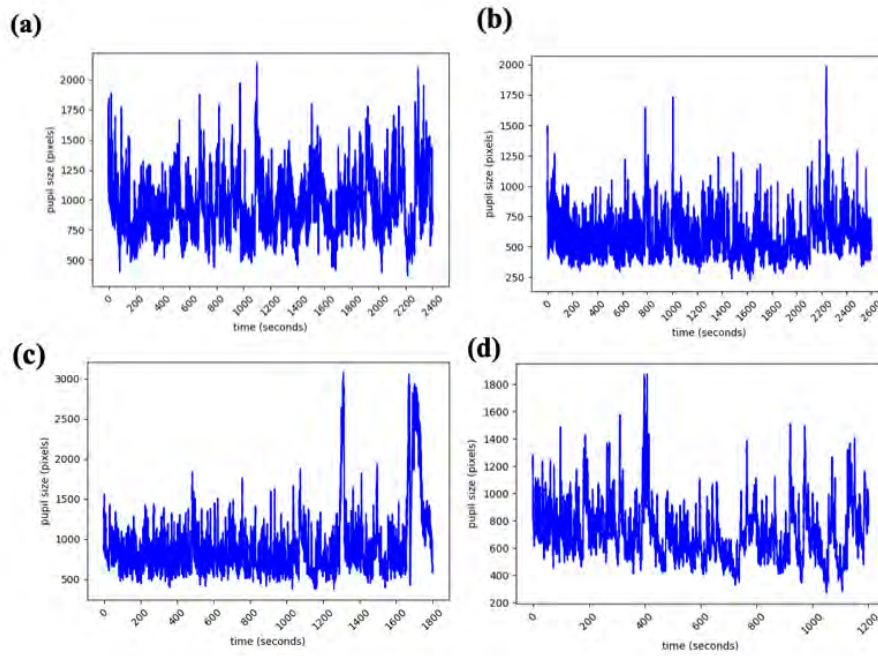
Supplementary Figure 3: line plots showing the change of pupil size over time in (a) session 1, (b) session 2, (c) session 3, (d) session 4

Sciences

Biomarkers of Acute Myeloid Leukemic Stem Cells as Therapeutic Targets for Precision Medicine

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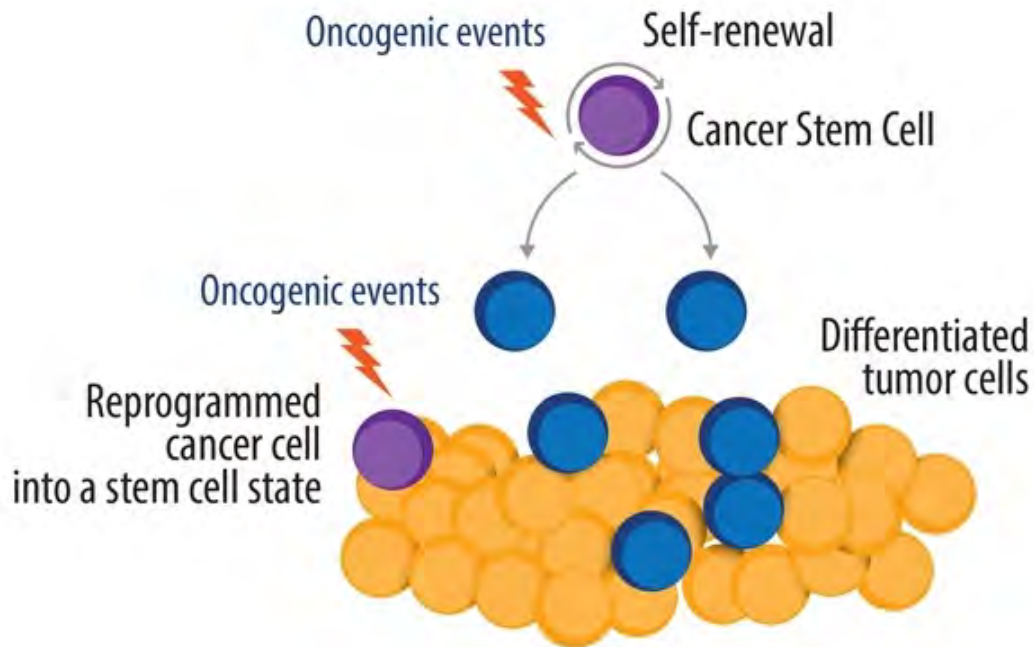
From *Are Cancer Stem Cells a Prime Target for Therapy?*
by E. Gross, 2018, Crown Bioscience.

Abstract

Acute myeloid leukemia (AML) is the deadliest blood cancer, due to its quick proliferation and hetero-geneity (Vetrie et al., 2020). Following traditional chemotherapy, more than 50% of AML patients will relapse (Teixeira et al., 2023). This is primarily due to minimal residual disease (MRD), or the presence of leukemic stem cells (LSCs) that are resistant to chemotherapy and cause uncontrolled tumor growth. LSCs share biomarkers similar to those in hematopoietic stem cells but have dysregulated mechanisms such as apoptosis or immune evasion (Rajsri et al., 2023).

This literature review explores the question: "What biomarkers arise from altered pathways in acute myeloid leukemic stem cells, and how can they be effectively utilized in developing a precision treatment regimen against minimal residual disease?". It compiles the most predominant biomarkers in LSCs that result in relapse of AML. Determining the role each plays in LSC survival elucidates which biomarkers are ideal pharmacological targets for precision medicine. Next, the previously identified biomarkers are analysed from a pharmacological perspective to identify the best suited therapies and in which way they can be combined. Lastly, the toxicity and efficacy of various drug treatments are evaluated with regard to patient well-being. Overall, the findings point towards biomarker-precision therapy showing high efficacy and relatively low toxicity in combination with low doses of cytotoxic/hypomethylating drugs. Although these are the most common form of AML therapy, nearly 50% of remission patients become resistant and relapse, indicating a need for improved treatment.

Keywords and phrases: *leukemic stem cells, biomarkers, precision treatment, minimal residual disease, acute myeloid leukemia*

Contents

1   Introduction

Hematopoiesis, or the formation of blood cells, begins with a multipotent hematopoietic stem cell (HSC). In the presence of intravenous and/or extraneous selective pressures, HSCs can also differentiate into either a myeloid stem cell or a lymphoid stem cell. Lymphoid stem cells in turn differentiate into natural killer cells or variations of small lymphocytes. Myeloid stem cells have a wider range, differentiating into either granulocytes, platelets, or erythrocytes (Figure 1).
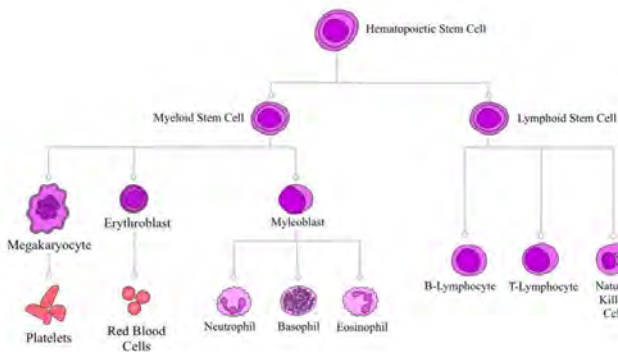
Figure 1: Pathway of hematopoiesis differentiation. Image adapted from PulseNotes (n.d.). Image drawn by Eryn Teye

During hematopoiesis, the halting of differentiation of myeloid progenitor cells can lead to acute myeloid leukemia (AML), giving rise to rapid clonal expansion in the bone marrow (Teixeira et al., 2023). As a result, malignant cells proliferate daughter cells with oncogenic mutations that negatively modulate their health, such as regulation of cell cycle checkpoints or apoptosis (Hoffbrand & Moss, 2016). Individuals over 65 are more at risk of developing AML due to mutation accumulation over time (Appelbaum et al., 2006). It has also been noted that the increase of malignant cells in the bone marrow or peripheral blood contributes to tumorigenesis and metastasis of AML (Van Dijk et al., 2021). Other factors increasing the risk of AML are familial inheritance, random genetic mutations, and exposure to carcinogens such as radiation, tobacco, and chemotherapeutic agents (Vakiti & Mewawalla, 2023). Acute leukemias are characterised by their rapid proliferation, and AML is known to be the most aggressive and heterogenous among them (Teixeira et al., 2023). This is due to

its wide scope of myeloid progenitor malignancies and fast accumulation of immature blasts (Vetrie et al., 2020).

Despite the heavily cytotoxic effect of anti-AML drugs, nearly 50% of AML cases become drug-resistant and eventually relapse (Thol & Ganser, 2020). The fast proliferation of AML tumor cells outpaces that of normal blood cells, and can lead to a fatal outcome within weeks. Traditional therapy such as chemotherapy or radiotherapy exerts a form of Darwinian 'selective pressure' on cancerous cells. As a result, therapy-receptive cells die while therapy-resistant cells survive and proliferate, increasing the overall resistance of the tumor (Goldman et al., 2019). The leukemic stem cells (LSCs) that survive first-line treatments, known as minimal residual disease (MRD), share characteristics of HSCs such as quiescence and increased drug efflux pumps (Rajsri et al., 2023). Resistance and relapse in AML cases are almost always attributed to MRD, as LSCs gain resistance to further treatments (Stelmach & Trumpp, 2023). Poor regulation of LSC's self-renewal, combined with an extended proliferative life span, allows for mutation accumulation and reinforces tumor heterogeneity (Rajsri et al., 2023). These genetically diverse pluripotent cells within the tumor contribute to uncontrolled growth as they serve as a source of cell regeneration and plasticity (Kantarjian et al., 2021).

The difficulty in AML treatment lies in the multiple routes of growth and reinforcement. Targeting a singular pathway or using one form of medicine has never been an effective treatment for AML. Biomarkers, or surface and intercellular molecules that can be used to determine the status of a cell, offer a distinct form of targeted therapy to only target aberrant cells (Graig et al., 2016). Rather than using blanket treatments such as chemotherapy that can equally impact all cells and risk adverse effects, specifying treatments to attack specific cell signatures can customize an AML therapy to a patient's biomarkers and wipe out the repopulating source of AML, LSCs (Graig et al., 2016). Additionally, the potential for combinatorial biomarker treatment can effectively reduce cell signatures associated with tumor metastasis.

This thesis explores the question: "What biomarkers arise from altered pathways in acute myeloid leukemic stem cells, and how can they be effectively utilized in developing a precision treatment regimen against minimal residual disease?"

In this discussion, examples of precision medicine regimens will be examined and specified towards various biomarkers that reinforce LSC development and progression. Additionally, this thesis will consider the potential toxicity of such an intensive drug regimen by attempting to balance therapeutic efficacy with patient health and well-being, as current research continues to demonstrate, a well-rounded approach to AML treatment is needed (Döhner et al., 2022).

Since including every biomarker in AML cases is unfeasible, and outside the scope of this thesis, this work focuses on exhibiting examples of personalized AML treatment routes. This shifts AML therapy from a standardized "one-size-fits-all" traditional method to a precise treatment dependent on an individual's biomarkers (Stavropoulou & Schwaller, 2017). Previous research referenced in this paper points to personalized medicine becoming the future of healthcare (Cantilena et al., 2022; Stavropoulou & Schwaller, 2017; Yang X. & Wang, 2018). This thesis intends to show the predicted trajectory of personalized medicine within the next decade. trajectory of personalized medicine within the next decade.

1.1 Research context

Addressing therapy is a pressing issue for AML as treatment protocols have not changed in the past 50 years. New technology could be used to tackle the rising complexities of the disease (Teixeira et al., 2023). With a relapse rate of 50% in AML patients, a need for precise treatment is evident (Thol & Ganser, 2020). Traditional therapy has poor results in patients older than 60 years old due to vulnerability to drug toxicity and higher prevalence of tumoral heterogeneity (Teixeira et al., 2023), which commonly leads to limited treatmentoptions in this population. For example, anthracycline (a chemotherapeutic intercalating agent used in AML) has been closely associated with congestive heart failure, and individuals who undergo stem cell transplants can experience graft-versus-host diseases and immunosuppression (National Cancer Institute, 2019). Targeting AML LSCs as the source of repopulation minimizes the chance of MRD, as heterogeneous LSCs will not have the opportunity to evade treatment and form metastasis (Teixeira et al., 2023). Thus, LSC biomarker identification is important to elucidate which tar-

geted treatment is necessary for the elimination of MRD *and* to lower the rate of relapse after achieving remission.

2 Methodology

This thesis is a literature review connecting oncology and pharmacology. This literature review effectively allows for the synthesis of scientific sources to examine the progress of AML LSC biomarker identification and treatment. Additionally, it allows for building a theoretical framework of a treatment regimen upon existing sources, as well as identifying consistent issues and trends encountered in the field. Reputable databases such as PubMed and the University of Amsterdam electronic library will be used for literature collection. Results will be restricted to publications from 1999 onwards to reflect modernity of the precision medicine field and language will be limited to English.
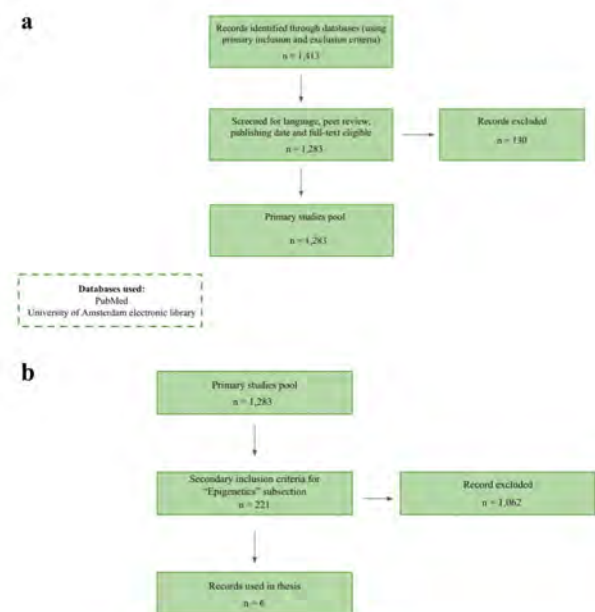
Figure 2: (a): Flow chart schematic depicting the search strategy for primary inclusion and exclusion criteria. (b): Flow chart schematic depicting an example search strategy for secondary inclusion criteria in section 4.1.

To begin with a broad pool of relevant articles, the following primary inclusion criteria were used: "Acute myeloid leukemia AND minimal resid-

ual disease AND biomarker AND leukemic stem cell OR cancer stem cell." The primary exclusion criteria were the following: "acute lymphoid leukemia, chronic myeloid leukemia, chronic lymphoid leukemia," resulting in 1,283 articles to choose from (Figure 2a). Since each subchapter of this thesis required different inclusion criteria (due to the wide intersection of fields), distinct secondary inclusion and exclusion criteria were used for every subchapter. These secondary criteria were applied in addition to the primary inclusion and exclusion criteria, allowing for more specificity when selecting relevant literature. For example, the secondary inclusion criteria for the epigenetics subchapter were: "epigenetics OR histones OR methylation," narrowing down the primary group to 6 articles relevant to the subchapter (Figure 2b). This was replicated with different secondary inclusion or exclusion criteria depending on the subchapter (Appendix 1).

3   Patient and Treatment Profiles

To understand how a personalized precision treatment plan can best hinder relapse and growth of MRD, two example patients (created to demonstrate the process of creating a personalized treatment plan) were studied. Demographic and biomarker information was synthesized from the most common mutations found in AML patients (Makkar et al., 2023). Further demographic information is displayed below in Table 1. Both patients were diagnosed with AML around the same time and began the three phases of intensive chemotherapy: induction, consolidation, and maintenance (Döhner et al., 2022). First, both patients underwent the induction treatment of high doses of two cytotoxic drugs, cytarabine and anthracycline. Cytarabine mimics the nucleoside cytidine, which is incorporated into the DNA of rapidly dividing cells and disrupts DNA polymerase. This incorporation blocks DNA replication during mitosis (Cortes et al., 2019). Anthracycline works as an intercalating agent by insertion between base pairs of a DNA strand, also interrupting DNA replication (Teixeira et al., 2023). After this round of treatment, both patients were placed on a consolidation chemotherapy regimen of intermediate doses of cytarabine, which intends to further maximize the response against MRD. As a follow-up treatment,

both patients recieved a standard stem cell (SC) transplant using donor SCs to introduce healthy repopulation in the bone marrow (National Cancer Institute, 2019).

Both patients were in remission of AML after this traditional treatment. The requirements for remission include bone marrow containing less than 5% tumor blast cells and having a blood cell count in the normal range (American Cancer Society, n.d.). However, a bone marrow biopsy found sizable amounts of LSCs that stimulated relapses. Unfortunately, more than 50% of AML patients will suffer relapse after consolidation chemotherapy (Teixeira et al., 2023). Chemotherapy is only most effective on cells that are actively dividing, such as those in synthesis or mitosis (Bruno et al., 2021). Table 2 lists the biomarkers expressed in each patient's LSCs, discussed further in sections four and five.

4   Biomarker Compilation

4.1   Epigenetics

AML has a relatively low level of genetic heterogeneity compared to other cancers, indicating the substantial role of epigenetic heterogeneity in intratumoral variances (Goldman et al., 2019). Epigenetics, or the modulation of gene expression, is a method SCs use to maintain pluripotency and to differentiate. Pre-transcriptional epigenetic mechanisms include chromatin restructuring, while post-transcriptional mechanisms can involve RNA splicing and histone modifications (Van Dijk et al., 2021).

As noted by Yamakazi et al. (2013), epigenetic modulation is expected to be a major distinction between LSCs and non-LSCs, since they contain no major genetic differences. Thus, researchers looked at genome-wide DNA methylation marks and two histone modifications (H3K4me3 and H3K27me3) to account for changes in chromatin structure between LSCs and non-LSCs. Specifically, H3K27me3 results in the formation of condensed heterochromatin, while H3K4me3 allows for euchromatin (Van Dijk et al., 2021).

In terms of histone modulation, H3K4me3 allows for activation via tri-methylation of a lysine residue, which has been associated with chromatin remodeling for increased transcriptional availability (Van Dijk et al., 2021). Conversely,

Table 1: Demographic information of example patients.

Demographic information	Patient A	Patient B
Age	51	77
Sex	Female	Male
Ethnicity	Caucasian	Hispanic
Past Medical History	Smoking active for $\sim$20 years	None
Inducing Cause of AML	Chromosomal translocation	Environment Carcinogens

Table 2: Biopsy results of example patients. A bone marrow biopsy was performed during a quarterly check-in during the maintenance phase of traditional therapy to monitor the status of each patient's health and characterize the genetic profile of leukemic cells (Abdulmawjood et al., 2019). From there, cells in the bone marrow aspirate were analyzed using flow cytometry and closely examined through a microscope (Dogan & Demircioglu, 2022). These biopsy results are further discussed in section 4.

Biopsy Biomarker Results	Patient A	Patient B
LSC cell surface markers	1. CD34+CD38+ 2. Overexpression of CD47	1. CD34+CD38+ 2. Overexpression of CD47
Epigenetic histone modifications	Overexpression of H3K27me3	None
Chromosomal translocation	MLL::AF9	Absent
Point mutations	Absent	IDH2
Hypoxic environment	Yes; overexpression of HIF1α	Yes; overexpression of HIF1α
Inflammation	Present	Present
Angiogenesis	Present	Present
PI3/Akt/mTOR axis	Hyperactive signaling	Normal
Hedgehog pathway	Normal	Increased levels of Smoothened
Wnt pathway	Increased levels of β-catenin	Increased levels of β-catenin
Epithelial-to-mesenchymal transition	Present	Present
Checkpoint inhibitors	Upregulated CTLA-4 and PD-1	Upregulated CTLA-4 and PD-1
Additional leukemic antigens	Overexpression of WT1	Overexpression of WT1

H3K27me3 creates chromatin repression through tri-methylation by recruiting repressive complexes, such as the Polycomb Repressive Complex 2 (PRC2). Van Dijk et al. (2021) found the increased loss of H3K27me3 to be correlated with heightened cell proliferation and decreased patient survival, as this histone mark is associated with decreased apoptotic behavior. Yamakazi et al. (2013) found H3K4me3 marks concentrated around the transcription start site of genes associated with AML induction, indicating hyperactivation of the resulting genes. H3K27me3, on the other hand, was found mostly evenly distributed throughout the epigenome, indicating that 40% of the genes without either methylation marks were attributed to differentiated lineage-specific cells (Yamakazi et al., 2013). These histone marks may work together in bivalent domains, which are genes that exist in a 'poised' state that can rapidly switch between active and repressed transcription. Together, they regulate the stemness or differentiability of a cell. French & Pauklin (2020) propose bivalent domains play a unique role in LSC plasticity by allowing cellular identity to be quickly switched between differentiation and pluripotency depending on the environment. Thus, these biomarkers are extremely promising to consider for LSC treatment.

In Table 2, Patient A is shown to have an overexpression of H3K27me3, indicating a hyperactive PRC2. A target for the H3K27me3 biomarker is its enzymatic 'writer' within the PRC2, histone-lysine N-methyltransferase enhancer of zeste homolog 2 (EZH2). Deletion of EZH2 resulted in decreased survival in mouse models (Basheer et al., 2019),

proving its role in tumor suppression. Remarkably, EZH2 has been found to function as a tumor suppressor in leukemic initiation, but oncogene in leukemic maintenance (Adema & Colla, 2022). During the onset of AML, loss of EZH2 results in accelerated oncogenic activity via bivalent promoters (Basheer et al., 2019). Thus, this is a promising histone target, as a bivalent promoter by design is relatively easy to modulate.

4.2 Chromosomal Translocations and Point Mutations

Epigenetics is intimately intertwined with chromosomal translocations; the fragmentation and reattachment of two parts of different chromosomes. Common causes of chromosomal translocations are erroneous repair mechanisms or DNA damage. The product of chromosome fusion can often cause the hyperactivation of pro-tumorigenic features. Patient A has a mutation of the MLL1 gene on chromosome 11q23 and AF9 on chromosome 9p22. Named the "MLL::AF9 translocation," this is one of the most common fusion partners in MLL-r AMLs (Chan & Chen, 2019). The gene resulting from this fusion can be classified as an oncogene, or a gene that increases cancerous symptoms such as hyper-proliferation or inhibition of apoptosis (Simon et al., 2005). MLL::AF9 increases cellular transcription by supporting RNA Polymerase II elongation at MEIS1 and HOXA genes. Consequent degradation results in a transcriptionally repressed chromatin landscape (Olsen et al., 2022). This is also closely connected with epigenetics; the MLL protein aberrantly deposits H3K4me3 at gene promoters, further increasing gene activation (Cantilena et al., 2022).

The subunits of the MLL::AF9 multiprotein complex are ideal targets for precision medicine, particularly to mitigate the migratory effect of AML tumor cells. Thus, individual parts of the multiprotein complex, such as the disruptor of telomeric silencing (DOT1L) and Menin proteins, are identified as targets (Figure 3). Methyltransferase protein DOT1L is mistakenly recruited because of the MLL::AF9 translocation and irregularly deposits H3K79me3, a histone mark associated with the active transcription of survival-promoting HOXA9 and MEIS1 genes (Nguyen et al., 2011). Menin stabilizes MLL-r fusion proteins together, promoting their oncogenic abilities. The AML mutational
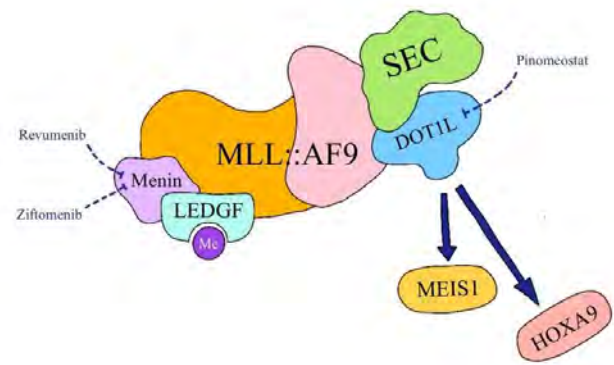
Figure 3: (MLL::AF9 fusion protein and components of the multiprotein complex. Image adapted from Chan & Chen (2019). Image drawn by Eryn Teye.

genetic landscape is relatively small compared to solid tumors (Miller et al., 2015), making every genetic target much more promising as there is a somewhat limited range of what mutations can be formed. This is equally applicable to other forms of chromosomal translocations in AML, as targeting their fusion will involve changing the target protein or stabilizers.

Patient B has an isocitrate dehydrogenase-2 (IDH2) point mutation, which affects 8-19% of AML patients (Kim, 2017). IDH2 is an important protein in the tricarboxylic acid cycle, which regulates metabolism through energy production. This protein is responsible for catalyzing the decarboxylation of isocitrate to α-ketoglutarate (α-KG). A mutated IDH2 enzyme (mIDH2) instead catalyzes the reaction of α-KG to 2-hydroxyglutarate (2-HG), an oncometabolite that results in DNA and histone hypermethylation and impaired differentiation of HSCs (Figure 4) (Mederios et al., 2017). Additionally, 2-HG inhibits the ten-eleven translocation (TET) enzymes responsible for DNA methylation – this deletion causes oncogenic cell expression in LSCs (Rausch et al., 2023). A targeted treatment alongside traditional chemotherapy can decrease the amount of tumor-forming LSCs.

4.3 Cell-independent factors

All cells have unique biomarkers on their surface. CD34 is a biomarker for HSCs, while CD38 is a biomarker for differentiated cells. Thus, AML LSCs are likely to express CD34+ CD38+ (Yoshida et al., 2016). These identifiers communicate to nearby
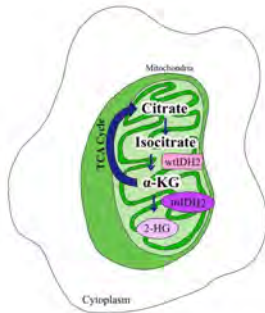
Figure 4: (IDH2 WT and IDH2 mutation in AML cells. IDH2 mutations are heterozygous and keep one WT allele, suggesting a gain of function (Medeiros et al., 2017). IDH2 = isocitrate dehydrogenase 2; α-KG = α-ketoglutarate; 2-HG = 2-hydroxyglutarate. TCA = tricarboxylic acid. Image adapted from Medeiros et al. (2017). Image drawn by Eryn Teye.

and immune cells the state a cell is in. The complex web of cell signaling interactions allows cells to control their expression based on extracellular factors. Tumor cells can release factors that influence nearby cells to change phenotype or function (Ju et al., 2022). Notably, many cell signaling pathways involved in AML contribute to maintaining stemness, allowing for a population of AML LSCs to sustain and grow a tumor (Ju et al., 2022). Key signaling pathways in LSC regulation are the PI3K/Akt/mTOR, Wnt, and Hedgehog, which are discussed next (Ju et al., 2022).

4.3.1 PI3K/Akt/mTOR pathway

The PI3K/Akt/mTOR pathway in healthy cells regulates metabolism and cell growth (Darici et al., 2020). In hematopoiesis, extracellular binding from growth factors begins a signal cascade via dimerization of a receptor tyrosine kinase (Figure 5). This receptor activates phosphoinositide 3-kinase (PI3K), which changes lipid phosphatidylinositol-4,5-bisphosphate (PIP_2) to phosphatidylinositol-3,4,5-trisphosphate (PIP_3). PIP_3 activates protein kinase B (Akt) by allowing it to be phosphorylated. Akt has many downstream targets, most notably the inhibition of apoptosis through the phosphorylation of the Bcl-2-associated death promoter (BAD) (Darici et al., 2020). The phosphorylation of the

pro-apoptotic BAD protein inhibits Bcl-2, promoting cell survival (Darici et al., 2020). Akt also activates the mammalian target of rapamycin 1 protein (mTORC1), which has downstream genes that upregulate nutrient signaling and proliferation (Darici et al., 2020). This process is frequently hyperactive in AML cells and can lead to aggressive LSC division (Su et al., 2022). The PI3K/Akt/mTOR axis is important in the maintenance and regulation of LSCs; downstream anti-apoptotic gene Bcl-2 is often overexpressed in LSCs (Darici et al., 2020). Additionally, deletion of mTOR-downstream genes resulted in apoptosis and halted proliferation specifically in MLL::AF9 leukemic mice (Gao et al., 2016). The PI3K/Akt/mTOR axis is implicated in crosstalk between LSCs and stromal cells in their environment, resulting in drug resistance (Darici et al., 2020). Thus, a further look into inhibiting any of the three signaling molecules or their downstream genes may result in the reduction of MRD and treatment of AML.

4.3.2 Wnt pathway

Normally, the Wnt pathway is necessary for determining self-renewal and differentiation of HSCs (Lee et al., 2020). The binding of Wnt ligands to the transmembrane receptor Frizzled activates the protein Dishevelled, which suppresses the degradation complex composed of AXIN, CK1α, APC, and GSK3β (Figure 6). β-catenin begins gene transcription after translocating into the nucleus and binding to the TCF/LEF transcription factors and the CREB-binding protein coactivator. This is common in advanced metastasized AML cases; nearly 50% of AML patients have abnormally high levels of β-catenin, hyperactivating this pathway (Simon et al., 2005). Wnt has been identified as a key regulator of MLL::AF9 translocation, making this an ideal drug target due to its interplay with chromosomal translocations (Sanchez et al., 2011). Wnt can lead to heightened cell sensitivity to many forms of therapy, improving patient survival rates (Yang Y. et al., 2013). Since both Patient A and B have increased levels of β-catenin, targeting either this transcription factor, the Frizzled receptor, or any downstream factors may lead to reduction of MRD in AML patients.
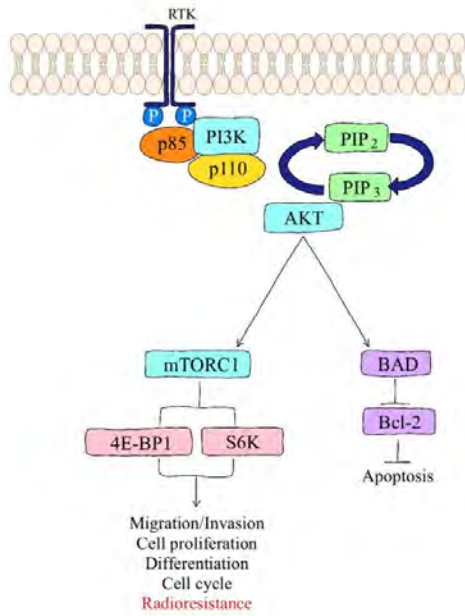
Figure 5: PI3K/Akt/mTOR pathway. RTK = receptor tyrosine kinase. Image adapted from Su et al. (2022). Image drawn by Eryn Teye.

Figure 6: Wnt pathway. APC = adenomatous polyposis coli; CBP = CREB binding protein; CK1α = casein kinase alpha; DVL = Dishevelled; GSK3β = glycogen synthase kinase-3 beta. LEF = lymphoid enhancer-binding factor; TCF = T cell-specific factor. Image adapted from Zhang & Wang (2020). Image credit to Eryn Teye.

4.3.3 Hedgehog pathway

The Hedgehog (Hh) pathway normally regulates the formation of the vertebrae through cell maintenance, differentiation, and regeneration in embryonic development (Terao & Minami, 2019). This process is necessary for LSCs to regulate their pluripotency, self-renewal, and proliferation (Yang L. et al., 2020). Transmembrane receptor Smoothened is responsible for transducing the signal from Hh ligands (Sonic, Indian, and Desert) into the cell. Without Hh ligands, Patched inhibits Smoothened and suppresses the pathway. In the presence of Hh ligands, Patched is inhibited, allowing Smoothened to activate a signal transduction (Figure 7). Suppressor of Fused (SuFu) and protein kinase A (PKA) disassociate and release the transcription factor Gli, which translocates into

the nucleus and activates gene transcription for anti-apoptotic genes, such as Bcl-2, and metastasis, such as SNAIL (Terao & Minami, 2019). Patient B has increased levels of Smoothened, which indicates Hh hyperactivation. Low levels of Hh ligands will inhibit Patched and allow heightened amounts of Smoothened to simultaneously activate multiple signal transduction pathways (Terao & Minami, 2019). Thus, downregulating or inhibiting Smoothened is necessary to eliminate MRD in Patient B.
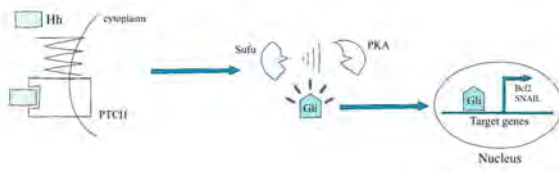
Figure 7: Hedgehog pathway. Hh = Hedgehog ligand; PKA = protein kinase A; PTCH = Patched; SMO = Smoothened; SUFU = Suppressor of Fused. Image adapted from (Pecorino, 2021). Image drawn by Eryn Teye.

4.3.4   Evasion of the immune system

LSCs can also use the immune system to aid in their plasticity and tumorigenesis (Sultan et al., 2016). AML LSCs can inhibit anti-tumorigenic immune cells, particularly macrophages, by SIRPα-mediated inhibition via their CD47 ligand (Theocharides et al., 2012). The CD47 receptor acts as a mark for immune cells to recognize they are not pathogenic. LSCs can use this to their advantage and overexpress this receptor, tricking the immune system into believing they are healthy cells (Qu et al., 2022). AML LSCs use their CD47 ligand to bind to SIRPα on a macrophage, inhibiting phagocytosis and the subsequent destruction of the LSC (Figure 8) (Qu et al., 2022). An additional ligand/receptor interaction occurs to improve specificity. These markers on the surface of LSCs offer a compelling target; a targeted drug regimen can incorporate monoclonal antibodies (mAb) to block the interaction of CD47 and SIRPα, allowing macrophages to dispose of tumor cells.

Similar to chromosomal translocations, targeting cell signaling is flexible — depending on the errant pathway, certain biomarkers can be exchanged depending on the specific AML case. Although the biomarkers mentioned above are the most prominent and shared among most AML patients, variation can be addressed by changing the biomarkers targeted in medicine. This opens the possibility of an immunotherapy-focused treatment regimen.
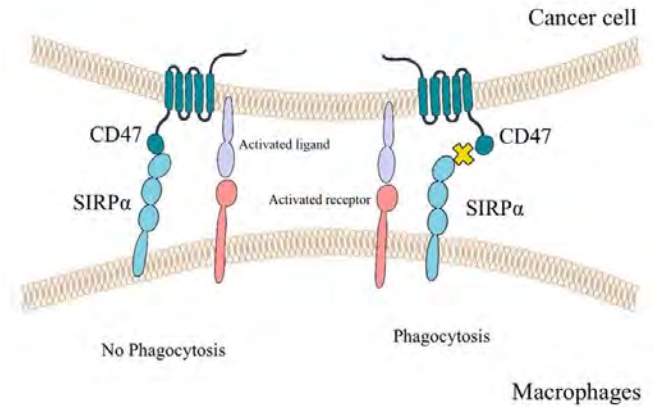
Figure 8: CD47/SIRPα interaction. The activated receptor/ligand binding is an integral part of an immune response to improve cell-specific targeting. Inhibition of CD47-SIRPα interaction inhibits phagocytosis. SIRPα = signal regulatory protein α. Image adapted from Qu et al. (2022). Image drawn by Eryn Teye.

4.4   Tumor Microenvironment

A healthy bone marrow microenvironment allows for HSCs to closely regulate their cellular components together (Bao et al., 2012). This can become weaponized within the tumor microenvironment (TME), an interconnected space that introduces a promising intersection of biomarker targets. Because HSCs originate from the bone marrow, this is likely the primary site of metastasis in AML (Bao et al., 2012). The TME offers the best circumstances for tumorigenesis; a rich community of growth factors, extracellular matrix, and infiltrating immune cells aid in the development of AML growth (Poli et al., 2018). LSCs are highly responsive to their environment, as they must quickly adapt to changing cues to survive (Poli et al., 2018). LSCs specifically live in TME niches, distinct from the rest of the TME (Plaks et al., 2015). LSCs in the niche produce factors that preserve hyperproliferation, maintain pluripotency, and support plasticity, all of which increase tumorigenesis (Bao et al., 2012). LSCs can remodel a healthy niche into a niche that favors the growth of tumor cells, by changing the rate of epithelial-to-mesenchymal transition, hypoxia, and angiogenesis (Marchand & Pinho, 2021). In a targeted treatment regimen, these processes can be downregulated to become uninhabitable to LSCs, which potentially decreases the repopulation

of tumor cells.

4.4.1   Epithelial-to-mesenchymal transition

Epithelial-to-mesenchymal transition (EMT) is a process where epithelial cells gain traits typically associated with mesenchymal cells, such as increased migratory and regenerative capabilities (Plaks et al., 2015). EMT is normally used in embryogenesis and wound healing to mobilize and differentiate cells, but this process is exploited in tumorigenesis to evade apoptosis and contribute to metastasis (Stavropoulou et al., 2016). EMT is closely associated with increased metastasis due to the increased migratory capabilities of cells (Figure 9) (Varisli & Vlahopoulos, 2024). Epithelial cells lose cell-cell adhesion molecules (E-cadherins) and upregulate mesenchymal phenotypic features, such as N-cadherin, fibronectin, and vimentin. This loss of E-cadherin-mediated cell-cell adhesion allows for increased migration and invasion into surrounding tissue, the main culprit of metastasis (Ju et al., 2022). N-cadherins allow for interactions between AML LSCs and stromal cells of bone marrow niches such as osteoblasts (Varisli & Vlahopoulos, 2024). Crosstalk between LSCs and osteoblasts in a niche regulates the former's quiescence, proliferation, and differentiation (Varisli & Vlahopoulos, 2024). Tumor cells derived from LSCs interact with bone marrow cells using N-cadherins, which aids them in evading apoptosis (Pal et al., 2022). The natural conclusion reached is that targeting the EMT process via N-cadherins will lead to the reduction of MRD and treatment of AML.
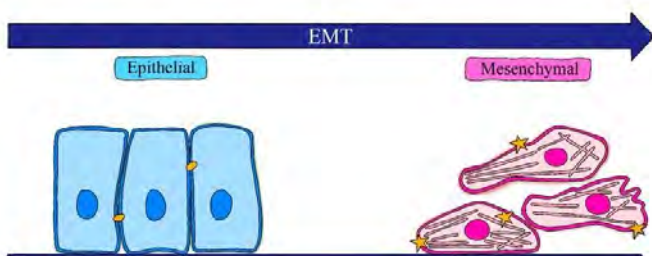
Figure 9: Epithelial-to-mesenchymal transition. Epithelial cells are tightly bound with E-cadherins, while mesenchymal cells freely move (Ju et al., 2022). E-cadherins are denoted by yellow circles, while N-cadherins are denoted by yellow stars. Image adapted from Marconi et al. (2021). Image drawn by Eryn Teye.

EMT is closely connected with epigenetics, as EZH2 has been shown to regulate the maintenance of mesenchymal phenotypes (Bao et al., 2012). The interplay of multiple factors can lead to easier knockout of tumorigenic effects, as the deletion or downregulation of one oncogene results in inhibition of others. Thus, targeting EZH2 in addition to N-cadherins may lead to the reduction of metastatic features.

4.4.2   Hypoxia

Hypoxia, or an oxygen-deficient environment, greatly favors metastasis. In normoxia, or normal oxygen levels, hypoxia-inducible factor 1-α (HIF-1α) is hydroxylated by prolyl 4-hydroxylase. A Von Hippel-Lindau protein is then able to bind to the hydroxyl group and tag HIF-1α with ubiquitin, a protein that directs HIF-1α for degradation via the proteasome (Bruno et al., 2021). However, oncogenic activation and increased proliferation of LSCs in a TME leads to an oxygen deficient TME (Bao et al., 2012). In a hypoxic environment, prolyl hydroxylases are inhibited, allowing HIF-1α to remain active (Figure 10). HIF-1α translocates into the nucleus to form a complex with HIF-1β and binds to the hypoxia response element (HRE) promoter to begin active gene transcription (Bruno et al., 2021). Expression of this gene functionality is associated with cancer, such as increased tumor cell metabolism, proliferation, and autophagy (Bruno et al., 2021). A particular gene, vascular endothelial growth factor (VEGF), is upregulated responsible for angiogenesis, or the production of immature blood vessels to sustain tumorigenesis (Plaks et al., 2015). A study conducted by Bao et al. (2012) found overexpression of HIF-1α or 2α increases phenotype particularly of LSCs, such as pluripotency and hyperproliferation, suggesting they are necessary for LSC maintenance.

Hypoxia also plays a large role in inducing EMT, as HIF-1α further activates EMT-related transcription factors (Bao et al., 2012). Lastly, severe hypoxia leads to outsized errors in DNA replication, introducing more intratumoral heterogeneity (Ju et al., 2022). Hypoxic conditions are correlated with increased angiogenic conditions (Bruno et al., 2021). Binding of stromal cell-derived growth factor (SDF1α) to CXCR4 in leukemic initiating cells is associated with oncogenic behavior, such as hyperactivation of the PI3K/Akt/mTOR axis and downregulation of apoptosis (Maganti et al., 2020). In this
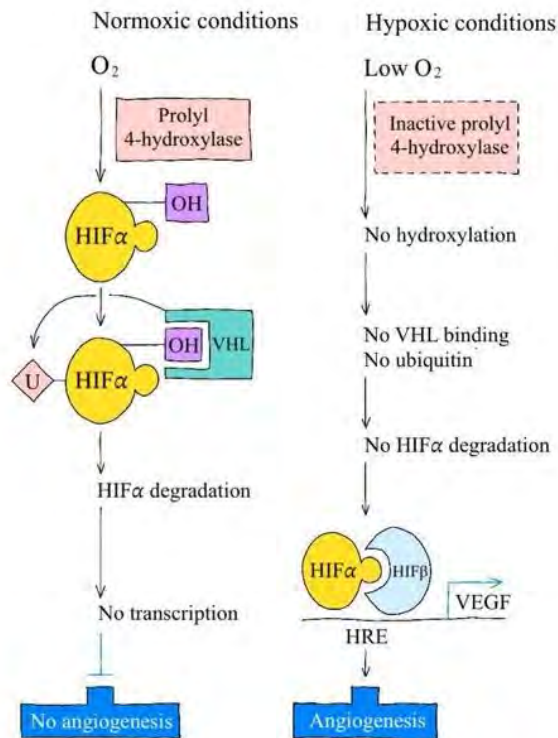
Figure 10: Normoxic and hypoxic pathways. HIF1-α = hypoxia-inducible factor 1-α; OH = hydroxyl group. VHL = Von Hippel-Lindau. Image adapted from Burger & Peled (2008). Image drawn by Eryn Teye.

case, Patient A and Patient B have an overexpression of HIF-1α in their LSCs, which results in hyperexpression of downstream genes. In particular, the biopsy reveals increased levels of chemokine receptor CXCR4. This occurs because HIF-1α causes increased downstream expression of transcription factor CXCL12 (Burger & Peled, 2008). This results in a positive feedback loop, where stromal fibroblasts in the TME secrete CXCL12, which binds to CXCR4 and perpetuates the cycle (Burger & Peled, 2008). Thus, a CXCR4 or HIF-1α antagonist may be most effective for downregulating hypoxic genes.

4.4.3 Angiogenesis

Angiogenesis is necessary for tumor metastasis, as it facilitates nutrient uptake and supports the vascular niche (Ribatti, 2012). Although infantile stages of AML involve the over proliferation of myeloid progenitors, more aggressive and developed forms involve metastasis of leukemic cells

in the bone marrow that secrete VEGF, affecting nearby stromal cells (Ribatti, 2012). Having a drug that addresses this is also necessary for starving out the burgeoning tumor. This can be combined with hypoxia treatment, as the cellular overexpression of HIF-1α causes gene expression of VEGF, which increases angiogenesis (Bruno et al., 2021).

5 Pharmacological Agents and Precision Treatment Regimen

Current treatment against AML begins with induction treatment, which aims to achieve complete remission through a combination of cytotoxic chemotherapy and demethylating drugs (Teixeira et al., 2023). For consolidation treatment, patients have the option of a hematopoietic stem cell transplant from healthy donors (Teixeira et al., 2023).

Emerging treatments such as epigenetic therapy and chimeric antigen receptor T-cells appear effective against MRD (Teixeira et al., 2023). In combination with transfusions and anti-infectious supportive care, this allows for increased patient survival (Döhner et al., 2022). Section five will view the previously identified biomarkers through a pharmacological lens. Which therapies are best suited to target them, and how can these therapies be used together? This is assumed to be supplemented during induction therapy for relapsed AML and is focused on how best to target LSCs to lessen the chance of MRD. Many of the treatments discussed here show promising results and are expected to receive full approval from government agencies within the next decade.

5.1 Epigenetic Therapies

In different cases due to dysregulation, pathways may be hyperactivated or hypo-activated. Thus, epigenetic-based medicine may be ideal to address the noted biomarkers above, as epigenetic modulation has been shown to play a large role in AML heterogeneity. Individually targeting each aberrant pathway in a patient is not sustainable in the long term (Yang L. et al., 2020). However, a blanket treatment involving epigenetic-modulating drugs can change the expression of hyperactive and hypoactive pathways, bringing them back to a healthy baseline. Current epigenetic treatments utilize non-selective hypomethylating agents azac-

Table 3: Summary of small-molecule inhibitors discussed in section 5.2.

Drug	Intended Target	Occurence
GSK126	EZH2 inhibitor	Patient A
Glasdegib	Inhibitor of Smoothened (downregulates Hh pathway)	Patient B
Enasidenib	IDH2 antagonist	Patient B
PRI-724	β-catenin antagonist (downregulates Wnt pathway)	Patients A and B
Venetoclax	Bcl-2 inhibitor (downregulates PI3K/Akt/mTOR pathway)	Patient A
ADH-1	N-cadherin antagonist (targets EMT and angiogenesis)	Patients A and B
Plerixafor	CXCR4 antagonist (downregulates hypoxic TME)	Patients A and B
Rituximab	CD47 antagonist	Patients A and B

itidine and decitabine, which reduce promoter hypermethylation and aberrant gene expression in LSCs (Rausch et al., 2023). It is important to note that these agents and the following epigenetic-based treatments should be used alongside traditional therapy to reduce MRD completely.

Referencing Patient A, targeting Menin or DOT1L is likely the best method to address their MLL::AF9 chromosomal translocation. As previously mentioned in section 4.2, MLL-r fusions depend on Menin for gene activation by mediating recruitment of MLL to target fusion genes (Chan & Chen, 2019) and DOT1L cause hyperactivation of genes through H3K79me3 (Nguyen et al., 2011). Similarly, Menin is required for H3K4me3 marks at HOXA9 genes, which are important for proliferation. Pinometostat, a DOT1L inhibitor, is modestly effective in combination with hypomethylating agent 5-azacitidine through clinical phase I trials (Doucette et al., 2021). As an antagonist, pinometostat binds to the catalytic domain on DOT1L and disrupts its enzymatic process (Doucette et al., 2021). By silencing the downstream effect of MLL::AF9, aberrant hyperactivation of HOXA9 genes will be silenced. To increase the efficacy of pinometostat, different combination therapies are being explored, as it is not suitable as a monotherapy (Stein et al., 2018).

Menin inhibitors were shown to be slightly more promising for disrupting the MLL::AF9 fusion protein. mAB revumenib was able to induce complete remission in 38% of relapsed MLL-r patients as a monotherapy in a phase I/II study (Rausch et al., 2023). Another Menin inhibitor monotherapy, ziftomenib, showed similar results, with 35% of relapsed MLL-r patients achieving complete remission (Rausch et al., 2023). Used alongside other efficacious small inhibitors, Menin inhibitors are a promising addition to a combinatorial treatment regimen to lessen MRD and subsequent relapse.

5.2 Small-molecule inhibitors

A method of targeting LSC biomarkers may be creating a cocktail of small-molecule inhibitors that individually single out each biomarker. Following is a discussion of small-molecule inhibitors that target biomarkers as referenced in section four. An overview is presented in Table 3 above.

The presence of overreactive PRC2 caused an over expression of H3K27me3 in Patient A (Van Dijk et al., 2021). As discussed in section 4.1, negating the effect of EZH2 or BMI1 with an inhibitor is likely to be effective (Basheer et al., 2019). Through ex vivo and clinical trials, EZH2 has been shown to be a more effective target (Basheer et al., 2019). A study from Calabretta et al. (2022) found that EZH2 inhibitor GSK126 lowers the expression of H3K27me3 and thus allows for decondensed chromatin. This inhibitor works well alongside traditional induction therapy, as cytotoxic agents work best when chromatin is exposed (Calabretta et al., 2022). This is poised to be effective in combination with standard chemotherapy, as a more pre-

cise treatment can limit the side effects experienced from traditional cytotoxic drugs.

The increased levels of Smoothened resulted in a hyperactive Hh pathway in Patient B (Terao & Minami, 2019). A targeted treatment involves inhibiting Smoothened using glasdegib, which was approved by the FDA in October 2018 (Hoy, 2019). Overexpression of the Hh pathway is observed in LSCs; treating this aberrant pathway is believed to enhance the sensitivity of treatment (Cortes et al., 2019). Glasdegib works by binding to Smoothened and inhibiting the binding of Hh ligands, therefore depressing the pathway (Hoy, 2019). Taking 100mg orally per day has been positively received; in combination with traditional chemotoxic drugs, 46.4% of patients achieved complete remission (Terao & Minami, 2019).

As noted in section 4.2, an IDH2 mutation causes oncometabolism in Patient B (Rausch et al., 2023). To effectively target this mutation, a small molecule inhibitor has been shown to be effective. Enasidenib, a drug that received approval from the Food and Drug Administration (FDA) in the United States, selectively binds to the catalytic site of mutant IDH2 and prevents the subsequent formation of 2-HG (Kim, 2017). A phase I clinical monotherapy study found a 40.3% response rate with relapse AML IDH2+ patients; 19.3% of patients achieved complete remission (Stein et al., 2017). Additionally, a study by Amatangelo et al. (2017) found that enasidenib was shown to induce differentiation of LSCs into wild-type (WT) neutrophils, thereby losing their tumorigenic capabilities. Patients take 100mg orally per day for a minimum of six months or until disease progression is favorable (Kim, 2017). Like epigenetic drugs, enasidenib in a combinatorial drug treatment is likely to be more effective than monotherapy (Amatangelo et al., 2017). Because the monotherapy data shows promise, this is likely to be returned tenfold alongside other drugs.

Hyperactivity in the Wnt pathway, as seen in the increase of β-catenin, results in altered cell proliferation for both patients (Simon et al., 2005). The drug most advanced in clinical trials is PRI-724, a β-catenin antagonist that blocks its interaction with CBP (Figure 5) (Zhang & Wang, 2020). Blocking the activity of transcription factor β-catenin blocks downstream transcription of its target genes. Promisingly, PRI-724 demonstrates minimal off-target effects and shows sensitivity to chemotherapy (Zhang & Wang, 2020). Although

Phase II trials continue to research what dosing is appropriate, PRI-724 is poised to be the most effective inhibitor of the Wnt pathway (Zhang & Wang, 2020).

Increased activity in the PI3K/Akt/mTOR pathway, resulting in aberrant signaling in Patient A. Approved by the FDA in 2018 is venetoclax, a Bcl-2 inhibitor. Although this drug doesn't target either of the three major proteins, it binds to Bcl-2 (activated downstream of Akt), blocking it from binding and inhibiting the pro-apoptotic proteins, BAX and BIM (Griffioen et al., 2022). By blocking this interaction, BAX and BIM are free to translocate to the mitochondrial membrane and initiate apoptosis (Griffioen et al., 2022). This drug additionally reduces oxidative phosphorylation in LSCs, further contributing to their decline (Griffioen et al., 2022). In addition to hypomethylating agents or traditional chemotherapeutic drugs (depending on the case), this has shown to be promising for targeting the PI3K/Akt/mTOR axis (Griffioen et al., 2022).

Targeting the microenvironment is necessary for both patients. Addressing EMT has been difficult for the scientific community, as targeting the entire mechanism could have unintended results on other cells that require the process for tissue regeneration and wound healing (Marconi et al., 2021). Thus, pinpoint targeting of N-cadherins has shown to be the most practical and promising. Since gaining FDA approval in 2008, N-cadherin antagonist ADH-1 has been used for treatment in solid tumors; research into repurposing ADH-1 for hematological malignancies has received interest in recent years (Pal et al., 2022). A study conducted by Pal et al. (2022) found in a leukemic mouse model, ADH-1 combined with dexamethasone (an anti-inflammatory glucocorticoid) had high in vivo efficacy and minimal toxicity. ADH-1 can additionally be used to target angiogenesis in Patient A, as preclinical trials have demonstrated its disruption of tumor vasculature (Pal et al., 2022).

As previously stated, hypoxia encourages metastasis; targeting chemokine receptor CXCR4, which is upregulated by cells in hypoxic environments, is emerging to be the most practical method to deter negative effects (Burger & Peled, 2008). CXCR4 antagonist plerixafor works by interrupting the interaction between LSCs and the bone marrow stroma (Maganti et al., 2020). Specifically, it binds in place of SDF1α on CXCR4, allowing LSCs to lose their anchor point to stromal cells within the

niche (Maganti et al., 2020). This allows them to become mobilized into peripheral blood, where traditional cytotoxic drugs are more likely to affect them rather than be protected in their niche (Maganti et al., 2020). Essentially, plerixafor works to resensitize LSCs and their resultant tumor cells (Maganti et al., 2020). Plerixafor is best used alongside traditional cytotoxic drugs; dosing must be managed on an individual level (Maganti et al., 2020).

To target CD47, mABs are best suited to block its interaction with SIRPα. Magrolimab is currently in Phase III development to determine proper dosing. Combined treatment with cytotoxic drug rituximab found favorable results in a hematopoietic cell line in vitro, and the destruction of tumor cells in vivo (Qu et al., 2022). Magrolimab works by blocking CD47, which removes the tumor cells' "shield"; rituximab binds to CD20 receptors and induces cell lysis (Qu et al., 2022).

Lastly, anti-inflammatory glucocorticoids can be supplemented alongside other small molecule inhibitors to target chronic inflammation of the tumor microenvironment (Récher, 2021). All the targeted treatments can be used during the traditional induction stage of chemotherapy again to mitigate the effects of tumor cells while targeting LSCs. Notably, dosing will have to be individually altered for each drug to mitigate toxic side effects.

5.3   Immunotherapy

An emerging field in cancer treatment is immunotherapy, the use of the patient's immune system to fight tumor cells (Rausch et al., 2023). Harnessing the body's natural defense system to fight tumor cells and LSCs leads to long-term immune memory (Rausch et al., 2023). The following sections discuss common immunotherapy methods, evaluating their respective advantages and disadvantages, and assessing their applicability in the treatment of both patients.

5.3.1 Allogeneic Hematopoietic Stem Cell Transplantation

Although not firmly considered immunotherapy, allogeneic hematopoietic stem cell transplants (allo-HSCT) are a common post-remission treatment that greatly improves patient survival (Marofi et al., 2021). Healthy SCs are collected from a donor and infused into a patient, to eradicate new tumor cells and restart the production of normal blood cells, which deters relapse. However, a major drawback to allo-HSCT is graft-versus-host disease, where the patient's immune system sees the donor cells as a threat and begins to attack them (National Cancer Institute, 2019). Depending on a patient's comorbidities and age, allo-HSCT may not be suitable (Maganti et al., 2020).

5.3.2 Chimeric antigen receptor T cell therapy

Chimeric antigen receptor T-cell (CAR-T) therapy is a novel treatment that shows promising results with AML (Marofi et al, 2021). First, a patient's T-cells are harvested and genetically engineered with chimeric antigen receptors using transfected viral vectors (Marofi et al., 2021). These receptors can recognize antigens expressed on tumor cells, allowing the T-cell to effectively target them for degradation. In AML LSCs, these antigens are likely to be CD38, CD44v6, and CD70, the most promising of which is CD38 (Marofi et al., 2021). These antigens are ideal because they are highly represented on LSCs and AML blasts compared to HSCs (Haubner et al., 2023). The reconstructed T-cells are transfused into the patient and target tumor cells with minimal off-target toxicity (Haubner et al., 2023). The modified T-cells will establish memory T-cells after remission, which are able to target the same antigens in the case of relapse (Marofi et al., 2021). A study from Yoshida et al. (2016) found that anti-CD38 chimeric antigen receptors combined with all-trans retinoic acid bolsters the cytotoxic effect of T cells. Phase I/II trials are ongoing for CD38, while research on CD44v6 and CD70 continues in the lab (Marofi et al., 2021). When full approval is achieved for anti-CD38 CAR-T treatment, both patients can benefit from this immunotherapy.

As tumor cells are well-skilled at immune system evasion (as discussed in section 4.3.4), this form of therapy is especially promising. CAR-T therapy has worked well in acute lymphocytic leukemia and B-cell lymphoma, leading many researchers to believe there is potential for efficacy in AML patients (Marofi et al., 2021). However, the lack of tumor-specific antigens in LSCs and tumor cells makes it difficult to apply CAR-T therapy to AML patients. Healthy hematopoietic cells also become targets without tumor-specific

antigens, leading to off-target effects and toxicity (Badar et al., 2022). Conversely, overreliance on a few tumor-specific antigens may risk resistance (Yang X. & Wang, 2018). Although the previously mentioned antigens are overexpressed on dysregulated AML cells, they are found on hematopoietic cells as well (Yang X. & Wang, 2018). This highlights a need to find AML-specific antigens. Additionally, AML is highly heterogeneous compared to other leukemias, therefore, discovering which tumor-specific antigens to target is difficult (Marofi et al., 2021). Thus, there is currently no approved CAR-T for AML – however, new research is focusing on reducing off-target effects by identifying more tumor-specific antigens and addressing heterogeneity with combinatorial antigen targeting (Atilla & Benabdellah, 2023).

5.3.3   Checkpoint Inhibitors

Checkpoints are normally used to prevent over-activation of the immune system; without them, healthy cells would be needlessly destroyed by T cells (Yang X. & Wang, 2018). In AML LSCs, the two most common checkpoints are programmed cell death protein 1 (PD-1) and cytotoxic T-lymphocyte-associated protein 4 (CTLA-4). When these ligands bind to their corresponding T-cell receptors, they lower immune responsiveness by inhibiting T-cell activity (Marofi et al., 2021). This signals to the environment they are 'healthy' cells, and not in need of disposal (Rausch et al., 2023). Thus, tumor cells and LSCs upregulate these transmembrane proteins to evade the immune system (Stahl & Goldberg, 2019). Complementary mABs are transfused into the patient to block the interaction of PD-1 and CTLA-4, enhancing the anti-cancer response (Stahl & Goldberg, 2019). Research into checkpoint inhibitors demonstrates it is not a suitable monotherapy – nivolumab and ipilimumab, respectively targeting PD-1 and CTLA-4, are in phase II clinical trials with a combination of either hypomethylating or cytotoxic agents (Stahl & Goldberg, 2019). Currently, no checkpoint inhibitors have yet been approved for AML.

5.3.4   Peptide vaccine therapy

Peptide vaccine therapy seeks to activate the immune system to target leukemic antigens on LSCs. Activation of memory T-cells via vaccine ther-

apy hypothetically lessens the chance of MRD, as the body can attack tumor clones long after treatment has been administered (Marofi et al., 2021). A peptide sequence is synthetically created complementary to a tumor-specific antigen (Barbullushi et al., 2022). When injected into the patient, the sequence is taken up by antigen-presenting cells, which display them on their surface (Barbullushi et al., 2022). When this sequence is 'learned' by cytotoxic T-lymphocytes, they proliferate and are released throughout the body to kill cells that express the original antigen (Barbullushi et al., 2022). Both patients have an overexpression of transcription factor Wilms' tumor 1 (WT1), which is highly expressed in most AML patients (Kreutmair et al., 2022). WT1 induces the transcription of C-myc and Bcl-2, each respectively responsible for pluripotency and inhibiting apoptosis (Barbullushi et al., 2022). Mutational WT1 (mWT1) leads to over proliferation and dysregulated differentiation i.e. leading to increased tumorigenesis (Barbullushi et al., 2022). The first phase I/II clinical study of a peptide vaccine saw a clinical benefit in three out of five patients after traditional induction therapy, with one patient fully cured of MRD, one patient entering remission, and another achieving suppression of mWT1 expression (Kreutmair et al., 2022). Although further investigation is needed to confirm and refine the results of anti-mWT1 vaccine therapy, it is a promising method to reduce relapse in AML patients.

6   Balancing Toxicity with Efficacy

By design, many anti-oncogenic drugs are designed to be highly cytotoxic in order to effectively target and eliminate tumor cells. Unfortunately, non-specific cancer drugs this can unintentionally harm healthy cells and lead to adverse reactions in patients (Marofi et al., 2021). How can researchers effectively use drugs to target LSCs without sacrificing the health of their patients?

When considering drug delivery, a dose-response curve is necessary. Figure 11 depicts the non-linear relationship between the dose and effect of the drug (Currie, 2018). A miniscule dose results in a sub-therapeutic effect, while a large dose increases the risk of adverse effects (Currie, 2018). Within these doses exists a therapeutic window, defined as the range where the concentration of the

drug exerts therapeutic effects, impacting healthy cells and causing adverse consequences (Currie, 2018). This is at the forefront of Phase I clinical trials, where researchers search for the maximum tolerated dose (MTD) within the therapeutic window. Because the MTD may vary due to a person's age or weight, finding an acceptable standard is necessary in the beginning stages of clinical trials.
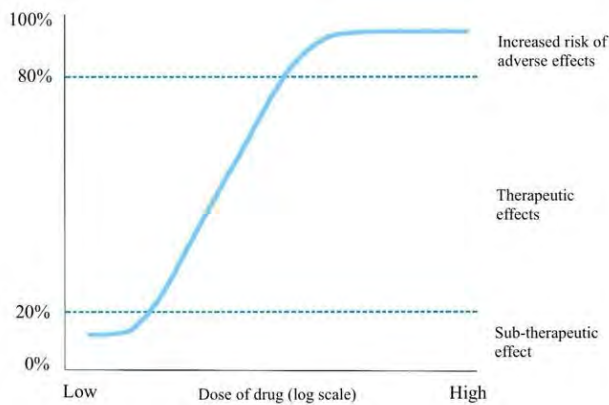
Figure 11: Graph depicting a dose-response curve. Image adapted from Currie (2018). Image drawn by Eryn Teye.

An inverse relationship exists between toxicity and efficacy; a higher dose can efficiently reach more dysregulated cells, at the cost of healthy cells (Currie, 2018). Efficacy can be impacted by many factors long after the patient receives the dose, such as pharmacokinetics and drug-receptor interactions (Currie, 2018). When several healthy cells are killed, toxicity may manifest as lethal side effects (Yoshida et al., 2016). For example, IDH2 inhibitor enasidenib has been found to frequently cause elevated bilirubin, nausea, diarrhea, decreased appetite, and vomiting in patients (Amatangelo et al., 2017). Although unfortunate, these are usual side effects in cancer treatment. A higher dose has been associated with differentiation syndrome, which induces cardiac and renal failure. The cause of differentiation syndrome is not well characterized (Kim, 2017). Thus, dosing within the therapeutic window is very important to mediate. Toxicity testing for combinatorial treatment will additionally be necessary, as adverse effects may occur from drug-drug interactions. Concerning CAR-T, off-target effects may manifest as cytokine release syndrome, which can trigger extensive inflammation and neurotoxicity (Marofi et al., 2021). To com-

bat this, a promising cell line study conducted by Haubner et al. (2023) found a new approach to CAR-T design by following three points:

1. Selecting overexpressed antigen biomarkers specifically in LSCs in comparison to HSC

2. Correctly quantifying biomarker density on LSCs in comparison to HSCs

3. Design co-stimulatory receptors to fully activate at these specific densities to reduce off-target binding on HSCs

A noticeable increase in anti-tumor efficacy and decrease in off-tumor effects were observed with this new design (Haubner et al., 2023). This study increased the sensitivity of their costimulatory receptor by rerouting T-cells to kill cells based on the presence or absence of a secondary antigen. Although this study used different antigen biomarkers not discussed in this thesis, the flexibility of CAR-T therapy allows the chimeric antigen receptors to be customized for different biomarkers. Research into CAR-T demonstrates that only taking overexpressed LSC surface antigens into account is not specific enough to minimize toxicity (Badar et al., 2022). Going forward, increased focus on density-directed CAR-T design and the addition of co-stimulatory receptors may lead to favorable results.

A biomarker-directed targeted therapy regimen is already a method of minimizing off-target effects; selecting cells that (over)express certain biomarkers correlated with AML dysregulation minimizes the probability healthy cells are targeted. Going further, genetic profiling of patients can be introduced to determine which predispositions individuals have and apply targeted therapy methods based on those (Visani et al., 2018). Within the field of pharmacogenomics, viewing single nucleotide polymorphisms and epigenetic regulation via microRNAs can demonstrate how interactions with drugs can vary on an individual level (Visani et al., 2018).

Addressing the limits of an individual patient is necessary as well. Although unpleasant, a patient in their 40s is generally able to endure minor side effects such as diarrhea and nausea (Zimmer & Kadia, 2023). As risk increases with age, symptoms in a younger patient pose a lower risk than they would in an older patient. In older patients, minor side

effects can lead to refractory symptoms and infections that worsen the chances of survival, in combination with a weakened immune system (Zimmer & Kadia, 2023). The treatment should be varied for an individual based on pre-existing comorbidities, age, and stage of AML progression.

7 Conclusion and Societal Implications

It is important to note that these drugs are not necessarily accessible to everyone; the cost of treatment can often amount to thousands, isolating many from treatment behind a socioeconomic wall. Chemotherapy alone in the United States averages around $145,189 for commercially insured patients (Pandya et al., 2020). Payer methods are highly correlated with treatment outcomes; those with private healthcare were more likely to survive treatment than uninsured patients (Marlow et al., 2009). Lastly, a study conducted by Patel et al. (2015) found that Hispanic and Black AML patients were less likely to receive chemotherapy and allo-HSCT, even with younger patients who had preferable cytogenetics. Internalized racial biases in the medical field result in being denied care and can be deadly. Curing AML and cancers in general requires a concerted effort from all sectors, not only the medical field. Not only should treatment be improved and individualized towards each patient, but lack of accessibility, racial biases, and socioeconomic barriers must be overcome. As biomarker-directed therapy is quite expensive, achieving equitable access is important.

How does biomarker-directed treatment in the future look for Patients A and B? Throughout this thesis, different combinations of small molecule inhibitors, chemotherapy, immunotherapy and/or epigenetic inhibitors were discussed as methods to target prolific LSC biomarkers to eliminate MRD. Using precise medicine can tailor therapies for an individual. Patient A can use a combination of epigenetic therapy (pinometostat) and small molecule inhibitors to target H3K27me3 marks with GSK126 and small molecule inhibitors PRI-724 to target β-catenin, and venetoclax to target Bcl-2. Similarly, Patient B can use IDH2 antagonist enasidenib and Smoothened inhibitor glasdegib. Both patients can use N-cadherin antagonist ADH-1, CXCR4 antagonist plexifor and CD47 antagonist rituximab to mod-

ulate their tumor microenvironment. It must be noted again that tumor heterogeneity is vast, and tumor biopsies may not capture the full scope of genetic profiling (Abdulmawjood et al., 2019). However, current research into liquid and longitudinal biopsies presents promising futures for uncovering the diversity of tumors (Abdulmawjood et al., 2019; Bragadin et al., 2024).

The nature of biomarker-directed treatment therapy allows for flexibility on the individual scale, rather than a generalized blanket treatment such as induction chemotherapy. Giving LSCs the opportunity to evade and repopulate after chemotherapy increases the chances of MRD and reduces survival rates (Teixeira et al., 2023). Although standard chemotherapy can often be highly efficacious at killing the majority of tumor cells, it unfortunately attacks healthy cells indiscriminately (Goldman et al., 2019), as well as posing an additional threat to older AML patients or those with a weakened immune system (Teixeira et al., 2023). Ultimately, precision therapy aims to increase drug efficacy and reduce toxicity and MRD recurrence – both through improved biomarker-directed targeting and specific drug design (Teixeira et al., 2023).

8 References

Abdulmawjood, B., Roma-Rodrigues, C., Fernandes, A. R., & Baptista, P. V. (2019). Liquid biopsies in myeloid malignancies. *Cancer Drug Resistance, 2*(4), 1044–1061. https://doi.org/10.20517/cdr.2019.88

Abraham, M., Klein, S., Bulvik, B., Wald, H., Weiss, I. D., Olam, D., Weiss, L., Beider, K., Eizenberg, O., Wald, O., Galun, E., Avigdor, A., Benjamini, O., Nagler, A., Pereg, Y., Tavor, S., & Peled, A. (2017). The CXCR4 inhibitor BL-8040 induces the apoptosis of AML blasts by downregulating ERK, BCL-2, MCL-1 and cyclin-D1 via altered miR-15a/16-1 expression. *Leukemia, 31*(11), 2336–2346. https://doi.org/10.1038/leu.2017.82

Adema, V., & Colla, S. (2022). EZH2 Inhibitors: The Unpacking Revolution. *Cancer Research, 82*(3), 359–361. https://doi.org/10.1158/0008-5472.can-21-4311

Amatangelo, M. D., Quek, L., Shih, A., Stein, E. M., Roshal, M., David, M. D., Marteyn, B., Farnoud, N. R., de Botton, S., Bernard, O. A., Wu, B., Yen, K. E., Tallman, M. S., Papaemmanuil, E., Penard-Lacronique, V., Thakurta, A., Vyas, P., & Levine, R. L. (2017). Enasidenib induces acute myeloid leukemia cell differentiation to promote clinical response. *Blood, 130(6), 732–741*. https://doi.org/10.1182/blood-2017-04-779447

American Cancer Society. (2018, August 21). Treatment Response Rates for Acute Myeloid Leukemia (AML). American Cancer Society, https://www.cancer.org/cancer/types/acute-myeloid-leukemia/treating/response-rates.html

Appelbaum, F. R., Gundacker, H., Head, D. R., Slovak, M., William, C., Godwin, J. E., Anderson, J. E., & Petersdorf, S. H. (2006). Age and acute myeloid leukemia. *Blood, 107*(9), 3481–3485. https://doi.org/10.1182/blood-2005-09-3724

Atilla, E., & Benabdellah, K. (2023). The Black Hole: CAR T Cell Therapy in AML. *Cancers, 15*(10), 2713–2713. https://doi.org/10.3390/cancers15102713

Atilla, E., & Benabdellah, K. (2023). The Black Hole: CAR T Cell Therapy in AML. *Cancers, 15*(10), 2713–2713. https://doi.org/10.3390/cancers15102713

Bao, B., Ahmad, A., Li, Y., Azmi, A. S., Ali, S., Banerjee, S., Kong, D., & Sarkar, F. H. (2012). Targeting CSCs within the tumor microenvironment for cancer therapy: a potential role of mesenchymal stem cells. *Expert Opinion on Therapeutic Targets, 16*(10), 1041–1054. https://doi.org/10.1517/14728222.2012.714774

Barbullushi, K., Rampi, N., Serpenti, F., Sciumè, M., Fabris, S., De Roberto, P., & Fracchiolla, N. (2022). Vaccination Therapy for Acute Myeloid Leukemia: Where Do We Stand? *Cancers, 14*(12), 2994–2994. https://doi.org/10.3390/cancers14122994

Basheer, F., Giotopoulos, G., Meduri, E., Yun, H., Mazan, M., Sasca, D., Gallipoli, P., Marando, L., Gozdecka, M., Asby, R., Sheppard, O., Dudek, M., Bullinger, L., Döhner, H., Dillon, R., Freeman, S., Ottmann, O., Burnett, A., Russell, N., & Papaemmanuil, E. (2019). Contrasting requirements during disease evolution identify EZH2 as a therapeutic target in AML. *Journal of Experimental Medicine, 216*(4), 966–981. https://doi.org/10.1084/jem.20181276

Bragadin, A., Del Bianco, P., Zulato, E., Attili, I., Pavan, A., Carlet, J., Marra, L., Guarneri, V., Indraccolo, S., & Bonanno, L. (2024). Longitudinal liquid biopsy predicts clinical benefit from immunotherapy in advanced non-small cell lung cancer. *Npj Precision Oncology, 8*(1). https://doi.org/10.1038/s41698-024-00704-9

Bruno, S., Mancini, M., De Santis, S., Monaldi, C., Cavo, M., & Soverini, S. (2021). The Role of Hypoxic Bone Marrow Microenvironment in Acute Myeloid Leukemia and Future Therapeutic Opportunities. *International Journal of Molecular Sciences, 22*(13), 6857. https://doi.org/10.3390/ijms22136857

Burger, J. A., & Peled, A. (2009). CXCR4 antagonists: targeting the microenvironment in leukemia and other cancers. *Leukemia, 23*(1), 43–52. https://doi.org/10.1038/leu.2008.299

Calabretta, B., Porazzi, P., Petruk, S., Pagliaroli, L., De Dominici, M., Deming, D., Puccetti, M. V., Kushinsky, S., Kumar, G., Minieri, V., Barbieri, E., Deliard, S., Grande, A., Trizzino, M., Gardini, A., Canaani, E., Palmisiano, N.,

Porcu, P., Ertel, A., & Fortina, P. (2022). Targeting Chemotherapy to Decondensed H3K27me3-Marked Chromatin of AML Cells Enhances Leukemia Suppression. *Cancer Research, 82*(3), 458–471. https://doi.org/10.1158/0008-5472.can-21-1297

Cantilena, S., Gasparoli, L., Pal, D., Heidenreich, O., Klusmann, J.-H., H.A. Martens, J., Faille, A., Warren, A., Karsa, M., Pandher, R., Somers, K., Williams, O., & de Boer, J. (2022). Direct targeted therapy for MLL-fusion-driven high-risk acute leukaemias. *Clinical Translational Medicine, 12*(6). https://doi.org/10.1002/ctm2.933

Chan, H. L.-Y., & Chen, C.-W. (2019). Rewiring the Epigenetic Networks in MLL-Rearranged Leukemias: Epigenetic Dysregulation and Pharmacological Interventions. *Frontiers in Cell and Developmental Biology, 7*(81). https://doi.org/10.3389/fcell.2019.00081

Cortes, J. E., Heidel, F. H., Hellmann, A., Fiedler, W., Smith, B. D., Robak, T., Montesinos, P., Pollyea, D. A., DesJardins, P., Ottmann, O., Ma, W. W., Shaik, M. N., Laird, A. D., Zeremski, M., O'Connell, A., Chan, G., & Heuser, M. (2019). Randomized comparison of low dose cytarabine with or without glasdegib in patients with newly diagnosed acute myeloid leukemia or high-risk myelodysplastic syndrome. *Leukemia, 33*(2), 379–389. https://doi.org/10.1038/s41375-018-0312-9

Currie, G. M. (2018). Pharmacology, Part 1: Introduction to Pharmacology and Pharmacodynamics. *Journal of Nuclear Medicine Technology, 46*(2), 81–86. https://doi.org/10.2967/jnmt.117.199588

Darici, S., Alkhaldi, H., Horne, G., Jørgensen, H. G., Marmiroli, S., & Huang, X. (2020). Targeting PI3K/Akt/mTOR in AML: Rationale and Clinical Evidence. *Journal of Clinical Medicine, 9*(9), 2934. https://doi.org/10.3390/jcm9092934

Van Dijk, A.D V., Hoff, F. W., Hua Qiu, Y., Chandra, J., Jabbour, E., S.J.M, E., Horton, T. M., & Kornblau, S. M. (2021). Loss of H3K27 methylation identifies poor outcomes in adult-onset acute leukemia. *Clinical Epigenetics, 13*(1). https://doi.org/10.1186/s13148-021-01011-x

Dogan, A., & Demircioglu, S. (2022). Diagnostic importance of bone marrow aspiration evaluation: A single-center study. *Pakistan Journal of Medical Sciences, 38*(4). https://doi.org/10.12669/pjms.38.4.4797

Döhner, H., Wei, A. H., Appelbaum, F. R., Craddock, C., DiNardo, C. D., Dombret, H., Ebert, B. L., Fenaux, P., Godley, L. A., Hasserjian, R. P., Larson, R. A., Levine, R. L., Miyazaki, Y., Niederwieser, D., Ossenkoppele, G. J., Röllig, C., Sierra, J., Stein, E. M., Tallman, M. S., & Tien, H.-F. (2022). Diagnosis and Management of AML in Adults: 2022 ELN Recommendations from an International Expert Panel. *Blood, 140*(12). https://doi.org/10.1182/blood.2022016867

Doucette, K., Karp, J., & Lai, C. (2021). Advances in therapeutic options for newly diagnosed, high-risk AML patients. *Therapeutic Advances in Hematology, 12*, 204062072110011. https://doi.org/10.1177/20406207211001138

Gao, Y., Gao, J., Li, M., Zheng, Y., Wang, Y., Zhang, H., Wang, W., Chu, Y., Wang, X., Xu, M., Cheng, T., Ju, Z., & Yuan, W. (2016). Rheb1 promotes tumor progression through mTORC1 in MLL-AF9-initiated murine acute myeloid leukemia. *Journal of Hematology & Oncology, 9*(1). https://doi.org/10.1186/s13045-016-0264-3

Graig, L. A., Phillips, J. K., Moses, H. L., Committee on Policy Issues in the Clinical Development and Use of Biomarkers for Molecularly Targeted Therapies, Board on Health Care Services, Institute of Medicine, & National Academies of Sciences, Engineering and Health. (2016). Introduction. In www.ncbi.nlm.nih.gov. *National Academies Press (US)*. https://www.ncbi.nlm.nih.gov/books/NBK379335/

Griffioen, M. S., de Leeuw, D. C., Janssen, J. J. W. M., & Smit, L. (2022). Targeting Acute Myeloid Leukemia with Venetoclax; Biomarkers for Sensitivity and Rationale for Venetoclax-Based Combination Therapies. *Cancers, 14*(14), 3456. https://doi.org/10.3390/cancers14143456

Gross, E. (2018, November 22). Are Cancer Stem Cells a Prime Target for Therapy? [Image]. *Crown Bioscience,* https://blog.crownbio.com/cancer-stem-cell-models

Haubner, S., Mansilla-Soto, J., Nataraj, S., Kogel,

F., Chang, Q., de Stanchina, E., Lopez, M., Rosa Ng, M., Fraser, K., Subklewe, M., Park, J. H., Wang, X., Rivière, I., & Sadelain, M. (2023). Cooperative CAR targeting to selectively eliminate AML and minimize escape. *Cancer Cell, 41*(11), 1871-1891.e6. https://doi.org/10.1016/j.ccell.2023.09.010

Hoffbrand, A. V., & Moss, P. A. H. (2015). Hoffbrand's Essential Haematology (7th ed.). John Wiley & Sons. Hoy, S. M. (2019). Glasdegib: First Global Approval. *Drugs, 79*(2), 207–213. https://doi.org/10.1007/s40265-018-1047-7

Ju, F., Atyah, M. M., Horstmann, N., Gul, S., Vago, R., Bruns, C. J., Zhao, Y., Dong, Q.-Z., & Ren, N. (2022). Characteristics of the cancer stem cell niche and therapeutic strategies. *Stem Cell Research & Therapy, 13*(1). https://doi.org/10.1186/s13287-022-02904-1

Kim, E. S. (2017). Enasidenib: First Global Approval. *Drugs, 77*(15), 1705–1711. https://doi.org/10.1007/s40265-017-0813-2

Kreutmair, S., Pfeifer, D., Waterhouse, M., Takács, F., Graessel, L., Döhner, K., Duyster, J., Illert, A. L., Frey, A.-V., Schmitt, M., & Lübbert, M. (2022). First-in-human study of WT1 recombinant protein vaccination in elderly patients with AML in remission: A single-center experience. *Cancer Immunology, Immunotherapy, 71*(12), 2913–2928. https://doi.org/10.1007/s00262-022-03202-8

Lee, J.-H., Faderl, S., Pagel, J. M., Jung, C. W., Yoon, S.-S., Pardanani, A. D., Becker, P. S., Lee, H., Choi, J., Lee, K., Kim, M., & Cortes, J. E. (2020). Phase 1 study of CWP232291 in patients with relapsed or refractory acute myeloid leukemia and myelodysplastic syndrome. *Blood Advances, 4*(9), 2032–2043. https://doi.org/10.1182/bloodadvances.2019000757

Maganti, H., Visram, A., Shorr, R., Fulcher, J., Sabloff, M., & Allan, D. S. (2020). Plerixafor in combination with chemotherapy and/or hematopoietic cell transplantation to treat acute leukemia: A systematic review and metanalysis of preclinical and clinical studies. *Leukemia Research, 97*, 106442. https://doi.org/10.1016/j.leukres.2020.106442

Makkar, H., Majhi, R. K., Goel, H., Gupta, A. K., Chopra, A., Tanwar, P., & Seth, R. (2023). Acute myeloid leukemia: Novel mutations and their clinical implications. *American Journal of Blood Research, 13*(1), 12. https://pmc.ncbi.nlm.nih.gov/articles/PMC10017594/

Marchand, T., & Pinho, S. (2021). Leukemic Stem Cells: From Leukemic Niche Biology to Treatment Opportunities. *Frontiers in Immunology, 12*. https://doi.org/10.3389/fimmu.2021.775128

Marconi, G. D., Fonticoli, L., Rajan, T. S., Pierdomenico, S. D., Trubiani, O., Pizzicannella, J., & Diomede, F. (2021). Epithelial-Mesenchymal Transition (EMT): The Type-2 EMT in Wound Healing, Tissue Regeneration and Organ Fibrosis. *Cells, 10*(7), 1587. https://doi.org/10.3390/cells10071587

Marlow, N. M., Pavluck, A. L., Bian, J., Ward, E. M., & Halpern, M. T. (2009). The Relationship Between Insurance Coverage and Cancer Care: A Literature Synthesis. Retrieved from PubMed Database. https://doi.org/10.3768/rtipress.2009.rr.0005.0905

Marofi, F., Rahman, H. S., Al-Obaidi, Z. M. J., Jalil, A. T., Abdelbasset, W. K., Suksatan, W., Dorofeev, A. E., Shomali, N., Chartrand, M. S., Pathak, Y., Hassanzadeh, A., Baradaran, B., Ahmadi, M., Saeedi, H., Tahmasebi, S., & Jarahian, M. (2021). Novel CAR T therapy is a ray of hope in the treatment of seriously ill AML patients. *Stem Cell Research & Therapy, 12*(1). https://doi.org/10.1186/s13287-021-02420-8

Medeiros, B. C., Fathi, A. T., DiNardo, C. D., Pollyea, D. A., Chan, S. M., & Swords, R. (2016). Isocitrate dehydrogenase mutations in myeloid malignancies. *Leukemia, 31*(2), 272–281. https://doi.org/10.1038/leu.2016.275

Miller, C. A., Wilson, R. K., & Ley, T. J. (2013). Genomic Landscapes and Clonality of De Novo AML. *New England Journal of Medicine, 369*(15), 1472–1473. https://doi.org/10.1056/nejmc1308782

National Cancer Institute. (2019). Adult Acute Myeloid Leukemia Treatment. *National Cancer Institute*; Cancer.gov. https://www.cancer.gov/types/leukemia/hp/adult-aml-treatment-pdq

Nguyen, A. T., Taranova, O., He, J., & Zhang, Y. (2011). DOT1L, the H3K79 methyltrans-

ferase, is required for MLL-AF9–mediated leukemogenesis. *Blood, 117*(25), 6912–6922. https://doi.org/10.1182/blood-2011-02-334359

Olsen, S. N., Godfrey, L., Healy, J. P., Choi, Y. A., Kai, Y., Hatton, C., Perner, F., Haarer, E. L., Nabet, B., Yuan, G.-C., & Armstrong, S. A. (2022). MLL::AF9 degradation induces rapid changes in transcriptional elongation and subsequent loss of an active chromatin landscape. *Molecular Cell, 82*(6), 1140-1155.e11. https://doi.org/10.1016/j.molcel.2022.02.013

Pal, D., Blair, H., Parker, J., Hockney, S., Beckett, M., Singh, M., Tirtakusuma, R., Nelson, R., McNeill, H., Angel, S. H., Wilson, A., Nizami, S., Nakjang, S., Zhou, P., Schwab, C., Sinclair, P., Russell, L. J., Coxhead, J., Halsey, C., & Allan, J. M. (2022). hiPSC-derived bone marrow milieu identifies a clinically actionable driver of niche-mediated treatment resistance in leukemia. *Cell Reports Medicine, 3*(8), 100717–100717. https://doi.org/10.1016/j.xcrm.2022.100717

Pandya, B. J., Chen, C.-C., Medeiros, B. C., McGuiness, C. B., Wilson, S. D., Walsh, E. H., & Wade, R. L. (2020). Economic and Clinical Burden of Acute Myeloid Leukemia Episodes of Care in the United States: A Retrospective Analysis of a Commercial Payer Database. *Journal of Managed Care & Specialty Pharmacy, 26*(7), 849–859. https://doi.org/10.18553/jmcp.2020.19220

Patel, M. I., Ma, Y., Mitchell, B. S., & Rhoads, K. F. (2015). How Do Differences in Treatment Impact Racial and Ethnic Disparities in Acute Myeloid Leukemia? *Cancer Epidemiology, Biomarkers & Prevention, 24*(2), 344–349. https://doi.org/10.1158/1055-9965.epi-14-0963

Pecorino, L. (2021). Molecular Biology Of Cancer. *Oxford Univ Press*.

Plaks, V., Kong, N., & Werb, Z. (2015). The Cancer Stem Cell Niche: How Essential Is the Niche in Regulating Stemness of Tumor Cells? *Cell Stem Cell, 16*(3), 225–238. https://doi.org/10.1016/j.stem.2015.02.015

Poli, V., Fagnocchi, L., & Zippo, A. (2018). Tumorigenic Cell Reprogramming and Cancer Plasticity: Interplay between Signaling, Microenvironment, and Epigenetics. *Stem Cells International, 2018, 1–16*. https://doi.org/10.1155/2018/4598195

PulseNotes Team. (2021, March). Haematopoiesis Notes. PulseNotes. https://app.pulsenotes.com/medicine/haematology/notes/haematopoiesis

Qu, T., Li, B., & Wang, Y. (2022). Targeting CD47/SIRPα as a therapeutic strategy, where we are and where we are headed. *Biomarker Research, 10*(1). https://doi.org/10.1186/s40364-022-00373-5

Rajsri, K. S., Roy, N., & Chakraborty, S. (2023). Acute Myeloid Leukemia Stem Cells in Minimal/Measurable Residual Disease Detection. *Cancers, 15*(10), 2866–2866. https://doi.org/10.3390/cancers15102866

Rausch, J., Ullrich, E., & Kühn, M. W. M. (2023). Epigenetic targeting to enhance acute myeloid leukemia-directed immunotherapy. *Frontiers in Immunology, 14*. https://doi.org/10.3389/fimmu.2023.1269012

Récher, C. (2021). Clinical Implications of Inflammation in Acute Myeloid Leukemia. *Frontiers in Oncology, 11*. https://doi.org/10.3389/fonc.2021.623952

Ribatti, D. (2012). Cancer stem cells and tumor angiogenesis. *Cancer Letters, 321*(1), 13–17. https://doi.org/10.1016/j.canlet.2012.02.024

Simon, M., Grandage, V. L., Linch, D. C., & Khwaja, A. (2005). Constitutive activation of the Wnt/β-catenin signalling pathway in acute myeloid leukaemia. *Oncogene, 24*(14), 2410–2420. https://doi.org/10.1038/sj.onc.1208431

Stahl, M., & Goldberg, A. D. (2019). Immune Checkpoint Inhibitors in Acute Myeloid Leukemia: Novel Combinations and Therapeutic Targets. *Current Oncology Reports, 21*(4). https://doi.org/10.1007/s11912-019-0781-7

Stavropoulou, V., & Schwaller, J. (2017). The hematopoietic precursor cell in which driver mutations occur is linked to AML aggressiveness – a potential target for personalized medicine. *Expert Review of Precision Medicine and Drug Development, 2*(1), 1–3. https://doi.org/10.1080/23808993.2017.1289065

Stein, E. M., DiNardo, C. D., Pollyea, D. A., Fathi, A. T., Roboz, G. J., Altman, J. K., Stone, R. M., DeAngelo, D. J., Levine, R. L., Flinn, I.

W., Kantarjian, H. M., Collins, R., Patel, M. R., Frankel, A. E., Stein, A., Sekeres, M. A., Swords, R. T., Medeiros, B. C., Willekens, C., & Vyas, P. (2017). Enasidenib in mutant IDH2 relapsed or refractory acute myeloid leukemia. *Blood, 130*(6), 722–731. https://doi.org/10.1182/blood-2017-04-779405

Stein, E. M., Garcia-Manero, G., Rizzieri, D. A., Tibes, R., Berdeja, J. G., Savona, M. R., Jongen-Lavrenic, M., Altman, J. K., Thomson, B., Blakemore, S. J., Daigle, S. R., Waters, N. J., Suttle, A. B., Clawson, A., Pollock, R., Krivtsov, A., Armstrong, S. A., Di-Martino, J., Hedrick, E., & Löwenberg, B. (2018). The DOT1L inhibitor pinometostat reduces H3K79 methylation and has modest clinical activity in adult acute leukemia. *Blood, 131*(24), 2661–2669. https://doi.org/10.1182/blood-2017-12-818948

Su, Y.-C., Lee, W.-C., Wang, C.-C., Yeh, S.-A., Chen, W.-H., & Chen, P.-J. (2022). Targeting PI3K/AKT/mTOR Signaling Pathway as a Radiosensitization in Head and Neck Squamous Cell Carcinomas. *International Journal of Molecular Sciences, 23*(24), 15749. https://doi.org/10.3390/ijms232415749

Teixeira, A., Carreira, L., Abalde-Cela, S., Sampaio-Marques, B., Areias, A. C., Ludovico, P., & Diéguez, L. (2023). Current and Emerging Techniques for Diagnosis and MRD Detection in AML: A Comprehensive Narrative Review. *Cancers, 15*(5), 1362–1362. https://doi.org/10.3390/cancers15051362

Terao, T., & Minami, Y. (2019). Targeting Hedgehog (Hh) Pathway for the Acute Myeloid Leukemia Treatment. *Cells, 8*(4), 312. https://doi.org/10.3390/cells8040312

Theocharides, A., Jin, L., Cheng, P.-Y., Prasolava, T. K., Malko, A. V., M. Ho, J., Poeppl, A. G., van Rooijen, N., Minden, M. D., Danska, J. S., Dick, J. E., & C.Y. Wang, J. (2012). Disruption of SIRPα signaling in macrophages eliminates human acute myeloid leukemia stem cells in xenografts. *Journal of Experimental Medicine, 209*(10), 1883–1899. https://doi.org/10.1084/jem.20120502

Vakiti, A., & Mewawalla, P. (2019, December 18). Cancer, Acute Myeloid Leukemia (AML, Erythroid Leukemia, Myelodysplasia-Related Leukemia, BCR-ABL Chronic Leukemia). NIH.gov; *StatPearls Publishing*. https://www.ncbi.nlm.nih.gov/books/NBK507875/

Varisli, L., & Vlahopoulos, S. (2024). Epithelial–Mesenchymal Transition in Acute Leukemias. *International Journal of Molecular Sciences, 25*(4), 2173–2173. https://doi.org/10.3390/ijms25042173

Vetrie, D., Helgason, G. V., & Copland, M. (2020). The leukaemia stem cell: similarities, differences and clinical prospects in CML and AML. *Nature Reviews Cancer, 20*(3), 158–173. https://doi.org/10.1038/s41568-019-0230-9

Visani, G., Loscocco, F., Isidori, A., & Piccaluga, P. P. (2018). Genetic profiling in acute myeloid leukemia: a path to predicting treatment outcome. *Expert Review of Hematology, 11*(6), 455–461. https://doi.org/10.1080/17474086.2018.1475225

Visvader, J. E. (2011). Cells of origin in cancer. *Nature, 469*(7330), 314–322. https://doi.org/10.1038/nature09781

Yamazaki, J., Marcos R.H. Estécio, Lu, Y., Long, H., Malouf, G. G., Graber, D., Huo, Y., Ramagli, L. S., Liang, S., Kornblau, S. M., JelínekJ., & Issa, J. J. (2013). The epigenome of AML stem and progenitor cells. *Epigenetics, 8*(1), 92–104.https://doi.org/10.4161/epi.23243

Yang, L., Shi, P., Zhao, G., Xu, J., Peng, W., Zhang, J., Zhang, G., Wang, X., Dong, Z., Chen, F., & Cui, H. (2020). Targeting cancer stem cell pathways for cancer therapy. *Signal Transduction and Targeted Therapy, 5*(8). https://doi.org/10.1038/s41392-020-0110-5

Yang, X., & Wang, J. (2018). Precision therapy for acute myeloid leukemia. *Journal of Hematology & Oncology, 11*(1). https://doi.org/10.1186/s13045-017-0543-7

Yang, Y., Mallampati, S., Sun, B., Zhang, J., Kim, S.-B., Lee, J.-S., Gong, Y., Cai, Z., & Sun, X. (2013). Wnt pathway contributes to the protection by bone marrow stromal cells of acute lymphoblastic leukemia cells and is a potential therapeutic target. *Cancer Letters, 333*(1), 9–17. https://doi.org/10.1016/j.canlet.2012.11.056

Yoshida, T., Mihara, K., Takei, Y., Yanagihara, K., Kubo, T., Bhattacharyya, J., Imai, C., Mino, T., Takihara, Y., & Ichinohe, T. (2016). All-trans retinoic acid enhances cytotoxic effect of T cells with an anti-

CD38 chimeric antigen receptor in acute myeloid leukemia. *Clinical & Translational Immunology, 5*(12), e116. https://doi.org/10.1038/cti.2016.73

Zhang, Y., & Wang, X. (2020). Targeting the Wnt/β-catenin signaling Pathway in cancer. *Journal of Hematology & Oncology, 13*(1). https://doi.org/10.1186/s13045-020-00990-3

Zimmer, M., & Kadia, T. (2023). Approach to the Older Patient with Acute Myeloid Leukemia. *Current Oncology Reports, 25*(11), 1203–1211. https://doi.org/10.1007/s11912-023-01450-0

A Secondary inclusion and exclusion criteria for biomarker search

Secondary inclusion and exclusion criteria for biomarker search.

Chapter	Inclusion Criteria	Exclusion Criteria
4.1 Epigenetics	epigenetics OR histones OR methylation	NOT somatic mutations OR case reports
4.2 Chromosomal translocations and point mutations	subtypes OR chromosomal aberrations OR complex karyotypes OR point mutations OR polymorphism	NOT case reports
4.3 Cell-independent factors	primary AML cells AND oncogenic pathways OR signaling pathways OR tumor suppressor pathways OR oncometabolites	NOT case reports
4.4 Tumor microenvironment	bone marrow niche OR stroma OR immune evasion OR hypoxia OR metastasis	NOT case reports

Social Sciences

Unveiling Racial Dynamics:

The Impact of Dutch Double Consciousness Among Racialized Others on Racial Discourse in the Netherlands

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Abstract

This study examines the impact of double consciousness among racialized others on racial discourse in the Netherlands, an area yet to be thoroughly examined in academic research. Specifically, the study explores the way Dutch double consciousness, as identified by Wekker (2016), has historically impeded conversations about race and racism and how these dynamics are shifting amid increasing anti-racist activism. To accomplish these objectives, this research employs qualitative methods, conducting semi-structured interviews with racialized others in the Netherlands. Analyzing the interviews through a conceptual framework and existing literature, the findings reveal that participants experience double consciousness specific to the Dutch context. This double consciousness inhibits conversations on race and racism in the Netherlands, as the desire not to stand out and to conform to Dutch cultural norms suppresses the vocalization of racial issues. However, a shift is occurring through increasing anti-racist activism; activists are challenging these norms and reclaiming their identities, thereby transforming racial discourse and prompting a broader reevaluation of race relations in the Netherlands. This study contributes to the underexplored area of activism and racial identity within the Dutch colonial legacy context, offering a novel application of the concept of double consciousness.

Keywords and phrases: *double consciousness, anti-racist activism, racial discourse, racialized other, the Netherlands*

Contents

1   Introduction

For a long time the Netherlands operated under the pretense that issues of race and racism were either irrelevant or nonexistent within its society. This perception persisted despite considerable evidence from scholars highlighting the Netherlands' colonial past and its enduring legacies of racism and colonial structures (see Essed & Hoving, 2014; Nimako & Willemsen, 2011; Oostindie, 2011). Racial discrimination and colonial violence are in fact very prevalent in Dutch society; yet, discussions surrounding race were actively avoided, with terms like Zwart (Black), ras (race), and Wit (White) carrying a taboo status, further perpetuating the silence surrounding racial issues. Ergo, the existence of race in Dutch society is denied, but the discrimination on the basis of race is not. This contradiction within Dutch society as well as other phenomena, such as color-blindness, racial denial, and White innocence, have long been identified by scholars as pervasive themes which reflect a broader unwillingness in the Netherlands to confront racial realities (Essed, 1991; Weiner, 2014b; Wekker, 2016).

However, within the past decade, the narrative has been shifting remarkably, driven by academic research, public debates, and activism. Critical discussions on *Zwarte Piet* (Black Pete), the global Black Lives Matter movement, and seminal works by scholars like Gloria Wekker have catalyzed a reevaluation of race and decolonization in Dutch society, challenging the long-standing silence on these issues (Dikmans, 2020; Ghorashi, 2023). This period has seen a surge in anti-racist movements reaching the broader population and bringing conversations about race to the forefront of national discourse (Caradonna, 2024). Furthermore, this transformative shift is reflected in actions taken by the Dutch government and society. For example, the government has initiated new policies and programs aimed at addressing racism and promoting diversity and inclusion, such as the National Program against Discrimination and Racism (Ministry of Interior and Kingdom Relations, 2022). Additionally, the tradition of *Zwarte Piet*, a blackface figure associated with the Dutch Sinterklaas celebration, is no longer widely accepted in society as there has been a significant decrease in its support (Gruber, 2022). As of 2016, 33% of people believed the appearance of *Zwarte Piet* to be an issue, whereas by 2022, that number had increased to 60%, nearly doubling over the course of six years (Driessen & van der Schelden, 2022).

Despite the transformative role of the recent surge in anti-racist movement in reshaping Dutch societal perspectives, the underlying factors driving this increased engagement remain underexplored. Gloria Wekker (2016), however, suggests a link between the historical lack of emancipatory anti-racist movements and the experience of Dutch double consciousness. The concept of double consciousness, coined by W.E.B Du Bois, originally refers to the internal struggle of reconciling two opposing identities experienced by Black individuals in a White-dominated society (Eze, 2011). Applying this concept to the Dutch context, Wekker (2016, p. 49) identified a specific form of Black Dutch double consciousness, which could be linked to the lack of a racial discourse. Yet, this relationship warrants further investigation.

The study aims to examine this potential connection by exploring the following question: What role has double consciousness among racialized others played in inhibiting conversations about race and racism in the Netherlands, and how has this dynamic shifted over time with increasing activism and an emerging racial discourse? The term "racialized other" generally refers to individuals and groups who are ascribed a distinct racial identity by dominant societal norms and structures, leading to their marginalization and differentiation from the majority population (Grell-Brisk et al., 2022). Racialized others are constructed within specific social, historical and political contexts to delineate "us" from "them" based on race (Gonzalez-Sobrino & Goss, 2019).

In this study, the term "racialized others" specifically refers to individuals within Dutch society who are identified through a racial lens due to their perceived African heritage or blackness. This definition stems from Wekker's (2016) critical analysis of racial categorizations in the Netherlands, in which she outlines how certain groups are perpetually viewed as "*allochtoon*" and "*autochtoon*." The term *allochtoon* is used to describe "those who come from elsewhere," while *autochtonen* are those considered native to the Netherlands (Wekker, 2016, p. 15).

In theory, a person is *allochtoon* if they themselves or at least one of their parents is born outside of the Netherlands (Centraal Bureau voor de

Statistiek, 2008). However, in practice, this is not the case, as the terms are no longer race neutral: White people whose parents were not born in the Netherlands were seen as *autochtoon*, whereas non-White people, even those whose parents were born in the Netherlands, automatically were deemed *allochtoon* (Essed, 1991). Broadly speaking, this us-vs-them dichotomy is primarily based on color and perceived cultural difference rather than actual place of origin (Rose, 2022). Therefore, people with a perceived blackness are being racialized "for endless generations, never getting to belong to the Dutch nation," labeled *allochtoon* by *autochtonen* forever (Wekker, 2016, p. 15).

So, in this study racialized others refers to those who are othered in Dutch society due to their race. This category primarily includes Surinamese, Antillean, and African individuals, and does not encompass all people of color. For instance, Indonesians, despite their brown skin, are not included within this category. Over time, they have been assimilated into the "*autochtoon*" category, partly due to their perceived cultural similarities and lighter skin color, which diminishes the perception of "otherness" (Wekker, 2016). Similarly, Muslim individuals, while also labeled *allochtoon*, experience a form of othering that is predominantly based on religion rather than race, leading to the construction of the Islamic other and creating a distinctly different societal experience from those othered based on race (Wekker, 2016). Thus, in this research, racialized other specifically refers to people of color who are othered in Dutch society due to their perceived blackness and African descent.

This conceptualization highlights the specific racial dynamics in the Netherlands, which categorize individuals not merely on the basis of country of origin, but through a interplay of race, culture, and enduring colonial mentalities. However, irrespective of this definition, part of this research involves probing the concept of the racialized other itself, exploring the implications of this labeling and the potential for change in how racial identities are perceived and constructed in Dutch society.

This research will employ qualitative methods, conducting interviews with racialized others in the Netherlands. These interviews are designed to explore participants' personal experiences and perceptions, assessing if and how double consciousness manifests in their lives and influences their en-

gagement in racial discourse and activism. These narratives will be analyzed through a novel synthesis of literature on double consciousness, race, and racism in the Netherlands. Specifically, this synthesis combines traditional theories on double consciousness with studies on Dutch racism and activism, offering a new application of double consciousness. The study will further examine how the dynamics of double consciousness and racial discourse have shifted over time in the Netherlands, taking into consideration societal events, such as the Black Lives Matter movement. A more detailed discussion of the research methods employed will be provided in the *Methodology* chapter.

By correlating individual experiences of double consciousness with broader societal changes, this study aims to deepen understanding of the relationship between racial identities and public racial discourse in the Netherlands. It endeavors to unravel whether phenomena of Dutch double consciousness continue to impede racial dialogue and how individuals navigate and possibly transcend these constraints in pursuit of emancipatory racial politics. This study not only integrates relevant theories but also introduces an approach to understand how activism emerges and is manifested in a context marked by its colonial legacy. In doing so, it aspires to contribute to race studies, amplify voices, and address the colonial legacy that continues to affect the everyday experiences of people of color.

The introduction to this study is followed by a methodology section, which outlines the research approach and methods employed to gather and analyze data. The third chapter is a conceptual framework, delving into key theoretical concepts and frameworks that inform the analysis, laying the groundwork for the subsequent empirical investigation. After the empirical findings of the study are presented, a discussion and conclusion section follows, which summarizes the main findings and suggests avenues for future research.

2 Methodology

2.1 Research Design

This study employs a qualitative research method to explore the evolution of racial discourse and double consciousness among Black racialized others in the Netherlands. Qualitative methods

were chosen over quantitative ones because they are suited to answering questions about experiences, meanings, and perspectives from the participants' viewpoints, essential for exploring subjective and complex phenomena like racial identity and discourse (Hammarberg et al., 2016; Sofaer, 1999). Such methods are particularly effective in capturing nuances and complexities in how individuals perceive and react to their racialized experiences, prioritizing depth over breadth, as opposed to quantitative methods (Hammarberg et al., 2016).

As the primary method of data collection, interviews were conducted with racialized individuals. This approach was selected because it provides a direct avenue for participants to articulate personal narratives and opinions on sensitive issues (Hammarberg et al., 2016). The interviews had a semi-structured format, chosen for flexibility and depth. Semi-structured interviews follow an interview guide, consisting of a few pre-determined questions, both open- and close-ended, providing room for spontaneity and follow-up inquiries (Adams, 2015). This type of interview thus allows for flexibility in the conversation and enables the interviewer and the participant to explore topics in depth while it also allows for unexpected insights to be explored as they arise during the conversation. In addition, this format is particularly suited for sensitive topics and capturing individual experiences, as open questions allow the participant to go at their own pace and share what they feel comfortable disclosing (Dunn, 2005).

Thus, the choice of semi-structured interviews over other forms of data collection, like surveys or fully structured interviews, was driven by the need to engage deeply with the participants' lived experiences. It fosters interactive dialogue where unexpected insights can emerge, while maintaining the structured focus needed to address the research question effectively.

In this study, the interviews were designed in a way that encourages participants to discuss their experiences with racial identity and societal interactions. The questions were derived from existing literature and were developed to prompt discussion on the aspects related to double consciousness and racial discourse that are delineated in the theoretical framework (See Appendix). A limited number of guiding questions were prepared, because follow-up questions often arise and one hour is

deemed the maximum length for a semi-structured interview in order to avoid fatigue (Adams, 2015). Hence, the interviews lasted between twenty-five minutes and one hour.

Nine interviews were conducted in Dutch and the other three in English. Although all participants were fluent in Dutch, those comfortable with English were invited to conduct the interview in that language to reduce the need for translation, making transcription easier. Five of the interviews were held in-person in a private location, while the remaining interviews took place online due to travel constraints. To facilitate the online interviews, digital platforms such as Zoom and Teams were utilized to video call with the participants. Video calling enabled real-time interactions and provided the visual component, allowing for face-to-face engagement despite the remote nature of the interviews. The use of web and video conferencing platforms is very common for conducting interviews; Archibald et al. (2019) even suggest that study participants prefer Zoom over a face-to-face medium.

All interviews were also audio-recorded with the verbal consent of the participants. Moreover, the interviewees were informed beforehand that participation was completely voluntary and they could withdraw from the research at any point. They were assured that their data would be handled with care and the questions were not expected to cause mental harm. In addition, there was the option to stay anonymous, if preferred. Apart from receiving verbal consent from the participants, the research has also been approved by the AUC Ethics Committee.

The analysis of the interview data will be guided by the concepts outlined in Chapter 3, *Conceptual Framework*. By integrating these theoretical concepts with the empirical data gathered from the interviews, the study aims to provide a nuanced understanding of the development of double consciousness, as well as contribute to broader discussions on race, racial discourse, and anti-racist activism.

2.2 Participants

Participants for this study were selected through purposive sampling, targeting individuals who identify as part of racialized groups in the Netherlands, specifically defined as racialized others, as conceptualized in the Introduction. Purposive sampling ensures that participants are rep-

Table 1: List of participants.

Name	Age	Ethnicity	Migration generation	Gender	Socio-economic status
Tygo	18	Surinamese (Creole[1])	Second generation	Male	Upper class
Amal	22	Dutch/Sudanese	Second generation	Female	Higher-middle class
Wanjiku	22	Dutch/Zambian	Second generation	Female	Middle class
Giani	24	Antillean/Surinamese (Javanese)	Second generation	Male	Middle class
Willems	25	Antillean/Columbian	Third generation	Male	Middle class
Nikita	26	Ethiopian	First generation	Female	Working class (past), lower middle class (current)
Daphne	40	Surinamese/Creole	Second generation	Female	Middle class
Miranda	42	Dutch/Antillean	Second generation	Female	Middle class
Germaine	49	Surinamese(Creole)	Second generation	Female	Middle class
Marcia	54	Surinamese(Creole)	First generation	Female	Middle class
John	59	Surinamese (Creole/Javanese)	First generation	Male	Working class (past), middle class (current)
Carla	80	Dutch/Surinamese (Creole)	First generation	Female	Working class

resentative of the population of interest, capturing diverse perspectives and experiences, which provide rich insights vital for the research's objectives (Campbell et al., 2020). The researcher used their own network to find interviewees, but also contacted individuals via LinkedIn to reach a wider range of participants. In total, twelve people were interviewed (See Table 1).

Age was an important factor in selecting participants, as people from various age groups have distinct experiences, values and perspectives. Thus, a wide age spectrum, spanning multiple generations, was necessary to capture a diversity of viewpoints. Considering the temporal element of the research question, which is to explore the way Dutch double consciousness and its impact on the racial discourse have evolved over time, participants from diverse age groups can provide insights into attitudes and experiences across generations. Additionally, comparing responses allows researchers to identify themes and generational differences

[1]In the Surinamese context, Creole refers to the descendants of slaves that were transported from Africa to Suriname during the trans-Atlantic slave trade.

(Kiger & Viarpo, 2020).

Furthermore, ethnicity was considered when selecting participants. As explained in the *Introduction*, the intersection of one's racial, ethnic and cultural identity, impacts the way one is othered within society (See Essed, 1991). Thus, purposive sampling was used to reflect a variety of viewpoints. To ensure an accurate representation of racialized others within the Netherlands, more individuals of Surinamese descent were selected, as immigrants from Suriname constitute the largest group qualifying as racialized others, followed by Antillians (Centraal Bureau voor de Statistiek, 2016).

In addition, gender is a significant factor in shaping the experiences of racialized others (Wekker, 2016), meaning that gender representation is crucial. The women-men ratio in this study was 2:1. Notably, a limitation of this research is the lack of non-cis gender participants. Therefore, future research is necessary to understand the experiences of individuals that are both racialized others and non-cis in the Netherlands.

Similarly, socio-economic class was taken into

account during participant selection. Socio-economic status often influences the racial composition of one's surroundings, potentially affecting the extent and nature of racism experienced (Essed, 1991). Including participants from various socio-economic classes enables a more nuanced understanding of how factors such as income, access to resources, and social networks intersect with racial identity and experiences of discrimination or privilege.

Additionally, geographic background plays a crucial role in shaping racial experiences. Participants in this study come from various regions within the Netherlands, as well as from different countries of origin. These diverse geographic origins offer unique insights into how regional and national contexts influence individuals' perceptions of race and belonging. For example, some participants were from predominantly White areas in the Netherlands, which has shaped their experiences and interactions with racialized identities.

Lastly, including people from different generations of migration allows for an exploration of perspectives across migration generations, as well as of the interplay of family dynamics, societal structures and belonging. By encompassing participants from such varied backgrounds, this study aims to provide a holistic understanding of the intricate intersections between ethnicity, age, socio-economic class, migration history, and gender in shaping racialized experiences.

2.3 Limitations

As mentioned in the previous subsection, one limitation is the lack of non-cis participants. Other limitations include biases, such as sampling bias and social desirability bias (Noble & Smith, 2015). For example, the selection of participants for interviews was influenced by factors such as convenience, accessibility, or willingness to participate to some extent, leading to sampling bias. Furthermore, participants may have provided responses that they perceive as socially desirable or acceptable rather than expressing their true thoughts, especially when discussing sensitive topics such as race. In general, the data collection process was influenced by the biases, assumptions, and perspective of both the interviewer and the interviewee, which shaped the interpretations of the findings.

Finally, while the participants were selected with the purpose of accurately representing the broader population of interest, the in-depth interviews explored specific cases and contexts, which may limit the generalizability of findings (Noble & Smith, 2015).

2.4 Reflection/Positionality/Reflexivity

As the researcher conducting this study, my identity as a racialized other with a Surinamese background has played a dual role in both shaping the research process and impacting my personal engagement with the findings. My experiences of otherness within Dutch society may have influenced the dynamics of the interviews. This shared identity may have fostered a deeper sense of trust and openness between the participants and myself, as they might have perceived a common understanding and empathy towards their experiences. However, this shared identity also required me to critically engage with my own biases and preconceptions throughout the research process. Being a part of the community I studied, my own opinions and experiences could have influenced the interpretation of the data. Striving for objectivity and trying to remain vigilant about not projecting my own experiences onto the participants' narratives was therefore crucial.

So, conducting this research prompted a reflective process where I continually had to examine how my interactions with the participants and the emerging data were influenced by my own experiences of identity and otherness. This reflexivity was not only imperative for maintaining the integrity of the research findings, but also educated me about myself. Engaging deeply with the participants' experiences provided me with a unique opportunity to reflect on the shared and divergent aspects of our encounters with race and racism. This personal impact, while enriching, also emphasized the importance of reflexivity in acknowledging how a researcher's identity can shape and be shaped by their scientific inquiry.

3 Conceptual Framework

This chapter will conceptualize double consciousness, examining its origins, evolution, and application across various fields and groups. It will first outline the foundational ideas set forth by Du

Bois (1903) and then show how this concept has been adapted and reinterpreted by different scholars over time to address the experiences of various marginalized groups, expanding its application beyond the initial context. Subsequently, the chapter will demonstrate how the construction and negotiation of blackness and whiteness influence the experience of double consciousness. The chapter concludes with a specific focus on the Dutch context, analyzing concepts like color-blindness, racial denial, and White innocence (see Essed, 1991; Rose, 2022; Weiner, 2014b; Wekker 2016). This exploration sets the stage for understanding the specific phenomenon of Black Dutch double consciousness identified by Wekker (2016), which is the subject of this study. Thereby, this chapter aims to lay the theoretical foundation for the empirical analysis.

3.1   Double Consciousness

The concept of double consciousness was coined by W. E. B. Du Bois, a U.S. American sociologist and civil rights activist, in his auto-ethnographic work, *The Souls of Black Folk*, in 1903. Du Bois (1903) used it to refer to the psychological challenge of dual self-perception that African Americans experienced in the oppressive American society, describing it as such:

> It is a peculiar sensation, this double-consciousness, this sense of always looking at one's self through the eyes of others, of measuring one's soul by the tape of a world that looks on in amused contempt and pity. One ever feels his two-ness—an American, a Negro; two souls, two thoughts, two unreconciled strivings; two warring ideals in one dark body, whose dogged strength alone keeps it from being torn asunder. (p. 10)

This description encapsulates the internal conflict faced by African Americans as they navigate their identities—being Black and being American. Bruce (1992) emphasizes that the two identities, confined within a single body, "were not just different from each other but were inevitably in opposition" (p. 304), making their reconciliation impossible. Moreover, Bruce (1992) underscores that Du Boisian double consciousness addresses the impact of White stereotypes on the self-perception

of African Americans. This external gaze, as described in the excerpt from Du Bois, is pervasive and inescapable. According to Itzigsohn and Brown (2015), individuals have to position themselves in both the Black world "and the White world, which dehumanizes them through lack of recognition" (p. 235). As a result, the projections of White people become realities that Black individuals have to process in their identity-formation, leading to the internalization of racialized ideas (Itzigsohn & Brown, 2015).

However, Dayal (1996) emphasizes that "double consciousness need not be conceived in the restricted sense in which W. E. B. Du Bois casts it" (p. 48). While Du Boisian double consciousness has profoundly influenced many sociological theories, its application has expanded into the realms of postmodern and postcolonial studies. Moreover, the concept has been taken outside the borders of the United States, taking it beyond the historical experiences of African Americans (Eze, 2011). It has been applied to diverse contexts, including discussions on the global diaspora (Dayal, 1996) and contemporary debates around the identities of modern Muslims (de Jong, 2019; Eze, 2011). Franz Fanon (1952) in particular made a significant contribution by extending the idea of double consciousness to encompass not just African Americans but all colonized and oppressed peoples. Offering a psychoanalytic and decolonial perspective, Fanon highlights how colonialism and racism affect the body and psyche, leading to fractured self-image. Fanon explains that "the blacks have had to deal with two systems of reference" (1952, p. 110), constantly oscillating between their own identity and the imposed perceptions of the White colonizers.

Building on this notion, Fanon's analysis delves deeper into the effects of these external perceptions on the Black body itself. Fanon's analysis focuses on the "epidermal schema" of the colonized body, which is "read by the colonizer in which Black skin reveals a quadruple layered historical, psychological, cultural, and sexual text of the colonized" (Jean-Marie, 2017, p. 196). Unlike the Jewish experience that Jean-Paul Sartre describes, where the prejudice faced by Jews does not necessarily negate their rationality or humanity, the Black experience involves an immediate and overwhelming reduction of Black individuals to their physical characteristics (Jean-Marie, 2017). Fanon (1952) articulates this distinction by explaining how the Black

person is "overdetermined from the outside" (p. 95), meaning that their entire being and identity are defined by external perceptions that are deeply embedded in racism and colonial history. Jean-Marie (2017) sees the clear link to Du Bois (1903) here, as the colonized body sees itself "through the eyes of others" (p. 10).

For Fanon, the psychology of blackness in relation to double consciousness involves a profound struggle not just with dual identities as described by Du Bois but with the very recognition of one's humanity and rationality (Haddour, 2005; Jean-Marie, 2017). He argues that the Black individual's rational and human aspects are obscured by the relentless focus on their physicality, which is a direct result of the colonizing and dehumanizing gaze. This impedes the recognition of their full humanity and rational prowess, reinforcing their perception as mere biological entities rather than complete human beings. Therefore, Fanon emphasizes that the struggle is not only about reconciling identities but also about confronting and transforming the deeper psychological and existential impacts of the dehumanizing gaze and systemic oppression. He illuminates the struggle for a decolonized identity and mental liberation, arguing that the colonized must undergo a process of psychological unshackling to reclaim their autonomy, rationality and humanity.

Based on the Fanonian perspective, Moore (2005) underscores the aim to achieve a single-minded consciousness in order "to rescue, to reconstruct and to revitalize the minds" of the colonized. Moore agrees with Wilson (1998) that social and political power is the key element to achieving this single-minded consciousness, as it enables individuals to shape their own realities. However, obtaining power is challenging as those in positions of authority do not instruct others on how to take their power away from them (Clarke, 1991).

Yet, not all interpretations of double consciousness emphasize its oppressive dimensions. Dayal (1996), for example, suggests that this condition can also embody a positive aspect, intertwined with feelings of nostalgia and the bittersweet experience of belonging in more than one place at the same time. Zygmunt Bauman (in Gilroy, 1993), interprets double consciousness as a counterculture to European modernity. Bauman suggests that this dual awareness can act as a form of cultural resistance that challenges the dominant values imposed by a Eurocentric worldview. Similarly, Gilroy (1993) himself posits that double consciousness provides a unique mechanism through which Black individuals can harness their ingenuity and creativity. These interpretations celebrate the resilience and adaptive capabilities of those navigating between different cultural realities, suggesting that double consciousness can empower individuals to redefine their identity on their own terms.

In synthesizing these diverse perspectives, it becomes clear that double consciousness is a multifaceted concept with broad applicability. This concept not only provides a lens through which the struggles and negotiations of racialized identities can be viewed but also highlights how these identities are constructed and influenced by broader societal forces. The upcoming subsection will explore how the constructs of blackness and whiteness impact the double consciousness of racialized individuals.

3.2 The Construction of Race in Relation to Double Consciousness

It is imperative to note that Fanon (1961) did not only focus on the effects of colonialism on the colonized, but also the colonizers—White people. Creating a binary world of us-vs-them is a psychological mechanism that distorts the colonizer's perception of self and others by portraying the colonized as inferior, thereby justifying their own dominance. This worldview, rooted in myths of superiority and entitlement, leads the colonizer to inhabit a world fundamentally based on false premises and unjust relationships. As a result, they become alienated from their sense of morality and justice through the enforcement of colonial dominance and perpetuation of the oppression of the colonized, losing touch with their own humanity (Fanon, 1961).

According to Fanon (1952), the perception of the White self affects the construction of blackness. He argues that a Black person's existence is not recognized on its own terms but is always seen in relation to the White person: "For not only must the black man be black; he must be black in relation to the white man" (p. 110). He refutes the idea that this relationship is reciprocal, meaning that White identity is not similarly defined in relation to blackness. So, in the racial dynamics established by colonialism and racism, the Black person is not granted the same ontological status as the White person. The Black individual lacks "ontolog-

ical resistance" (p. 110) in this context, meaning their existence and identity are not acknowledged or validated independently but are always contingent upon how they are perceived by the White person.

Contrasting with Fanon, Robin DiAngelo (2018) introduces the idea that whiteness itself is defined through its opposition to blackness. DiAngelo (2018) argues that whiteness only understands itself in relation to what blackness is not, thereby perpetuating a racial dynamic where identities are mutually constructed through a process of differentiation and opposition. This viewpoint implicitly challenges Fanon's assertion by suggesting that White identity, much like Black identity, is shaped in response to the other, forming a complex interdependence that Fanon perceived as predominantly one-sided. Stuart Hall (1980) also believes the construction of racial identities has often been defined in oppositional terms. According to Hall, especially in societies shaped by colonialism and slavery, blackness and whiteness have been conceptualized in opposition in order to maintain oppressive power dynamics and hierarchies. The economic, political, and ideological practices of racism "secure the hegemony of a dominant group over a series of subordinate ones, in such a way, as to dominate the whole social formation" (Hall, 1980, p. 346).

While Fanon (1952) emphasizes the unilateral imposition of identity by a dominant culture, DiAngelo (2018) and Hall (1980) offer a perspective that suggests a more reciprocal, if still problematic, interaction in the formation of racial identities, where whiteness is also inherently informed by and constructed in response to blackness. Yet, this dynamic is not merely reciprocal; it is hierarchical and fundamentally uneven, as whiteness assumes a superior position. So, while the relationship is perhaps reciprocal, Fanon is correct that Black individuals do not possess "ontological resistance" (p. 110), as their identity is not recognized autonomously but is always mediated through and contingent upon the dominant White norms and perceptions.

Moreover, Hall suggests that race is a "floating signifier" (Hall, 1997)—not a fixed or natural category but rather a product of complex social processes, constructed through the articulation and intersection of various forms of social differentiation, such as class, ethnicity, ideology, culture, and his-

torical context. According to Hall (1997), as well as DiAngelo (2018), race is thus constructed and renegotiated in relation to whiteness at different times and places as these social relations and power dynamics change.

The construction and negotiation of blackness and whiteness are intertwined with double consciousness. As racial categories are defined in contrast to one another, whiteness is typically positioned as the norm or ideal, against which all other racial identities are measured (Jensen, 2020). This positioning of whiteness as the ideal influences how all other racial identities are perceived and understood (Fanon, 1952; Hall, 1998). Dominant societal groups create and enforce norms that determine what is considered normal and desirable, profoundly affecting both the behavior of individuals and their self-perception (White, 2005). As a result, individuals from racialized backgrounds frequently find themselves viewing their own identities through the lens of the dominant White culture. The internalization of this external perspective can be identified as manifesting double consciousness, where the internal conflict of aligning one's self-identity with external perceptions becomes a pervasive psychological struggle. Therefore, investigating how race is constructed and negotiated is crucial for understanding double consciousness.

This subsection provided a foundational understanding of how the construction and negotiation of racial identities within broader societal contexts impacts double consciousness. The following subsection will delve into the Dutch context, examining race relations and how double consciousness manifests in the Netherlands.

3.3 The Dutch Context: White Innocence and Black Dutch Double Consciousness

Since the first wave of colonial migration towards the Netherlands in the 1950s, issues of race and racism persisted in Dutch society. In *Understanding Everyday Racism*, Essed (1991) describes the ways in which colonial legacies continue to shape racial dynamics and how racism is embedded in everyday interactions and structures of Dutch society. Racialized others continue to be "excluded and marginalized in all sectors of society," as they are racially profiled by the police, routinely harassed in public, and discriminated against in the

housing market, job market, and education (Essed, 1991, p. 6).

Despite these facts, race and racism have been disregarded and seen as a non-issue within Dutch borders. The Netherlands portrays itself as a racially tolerant and inclusive society, striving for race neutrality (Rose, 2022). This approach aims to downplay racial differences and treat individuals as equals regardless of their race or ethnicity. However, this color-blindness is problematic since it diminishes the importance of race and often masks systemic inequalities and discrimination, upholding colonial structures, allowing them to persist unchallenged. As Rose (2022) points out, "color-blindness does not eliminate the ability to see color. Instead, it obscures the ability to see the effects of color" (p. 243). In addition, color-blindness can lead to an apolitical sense of being, where discussions about race and racism are avoided or dismissed as irrelevant. Color-blindness even labels resistance to racism as racist and unfounded, leading to the silencing of Black people in Dutch society when they confront racism (Essed & Nimako 2006). White individuals thus position themselves as arbiters of what constitutes racism, prioritizing their own perspectives over those of who directly experience racial discrimination (Essed, 1991). In essence, the refusal to acknowledge racial inequalities perpetuates the very racism that color-blindness purports to deny.

Moreover, Weiner (2014b) and Essed & Hoving (2014) identify racial denial and racial Europeanization as an explanation for Dutch aphasia, the inability to talk about race and racism. Racial denial stems from the illusion of color-blindness and racial Europeanization refers to the tendency to conceptualize Europe as inherently White and ethnically homogenous, overlooking cultural diversity and positioning whiteness as the normative standard against which other identities are measured. According to Weiner (2014b), racial denial and racial Europeanization in turn lead to the disconnect between past and current oppression, making people oblivious to the enduring colonial structures.

So although people deny racial discrimination and colonial violence, racism and xenophobia are prevalent in Dutch society. Wekker (2016) examines this exact paradox in her book, *White Innocence*, in which she explores how historical legacies of Dutch colonialism continue to shape contemporary Dutch society, particularly in relation to race, identity, and inequality. Building upon Fanon's insights, she extends the examination of the colonizer and coins the term "white innocence" (2016, p. 29), encapsulating the complex interplay of denial, ignorance, and complicity among White individuals. Wekker employs Edward Said's concept of the "cultural archive" (1993, p. 52), the accumulation of representations, symbols, and discourses that shape perceptions of the self and the other, to conceptualize how narratives of innocence and denial are embedded within the collective consciousness of Dutch society. Central to Wekker's analysis is the narrative of Dutch racial exceptionalism—the belief that the Dutch have a unique moral standing in relation to issues of race and colonialism—which perpetuates the notion of Dutch moral superiority and innocence, serving as a shield against acknowledging historical injustices and individual experiences of racism. By denying or downplaying the existence of racism and colonial legacies, White individuals can uphold their privileged position within society while simultaneously absolving themselves of responsibility for addressing systemic inequalities. So, this White innocence and "smug ignorance" of White individuals in the Netherlands not only safeguard White privilege, but also perpetuate cycles of systemic oppression and hinder efforts towards social justice and emancipation of racial minorities (Wekker, 2016).

In the Dutch context, the Black identity is constructed in relation to whiteness as well (Essed & Hoving, 2014; Wekker, 2016). Identities are shaped by Dutch colonialism, global diasporic influences and local social conditions (Nimako & Willemse, 2011; Balkenhol, 2021), and are constructed in relation to the colonizer's White innocence and smug ignorance (Wekker, 2016). As a result, Wekker (2016) has identified a "specific nature of black Dutch double consciousness" (p. 49), rooted in the Dutch colonial past and White innocence. This Dutch double consciousness is not merely a replication of Du Bois' original concept but rather an adaptation that accounts for the unique historical, cultural, and social fabric of the Netherlands. She conceptualizes it as the inner conflict of Black Dutch people, who have to reconcile their racial identities in a society that denies the existence of race, and who receive racist remarks despite the social norm to not talk about race. Wekker points to the "couleur locale, the imbrication of each lo-

cal double consciousness system with locally dominant ways of (not) dealing with race" (2016, p. 38). By using couleur locale, Wekker underscores how the Dutch manifestation of double consciousness is deeply embedded in the local cultural and historical context. This "local color" affects how Black individuals in the Netherlands perceive themselves and navigate their identities within a society where race and racism are often minimized or ignored, thereby shaping their experiences of racism in distinct ways that differ from those in other societies, leading to a specific form of Dutch double consciousness.

Wekker (2016) suspects that the nature of this Dutch double consciousness inherently impedes resistance against racism, inhibiting conversations about race in Dutch society. As a result, there would be an absence of strong emancipatory anti-racist movements in the Netherlands. As Wekker does not delve into it further, this link warrants additional investigation. Moreover, a significant shift has occurred in societal attitudes and conversations around race, propelled by public debates, activism and scholarly work, including her own. Therefore, this research will explore the evolution of the interplay between double consciousness and racial discourse in the Netherlands, specifically investigating Wekker's suggestion that a Dutch-specific form of double consciousness has restrained anti-racist dialogue and activism. In order to achieve this, the study will use the concepts established in this chapter to analyze the experiences of racialized others in the Dutch sociocultural context and their correlation with the evolution of racial discourse and activism within the Netherlands.

4 Lived Experiences of Dutch Double Consciousness and its Impact on Racial Discourse

This chapter will examine the manifestation of the concepts and theories that were outlined in Chapter 3, as well as explore their impacts on racial discourse in the Netherlands through the lived experiences of racialized others. Based on the conducted interviews, it can be concluded that the participants indeed have struggled with a form of double consciousness that seems specific to the Dutch context. Themes such as conformity, self-

suppression, outsider feeling and internalization were prevalent in the conversations. In order to illuminate the perceived Dutch double consciousness, this chapter is structured into several key subsections that delve into the nuanced aspects of this phenomenon. First, the feeling of belonging in the Netherlands and the challenges of navigating dual identities will be explored. Following this, *Behavioral Adaptations and Social Conformity* will highlight how the need to fit into Dutch societal norms leads to modified behaviors and self-silencing among the racialized others. Thirdly, the psychological element of double consciousness will be discussed, as these navigations and adaptations cause mental and emotional strain. Finally, this section will analyze how these experiences influence participants' engagement in conversations about race and anti-racist activism.

4.1 Reconciling Identities

As a racialized other in the Netherlands, one often has multiple ethnic, cultural, and/or racial identities. Reconciling these identities can be challenging, particularly when one's sense of belonging is contested or ambiguous. This difficulty is exacerbated by racist encounters and how individuals are perceived by others, which can significantly influence their self-image. This impact is illustrated by the experience of Nikita, a historian who now works as an Event Manager at the Black Archives. Despite feeling culturally Dutch, she is perpetually othered:

> I would never *really* call myself Dutch. Yes, I am very Dutch in certain things, but I would never say that I feel at home here. But I think that also has a lot to do with the racism you experience. And that others don't see you as Dutch. So the perception of others also plays a role in your own perception.

This feeling illustrates what Du Bois described as "this sense of always looking at one's self through the eyes of others" (1903, p. 10) and shows how others' actions and opinions impact one's sense of identity and belonging. It further shows how individuals remain excluded from full societal acceptance due to racial perceptions and external classifications. This exemplifies the observation of Essed and Nimako (2006) that having White skin is often considered a requirement for being seen as a *true*

European national. This exclusionary perspective is deeply embedded in how Europeans, in this case the Dutch, view themselves and their national identity, associating Dutchness with whiteness (Goldberg, 2006). Miranda recognizes this perspective as she is often asked "Where are you really from?" She explains that "because you have more melanin in your skin that means that you don't really belong there, that you come from elsewhere." This was also emphasized by another participant, Wanjiku, who navigates the rigid racial categories within Dutch society. Despite being biracial, she identifies more strongly with their Black heritage due to societal categorization:

> I identify as Black, even though I'm mixed race. But because of my experiences growing up in the Netherlands, I don't really view mixed as a racial category. I feel like you're forced to pick because White people will never view you as White because you don't look White, whereas Black people are more accepting. You could also argue, I'm lighter, so why can't I fit in with the White people? But it's just that whiteness is such a rigid concept that anything that's not White is not good enough. So I was always more pulled towards my Black side because that's where I found more acceptance.

This feeling was echoed by Miranda, who feels accepted by the Antillean community, but not in Dutch society, despite being biracial and having been born in the Netherlands. These narratives demonstrate how the rigid dichotomies of racial categorization force individuals into certain identities. Furthermore, it shows that blackness and whiteness are constructed in oppositional terms, as DiAngelo (2018) and Hall (1980) argue, and that the Black and biracial individual lacks what Fanon (1952) calls ontological resistance.

Reconciling racial, ethnic, and/or cultural identities presents another layer of complexity to the challenges of belonging and identification. While to some participants it came more easily to integrate these aspects of their identities, for others, it is an ongoing struggle marked by internal conflict. Daphne's experience exemplifies the latter. Born and raised in the Netherlands, she was immersed in Dutch cultural norms at school, which starkly contrasted with the Surinamese culture of her family life. She describes living as a "chameleon," constantly adapting to the cultural expectations of her surroundings:

> Sometimes I felt like I was too Dutch. I embraced my Dutch cultural norms too much. So I didn't really fit in the Surinamese community anymore. But I actually have both in me and it took a very long time to find the right balance, because I really lived in two worlds, in two cultures as a kind of chameleon. So that means that I couldn't be myself, nor knew *how* to be myself.

Daphne's narrative underscores the internal struggle highlighted by Du Bois—navigating dual identities in a society that demands conformity to a singular norm. Although Daphne has found a personal balance, this does not shield her from societal exclusion. Because she integrated aspects of her Surinamese identity, she is still not fully accepted as Dutch, which is further exacerbated by her skin color. This shows not only that perceived cultural difference plays a role in othering (Rose, 2022), but also that Black individuals are often reduced to their physical characteristics (Fanon, 1952). This persistent discrimination based on external characteristics means that Daphne, like many racialized individuals, continues to face pressure to further adapt her behavior to fit a more socially acceptable mold. The next subsection explores this theme in greater detail, as the need for behavioral adaptation is not unique to Daphne but was common among many participants.

4.2 Behavioral Adaptations and Social Conformity

A common pattern that emerged from the interviews is that racialized individuals often feel compelled to adapt their behavior in order to avoid exclusion. This need stems largely from the visibility of their racial difference, which can make them targets of scrutiny and/or discrimination. Amal captures this sentiment, noting, "If you always have the feeling that you stand out already by just being, then you try not to stand out more." Being conspicuous by merely being thus pressures racialized others to minimize their presence further. Daphne elaborates on this experience, "I realize that I have

actually always made myself smaller, and very often also wanted to be invisible, or wanted to do it right, so that I wouldn't stand out negatively because of my behavior." Her account underscores the dual burden of conforming both physically and behaviorally in a society where she feels perpetually out of place.

In fact, many of the participants devised ways to decrease visibility. Besides minimizing oneself, another strategy employed by racialized individuals to avoid standing out involves closely adhering to Dutch social norms. According to Rose (2022), Dutch normality encompasses behaviors that align with dominant societal values in the Netherlands. Cultural variations are typically accepted in this context only if they adhere to the established norms of Dutch conduct. This pervasive inclination to maintain conventional discourse effectively suppresses views that differ from the mainstream, thereby hindering the ability of individuals with alternative perspectives to express themselves freely (Rose, 2022). This was expressed by Wanjiku, who describes Zambian culture as "loud," "extrovert," and "all-encompassing," and found herself needing to suppress these vibrant traits to blend into the more reserved Dutch cultural landscape. She reflects on this, saying, "Dutch culture is very much "just be normal," you know. Don't act too crazy. So, because of that, I sometimes did feel like I had to switch it up." The pressure to conform can sometimes lead individuals to distance themselves entirely from their cultural heritage. This phenomenon is exemplified in the experience of Miranda, whose mother, originally from Curaçao, took drastic steps to ensure her family assimilated into Dutch society. Miranda recounts that:

> She was quite radical in her actions to adapt. She wanted us to dress very White. We did not learn the [Papiamentu] language from my mother. We always ate Dutch. The clothes did not stand out. That is what she wanted for us: that we did not stand out. She always warned us not to be too much around Black people.

Similarly, Carla, an 80-year-old first-generation migrant, deliberately avoided passing on her Surinamese heritage to her children in an effort to ensure their acceptance into Dutch society. Carla states that:

> I never told them much about Suriname. Never. I spoke Surinamese with my husband and we ate Surinamese food at home, but I never felt the need to talk about it, you know? I wanted the children to grow up in Dutch society. I just raised them the way they should be: the Dutch way. I wanted them to feel Dutch and I did not want them to hang out with other brown people much.

These narratives illustrate the profound lengths to which racialized individuals go to assimilate, often at the expense of their own cultural identity and of connecting with other people. In fact, this experience is not singular as Wekker (2016) explains that many gay men would often be in relationships with White men to obscure their blackness. This severe adaptation highlights the deep-seated fears of exclusion and the pervasive pressure to conform to normative societal expectations.

Moreover, racialized others constantly need to prove themselves to demonstrate that they are smart and to affirm their Dutch identity against prevalent stereotypes. Amal illustrates this experience as she shares, "I always tried very much to prove that I was very Dutch, because people assumed that I wasn't due to the way I look." Additionally, in her educational environment, Amal constantly needed to prove that she was intelligent, contrary to "the blonde boys where it wasn't questioned if they were smart." John elaborates on the broader implications of this struggle, noting, "When you have a color, you have to be better than an *autochtoon* Dutchman. Whether it's at school or in sports, you have to prove yourself more to be accepted as a Dutchman." This reflects an intense pressure not only to adapt but to excel.

Wekker (2016) and Rose (2022) underscore that in the Netherlands, as in many Western societies, whiteness is seen as the norm and invisible—not actively noticed or acknowledged as a distinct race. It grants White people individuality, where they are seen as individuals rather than representatives of their race. In contrast, non-White people deviate from this White norm, meaning they themselves and their actions are primarily seen and judged as part of a racial group. The experiences of Amal and John show the lack of individuality that society grants them. Wanjiku also emphasizes that:

> If you're the only Black person in a

White space, people will generalize your behavior with what they perceive as the behavior of all Black people. So, I did always feel like I have to do my best, because I have something to prove, because people will, before even knowing me, stereotype me in a negative way, as stupid or as incompetent.

Wekker (2016) states that it is the Dutch system of oppression that portrays Black individuals as being intellectually inferior. Together, these experiences reveal a common theme among racialized individuals: the extensive effort involved in navigating public spaces that are often unwelcoming or outright hostile. The constant pressure to adjust and conform not only impacts their daily interactions but also shapes their broader sense of self and belonging within Dutch society. These mental impacts will be explored in the following subsection.

4.3 The Psychological Dimension of Double Consciousness

As we have seen, external perceptions and racist experiences contribute significantly to feelings of alienation. Participants frequently feel they do not truly belong, a sentiment that is compounded by the constant need to adapt their behavior to fit into a society that may not fully accept them. This ongoing adjustment requires considerable mental effort, and the strain of continually having to prove their belonging can be immensely taxing. The psychological toll of these efforts manifests in various forms of emotional and mental fatigue, affecting overall well-being and sense of self. Furthermore, the challenge of reconciling different identities adds another layer of complexity to their psychological experiences. This reconciliation is not only about managing how they are perceived by others but also about aligning these perceptions with their self-identity, a process fraught with internal conflicts and stress.

Experiences of racism and othering are particularly mentally challenging (Brondolo et al., 2009). Almost all participants in this study have faced blunt racism, microaggressions, or othering, and describe these experiences using words such as "sad," "traumatic," "isolating," "rejection," and "painful." Such encounters are not only distressing in the moment but can leave long-lasting emotional scars, as they frequently lead to the internalization of racist ideas from the dominant society. Nikita reflects on her early desires and self-perception, stating, "When I was younger I wanted to be White and when I got older, I had a lot of trouble seeing myself as beautiful, because the idea of what was beautiful around me looked very different." This sentiment is echoed by Amal, who yearned for features that aligned with Western beauty standards: "I wanted straight hair and I wanted to be blonde. All of those things were definitely internalized. Especially because I just didn't have people around me who looked the same, it was very hard to appreciate the way I look." Wanjiku further underscores this point by identifying the broader societal teachings that contribute to such perceptions: "viewing whiteness as the ideal because that's just what you're taught." White (2005) highlights that while the sentiment stems from colonial times, in today's society a person is still thought to be more beautiful and desirable the more White they are. These personal accounts vividly illustrate the psychological impact of racism described by Fanon (1952). Racism and the pressure to oscillate between one's own identity and the imposed perceptions of White colonizers indeed impact the psyche severely, leading to a fractured self-image. As shown through the perspectives, this fracturing is not merely about the external pressures to conform but also involves a deep, often painful reckoning with one's self-worth and beauty in a world that elevates whiteness as the standard.

This internalization and the resultant fractured self-perception are not new phenomena but have been occurring for generations. As previously illustrated by the examples of Miranda's mother and Carla who do not want their children to hang out with other brown people, there is a persistent belief in negative stereotypes about their own communities. These attitudes are not arbitrary but stem from historical contexts of oppression and colonization. Marcia provides insight into how these perceptions evolved, particularly in Suriname, a former Dutch colony. She recounts that:

In those years when Suriname was a colony, it was suppressed for generations. They saw it as a taboo to actually talk openly about their own culture. Everything about the Dutch was seen as holy, perfect, and blissful. There are many different cultures within Surinamese society, but there is also a

group that does little with that culture. They left behind their own culture and went along with the Western Dutch culture, because they think it is better.

This suppression throughout history caused negative connotations with their own cultures and the glorification of Dutch and Western culture. This not only underscores the internal conflicts faced by individuals as they navigate their identities but also highlights the systemic roots of such struggles. It demonstrates Fanon's (1952) argument on how colonialism and deeply internalized racism can shape and distort the self-perception of racialized communities.

Fanon (1952) also emphasizes the struggle of confronting and transforming the deeper psychological impacts of systemic oppression. This battle is often grueling; yet, fortunately, many participants received support from family and friends, which played a vital role in their journey to resist these internalized beliefs. This was a common theme across the interviews and shows that social networks help racialized others process racist encounters, as Brondolo et al. (2009) suggested. Additionally, participants actively engage in reinforcing anti-racist ideas within themselves as a form of resistance. Marcia speaks about her approach to dealing with these challenges, highlighting her resilience:

> That's how I'm trying to deal with it: by giving a positive twist. It hasn't been easy. But to me, everyone is a human being, regardless of color, sex, origin, culture, and religion. I always try to see the positive in that. The world is not just made up of white or black. If you look at the world map, it's actually a flower garden of different groups of people and cultures.

Constant reminders of the value and beauty in diversity help the participants to counteract negative stereotypes and promote self-love.

4.4   Impact on Racial Discourse

The nature of Dutch double consciousness appears to inherently inhibit the discourse about race and racism in the Netherlands. As racialized individuals adapt their behavior to not stand out and

to adhere to the Dutch norms, they engage in self-suppression and self-silencing. For instance, the cultural imperative not to "make a fuss" and to act "normal" discourages openly addressing or challenging racist encounters, effectively stifling discussions about race. Rose (2022) explains that in the Netherlands, discussing racism is taboo, and those who bring it up tend to be marginalized because they deviate from the accepted norm. Wanjiku illustrates this dynamic based on her observations and personal experiences:

> A lot of immigrant parents will teach their children, and I saw this with my friends, "don't talk about it, don't make a fuss." Because once you speak, you get villainized. Being quiet actually makes you assimilate and makes you be more accepted by the White society. And that ensures survival.

This testimony highlights that silence is often seen as a necessary strategy for assimilation and survival in a society that may penalize those who challenge the status quo or highlight systemic inequalities. Miranda's observation further underscores how Dutch cultural norms discourage outspokenness about racial issues. She explains,

> If we're talking about Dutch culture, then I always think about avoiding. Speaking up, protesting, being assertive—that's really not Dutch. That has a very negative connotation. And for that very often Black women are accused of making too much noise and always being angry. I'm not angry at all. I'm just assertive.

This avoidance is a pervasive aspect of Dutch culture that actively suppresses discussions about racial issues through misinterpreting assertiveness as aggression. According to Lozada et al. (2021) this is part of a broader issue, noting that power structures are often designed to suppress the emotional expressions of racialized others, preventing their feelings from being validated. Consequently, Black individuals' responses to racism are often mischaracterized through stereotypes, including the "angry black person" (Durik et al., 2006, as cited in Lozada et al., 2021, p. 13). Moreover, the perception of ingratitude plays a significant role

in silencing those who experience racism. According to Brondolo et al., (2009), immigrants are often seen as having a provisional place in society. Voicing complaints about their conditions, particularly on issues like racism, can lead to them being labeled as ungrateful or undeserving of Dutch citizenship. Wanjiku elaborates on the pressures faced by immigrant communities to remain silent about racial injustices, which are often seen as a betrayal of the hospitality extended by the host society. She observes, "What I saw is that my friends' parents actually were like, no, don't seem like you're ungrateful to be here, because a lot of White Dutch people will see you standing up against racism as being ungrateful." This was further illustrated by Carla, who does not want to seem ungrateful herself: "I was sad that two people from Suriname started talking about [*Zwarte Piet*] being racist, because it made all Surinamese people look bad in the eyes of the Dutch, not grateful."

These examples reveal a pervasive reluctance among racialized individuals to address racial issues, as seen in narratives like that of Willems, who reflects on the collective mindset of minimizing racial problems: "We had adopted the role of "everything is fine," because we believed we had it relatively good compared to other places where it was worse. We told ourselves, "It's not that bad," and thus, we did not want to complain." Such justifications illustrate the trade-off between ingratitude and silence, significantly stifling the discourse on race and racism in the Netherlands.

Additionally, participants have highlighted the notion of tolerance as a barrier to substantive conversations about race and racism. As discussed earlier, the Netherlands perceives itself as racially tolerant and strives for race neutrality. Similar to Rose (2022), Amal critiques the contemporary manifestation of this tolerance, noting, "we're so focused on how tolerant we are, that we're color-blind. But that's the whole problem, because color is there. So you can't just pretend it's not influencing people's lives." As highlighted by Rose (2022), color-blindness blinds people to the effects of color, not color itself. This is frustrating to Amal, because the prevailing belief in Dutch tolerance contributes to racial denial, reinforcing a narrative that racism is an anomaly rather than a systemic issue. "People are just struggling to be self-reflective and acknowledge that they are racist," Amal adds. This lack of self-reflection hinders the ability to recognize and address forms of racism embedded in daily interactions and institutional structures. While Wekker (2016) refers to this as White innocence, Andrews (2016) labels this the "psychosis of whiteness" (p. 440), a condition in which the concept of whiteness skews perceptions of reality, leading to a selective memory that overlooks the colonial times and racism on which that very whiteness was established.

In addition, Amal senses a feeling of superiority within the Dutch nation: "They say 'we don't have [racism] here'; like a superiority feeling, which is frustrating." According to Ghorashi (2023) this cultural superiority narrative is rooted in the categorization of immigrants as "disadvantaged" and "weak" (p. 17). This leads to the idea of needing to help the immigrant, which contributes to the Dutch self-perception of being a tolerant and charitable country, while reinforcing cultural superiority.

This prevailing idea of Dutch tolerance significantly inhibits the development of a racial discourse, as voicing concerns about racism is often seen as challenging the deeply embedded narrative of tolerance. Nikita's experience highlights the contradiction inherent in this societal attitude: "White people say: this is such a tolerant country, we are all tolerant. But if you say something about racism, you get a very violent reaction. So the fact that there is a very violent reaction made it very difficult to discuss it." Her account reveals the hostile backlash that often follows racial discussions, further discouraging open dialogue. This confirms Wekker's (2016) argument that the Dutch aggressively deny the existence of racism. DiAngelo (2018) calls this defensive response "White fragility," emerging from a feeling of guilt and discomfort when confronted with White supremacy. As a result, this White fragility inhibits conversations about race. Not only does this vehement opposition reinforce a sense of isolation among those who experience it, but also makes them doubt if racism is an issue at all. Nikita explains: "If you live with people, who deny the problem, it feels like the problem is with you. Especially when you are young you think 'It's all on me.'"

These experiences directly reflect the paradox identified by Wekker (2016), who posits that racialized individuals in the Netherlands are presented with a double bind, as articulated by Prins (2002): "If you want to be equal to us, then don't talk about differences; but if you are different from us, then

you are not equal." Therefore, the challenge remains substantial. On one hand, there is a desire among racialized individuals to be seen as equals within Dutch society, which often means suppressing their racial identity and/or discussions about racial inequality. On the other hand, their racial, ethnic and/or cultural identities underscore their differences, which the societal framework of tolerance does not fully accommodate. This dynamic effectively silences meaningful dialogue about race, perpetuating a cycle of non-recognition and inequality.

4.5 Conclusion

This chapter has substantiated Gloria Wekker's assertion that a Dutch-specific double consciousness indeed exists. Participants have demonstrated this double consciousness through their struggles with reconciling dual identities, the modifications they make to their behavior to stand out less and adhere to societal norms, and the profound psychological battles they endure, consistently referenced against existing literature.

Wekker's hypothesis about the inhibitory effects of Dutch double consciousness on racial discourse has also been confirmed. A closer examination of this relationship reveals that the nature of Dutch double consciousness inherently stifles discussions on race and racism in the Netherlands. Integral to Dutch double consciousness is an adaptation to cultural norms such as avoiding confrontation, acting "normal", displaying tolerance, and expressing gratitude. These norms, as well as Dutch color-blindness and White fragility, not only suppress the vocalization of racial issues but also provoke significant backlash against those who dare to speak out, exacerbating the negative mental impacts of double consciousness.

Through this exploration, it has become evident that Dutch double consciousness not only shapes individual experiences but also significantly influences the broader racial discourse, maintaining a cycle that hinders true equality and recognition within Dutch society. However, this cycle may have been interrupted by the rise in anti-racist activism, which will be explored in the following chapter.

5 Changing Dynamics: Activism and the Evolution of Racial Discourse

While Dutch double consciousness has historically inhibited conversations about race, the dynamics within Dutch society are visibly changing. All participants in this study recognize a shift towards greater social awareness and a more active engagement with racial issues. This observed shift is central to the investigation into how double consciousness impacts racial dialogue in the Netherlands and how these dynamics evolve. This chapter explores how the relationship between double consciousness and racial discourse is evolving in response to these changes, particularly through the influence of activism. The first subsection will give an overview of how activism emerged and evolved within the Dutch context, tracing its roots and examining the catalysts that spurred its growth. It then examines how this activism has challenged and reshaped societal norms, altering the way race is negotiated and, consequently, influencing the experiences of double consciousness. Subsequently, the chapter will delve into the generational differences in approaches to activism and racial discourse, a major pattern identified during the interviews. Finally, the narrative will then transition to the current state of activism, discussing its challenges and potential future directions.

5.1 The Evolution of Activism

Activism in the Netherlands, particularly concerning racial issues, has historical roots that predate the contemporary movements often spotlighted in media and public discourse. Nikita provides a crucial perspective on the long-standing nature of these efforts. She states that when a movement is growing and bringing a lot of change, people only tend to look at that specific period. "But as a historian, it helps to just look back and then you see that there have been activists for a very long time." Dutch anti-racist activism actually dates back to the 1950s. This ongoing but often unrecognized struggle set the stage for the current wave of activism, which gained momentum due to several factors. Nikita explains:

> There was probably more space for activism because you had a new gener-

ation in 2011. Most people who were born here, not all, but these people felt brave enough to claim this country, to say "I also live here and I am Dutch, that also means equality for me." So, it has gotten more momentum because there was a different generation and they could build on the work that others had done.

This shift underscores the vital role that second and third-generation migrants have played in invigorating the activism landscape. They bring a new perspective—born and raised in the Netherlands, these younger activists demand equality not as outsiders, but as rightful citizens. Wanjiku, a second-generation migrant, articulates the urgency of this generational shift in activism, "I realized, if I don't say it, nobody's going to say it, and these White people are just going to continue being racist." The generational shift in activism gave motion to the Kick Out *Zwarte Piet*(KOZP) movement in 2011, turning it into a force that could no longer be ignored within Dutch society. According to Nikita, KOZP created space to talk about racism. "So, when Black Lives Matter started in 2020, there was space in society but also a structure in activism to set up those huge demonstrations. And that was achieved by a very long history and courageous young activists." This bravery and sacrifice are recognized by community members like Daphne, who deeply admires the leaders of these movements. Reflecting on their contributions, she says:

> The leader [of KOZP], [Jerry] Afriye, actually sacrificed his life [to activism]. If you look at history, there have always been people needed like that; Sylvana Simons, who opened this debate in politics—these are people who, at the expense of their own peace of mind, have opened this debate. I think that's really admirable. I wouldn't have dared.

Daphne's reflection underscores the personal costs involved in pushing societal boundaries and initiating uncomfortable but necessary conversations about race. This shows that the new wave of activism is marked not just by increased visibility but also by the psychological transformation of its participants. Echoing Fanon's (1952) concept of psychological unshackling, these activists have embarked on a journey to liberate themselves from imposed identities and narratives. By choosing to openly challenge societal norms and confront uncomfortable truths about race and identity, they are reclaiming their power, autonomy and humanity. They have broken away from the traditional Dutch norms of avoidance and tolerance, stepping out of the shadows of double consciousness to assert their place and rights within society. With this power they can continue to shape their own realities (Moore, 2005; Wilson, 1998).

Activists have also drawn significant strength from international influences, which have enriched and supported the unshackling process. Academic and cultural exchanges have been essential throughout history. Nikita provides a historical perspective, noting, "For example, in the 1950s, Du Bois came to the Netherlands to speak with Afro-Surinamese activists about anti-colonialism and Surinamese independence. So you see that there is already a very long history of people looking for each other." In the current era, this search for solidarity and shared knowledge surrounding racial issues has been greatly facilitated by social media (Köksoy & Demir, 2021). All participants highlighted that social media greatly influenced the evolution of activism in the Netherlands, transforming how activism is conducted and expanded. Amal highlights this transformative role: "Social media really helped to bring people together who were normally not in the same locations but could now find each other over the internet." Giani, a specialist in media studies, views social media as a key driver behind activism, but emphasizes that the fact that people are becoming more literate and well-read contributes to a broader social awareness as well. Tygo further elaborates on the impact of social media on Dutch activism specifically, emphasizing its empowering effect:

> I think social media makes people more willing or courageous to actually share their own thoughts, which has a snowballing effect. It enables people to spread that message as far and wide as they can, which leads to protests. I think the way Black Lives Matter spread through social media gave a lot of people in the Netherlands power to go onto the streets.

The profound sense of solidarity and connectivity among the Black diaspora emerges in the narra-

tives of the participants as a tangible embodiment of Gilroy's (1993) concept of the Black Atlantic, a transnational and intercultural space that shapes Black identities. Gilroy (1993) argues that the experiences of African diasporic peoples must be seen through the movements, exchanges, and interactions that have occurred across and around the Atlantic Ocean. Giani also emphasizes that everything started with the trans-Atlantic slave trade, on a personal and systemic level: "Without that, my parents would never have met each other. It's the only reason I exist. Everything that has happened after transatlantic slave trade has been a result of that." According to Gilroy (1993), the Black Atlantic reinforces a shared consciousness and solidarity among African diaspora, as well as a space that fosters political and ideological resistance against racism and inequality. This interconnectedness is illustrated by Nikita:

> The origins of the diaspora can be traced back to the transatlantic slave trade. From that point in history, we are connected in a joint fight against colonialism, against racism, against everything that has to do with it and everything that keeps it going, including capitalism. I am Ethiopian but my struggle is connected to all diaspora, because what affects me also affects Afro-Surinamese and people from Curaçao etc.

This highlights that shared history has not only shaped identities but has also fostered a collective resistance against oppression, transcending national borders and cultural barriers, like Gilroy described, and contributing to the construction of Dutch activism.

5.2 Impact of Activism on Social Norms and Racial Discourse

One of the most notable impacts of activism has been the inspiration it provided to other Black individuals, empowering them to speak up. Although many of the participants still do not feel completely comfortable discussing race, there is a clear progression towards greater openness. Daphne articulates this shift in her own experiences:

> When I looked at Afriye's interviews, I thought, "Wow, he's just a human being

and he stands for something and does something about it." These kinds of individuals have actually made me braver to speak out about racism in public, at work. That's just beautiful. Now, if a comment hurts me, I will say something about it.

Amal similarly experienced this snowballing effect. Seeing other people participate and speak up led to her becoming more comfortable with addressing racial issues:

> I went to a [BLM] protest, which was so scary for me. My mom came with me and we were like "okay let's do this." I think it was really nice to see that there were more people who cared and who were aware; even if they were not like in my inner circles, those people were around. So, that gave me a bit of confidence to discuss it more and it made me see that it was also an issue in the Netherlands, and I was not just imagining it.

These narratives demonstrate that by witnessing the courage of others, individuals can find the strength to engage in conversations about race and racism. However, activism extends beyond inspiring stories about courageous people; it actively challenges norms entrenched within Dutch society. It confronts the dominant narratives of tolerance, color-blindness, and innocence, as well as the norms that foster double consciousness in the Dutch context—avoidance, silence and denial. Wanjiku articulates the effectiveness of anti-racist movements: "They have been successful in actually speaking about race, speaking about blackness, speaking about the history of slavery and colonialism, and really challenging and reshaping the narrative in the Netherlands." Wanjiku's statement underscores the role that anti-racist activism plays in challenging and reshaping public discourse.

This active reshaping of narratives is an example of how activism can serve as a critical site of race negotiation. By challenging entrenched norms and the hegemony of dominant racial narratives, activists disrupt existing power dynamics and strengthen the ontological resistance of Black individuals. In turn, this renegotiation of race influences the experienced double consciousness of

racialized others, as established in the Conceptual Framework. So in the Dutch case, activism serves as a mechanism through which individuals can transcend the limitations imposed by double consciousness and through which race can be negotiated.

Based on the interview data, it appears that this renegotiation of race has transformed the nature of the double consciousness and aided the psychological unshackling process of the participants. As a result, individuals are becoming more comfortable discussing race and racism, marking a significant shift in societal discourse and personal empowerment. Amal's experience illustrates this ongoing change: "I think I still am not fully comfortable, but I discuss it with my friends and only more recently I started actually bringing it up during family events." Her statement reflects the complex reality many face; while race is increasingly becoming part of personal and public conversations and thus progress has been made, discussing race openly remains challenging. This transformation underscores the critical role of activism in fostering a more open dialogue about race, aligning with Hall's (1997) and DiAngelo's (2018) insights on how cultural identities are not only constructed but also continuously transformed through discourse.

5.3 Generational Differences

All participants have observed an increase in activism and an accompanying change in Dutch society. However, there appears to be a distinct generational divide in terms of engagement with activism, as well as perceptions of its impact on society. Notably, none of the participants aged 49 and older reported active engagement in recent activism. This disengagement is reflected in the insights of Marcia, 54, who articulates a broader sentiment prevalent among the older generation: "[Activism] is something that has been coming up in recent years. Yes, it's something. But then there's another generation that actually distances itself from it: the older generation." John also contrasts his generation's approach to racism with that of younger activists: "My generation just left it for what it is. And that is where you see the difference with the younger generation. They don't like it and they want to do something about it." This statement highlights a fundamental shift in how different generations respond to racial injustice, with

the younger generation feeling a stronger impetus to actively challenge and change the status quo. Marcia offers an explanation for the older generation's reluctance to confront racism:

> After the Surinamese came here decades ago to the Netherlands, the older generation has never done anything about racism. They actually left it for what it is. They did not dare to do anything about it, because they wanted to be seen as timid and obliging to the Dutch people, to the Dutch society. So the mentality was "it is what it is."

This mentality of wanting to seem timid, obliging, and grateful, as discussed earlier, is the reason for not speaking up about racism. This sentiment of passive acceptance contrasts sharply with the proactive stance of newer generations, who were born in the Netherlands and are more inclined to assert their rights and challenge the status quo.

Another notable difference revealed in the interviews is the more pessimistic outlook on racism and the impact of activism held by older participants. Participants aged 49 and older perceive racism as a pervasive, almost intractable part of society. John reflects this sentiment, stating, "I think that every person has something racist in them. And that you just cannot get rid of it." Similarly, Germaine expresses a resigned view: "Despite the fact that we are growing with generations, I think racism will always be a thing." While both old and young agree that it is important to recognize that racism is indeed deeply embedded in societal structures, this negative perspective influences engagement in activism among the older generation. As John puts it, "I think nothing will change. In 100 years, it's still the same. So why would I put energy into something I can't change?"

Moreover, while recognizing that activism has positively impacted society in many ways, older participants also emphasize the negative consequences, unlike their younger counterparts. Germaine and John highlight the polarization it has caused: "The negative side is that now there are always two sides and that people are going to start a fight and always blame each other. They do not want dialogue," Germaine observes. John adds, "I think it has created a division in society. Two camps were created. I just think that people have become more opposed to each other. Whether that's good

for Dutch society, I don't know." These reflections on the divisive effects of activism segue into the broader challenges and future directions the movement faces. In the next subsection, these challenges will be explored in depth, assessing how activism can evolve and continue to challenge racism.

5.4 Challenges and Future Directions of Activism

While activism has positively impacted Dutch society, it faces significant challenges, as many interviewees point out. One of the major hurdles is the aforementioned increasing polarization within the country, which is reflected in Dutch politics by the rise of far-right political parties. Nikita comments on this trend:

> I think that there will be a backlash, because you now have more support for far-right political parties, more anti-migration policies and rhetoric, and this also affects how we think about racism and inequality in this country. So, I do think that the space that is created to talk about this topic will decrease, and that certain politics and rhetoric will take up more space.

Another challenge highlighted by activists like Amal is the superficial nature of the current awareness about racism. Amal expresses her frustration: "I see that people are becoming aware, but I'm frustrated by the fact that it feels like they're becoming aware because it's now socially necessary to be. Instead of feeling the actual need for change." According to Amal, people don't see the foundational issues inherent to racism and the need for change. "It feels performative; just to live up to society's expectations rather than to genuinely feel like racism is bad. So superficial," she says. According to Essed and Nimako (2006), this is perpetuated by color-blindness, which makes speaking about racial injustices and resistance seem baseless and unnecessary.

Furthermore, related to superficiality, the lack of practical actions towards structural change poses a challenge. Going beyond mere apologies or acknowledgments is a critical area for activism. Tygo discusses this, pointing to King Willem-Alexander's apology as a significant but insufficient step: "I am someone who thinks that actions speak

louder than words. So, while the apology was appreciated, where do we go from here? I see it as a potentially good starting point, not as if everything's good now." Echoing this sentiment, Wanjiku emphasizes the need for structural changes: "I think systematically and institutionally we're still not doing enough. It's a lot of talk, but we also need to have practice." She emphasizes the need to look at the education system, healthcare, and the media.

Giani, who was content manager for *Omroep Zwart* (Broadcast Black), a broadcaster that aims to challenge dominant power structures of the TV industry, emphasizes the need for change in both education and the media landscape. Giani mentioned that the transatlantic slave trade is rarely discussed in the history curriculum, while he believes it is the only reason he exists. "I think that the curriculum, the entire Dutch history, has to be rewritten. They say history is written by the conquerors. That's exactly what happened here. Because this is a history in which I cannot recognize myself." The need for change in education is a common theme in the interviews, also emphasized by many scholars as it perpetuates colonial amnesia (Oostindie, 2011; Weiner, 2014a). Giani also highlights that more change is needed in media companies, because "they set the tone for what is said about racism. So you need people there who set the agenda from another viewpoint than of White old men. Because then the conversations we have about race will be very different."

These reflections suggest that while activism has made strides in bringing issues of racism and inequality to the forefront, there remains a substantial need for deeper, more systemic changes. Willems recognizes that it will be difficult to challenge entrenched power structures, particularly in media. Working as a journalist for *Omroep Zwart*, he has an insight into the Dutch television landscape.

> To get something on television you need a lot of experience or a well-known face. But the thing is, the Dutch TV landscape always uses the same White faces. So there are no people of color who have enough experience to get their own show. And that's a cycle. That is why there is so little diversity on television. So the reality is more difficult. But I do hope we can. With institutions like

Omroep Zwart we have already taken a
step.

Besides the broader societal challenges, activism can also be profoundly traumatic and mentally draining for those involved. Rodgers (2010) illustrates that the emotional labor of activism can often impact activists' mental health and diminish their quality of work. Nikita, who identifies as an activist, reflects on the personal toll it takes: "Sometimes it can be difficult to do this work. You do a lot of work, more than you can actually do, because you are so passionate, motivated. But then you also go over your own limits quite quickly." Her experience highlights the fine line activists often walk between commitment to their cause and the risk of personal burnout. The emotional strain of activism is further illuminated by Wanjiku, who discusses the psychological impact of continually engaging in racial dialogues:

> It made me very emotional and I sometimes cried afterwards. It's so difficult and it can be very traumatic. I just feel like I have to do it. And I don't want to say it's a duty, but it's also a lot of emotional labor, and I don't think that labor should fall on the backs of Black people.

Miranda echoes this sentiment as she gets emotional during the interview, revealing the exhaustion that comes with being both a victim of racism and an advocate for change: "When I say something about it, I notice it's exhausting. Oh, I'm getting emotional... It's exhausting to be someone who's actually a victim of racism. And as a victim, you always have to tell the story." Daphne highlights that this emotional labor comes on top of the already existing grief: "There is so much pain. From personal experience, my grandmother was also a little girl living in slavery. So, it is very close to me too. The grief is real. The sadness is real. The trauma is real. It's real."

Nikita describes how society makes activism even more challenging. "A lot of people in this work also deal with traumas and then you also have a society, a political system, which is not really supportive of your work and now is becoming more right-wing. So it is quite intense." These conditions make the activism environment particularly demanding, as societal and political resistance can exacerbate personal hardships. Despite these

formidable challenges, Nikita finds motivation to continue her activism through visible progress and community support. "I think that what keeps me going is that I see that there has been a lot of progress. It may go slowly and sometimes it's all very symbolic, but also symbolic progress is progress," she reflects. This recognition of even incremental gains provides a sense of accomplishment and purpose. Highlighting the importance of community, she adds, "I work with very pleasant, sweet, strong, enthusiastic people, who also keep me on my feet. And then, moving forward together, is also what keeps me going."

Willems contributes another layer to the motivation behind activism, focusing on education and the need for diverse perspectives. He notes, "The Dutch media landscape is full of White, hetero, cis men. So, I try to provide as much education as possible in the articles that I pitch: How can I give people more insight into certain things, such as intersectionality, race, gender, sexuality, etc.?" Willems' efforts to educate and broaden perspectives underscore a proactive approach to activism, where influencing public discourse and expanding representation become key motivators. Finally, Nikita also draws motivation from the broader impact of their efforts on future generations:

> I grew up with *Zwarte Piet*, I can't change that anymore. But the fact that young children don't grow up with it anymore, that is also something that motivates me. All the work we do now, generations after us no longer have to do.

This reflection demonstrates a key goal of social activism: to create a more equitable society for future generations, ensuring that they will not have to endure the same stereotypes and systemic inequalities.

5.5   Conclusion

This chapter highlighted a significant shift in the racial discourse within the Netherlands towards increased dialogue and growing awareness, driven largely by the efforts of activists who have undergone a process of psychological unshackling. By stepping out of their double consciousness and reclaiming their identities, these activists have inspired others to do the same, collectively trans-

forming how race is negotiated in Dutch society. Their efforts have not only challenged entrenched norms but have also reshaped the landscape of double consciousness, marking a pivotal change in societal discussions about race. Although the internal conflict of double consciousness persists, these activists have begun to transform it into a space of resilience and agency.

Moreover, a notable generational difference emerged from the interviews regarding engagement with activism and its societal perception. Older participants often distanced themselves from activism and focused more on its negative aspects, while nevertheless acknowledging its importance. In contrast, younger participants were more actively involved and viewed activism as a crucial driver of societal change. This generational divide does not limit the research but rather enriches it, offering a broader range of perspectives on the role and impact of activism in shaping racial discourse.

Despite the positive changes brought about by activism, the research also uncovered significant challenges. Activism in the Netherlands faces issues such as sociopolitical polarization and the personal toll on activists themselves, which makes the sustainability of these efforts a critical concern. As Nikita questions, "So what I'm really thinking about now: How can I continue this work in a sustainable way for a long time? Because I really want that." To conclude, while activism has undeniably advanced the dialogue on race in the Netherlands, it must navigate complex societal dynamics and internal challenges to continue progressing.

6   Discussion & Conclusion

This research has examined the role of double consciousness in inhibiting conversations about race and racism in the Netherlands. It has substantiated Gloria Wekker's (2016) assertion that a distinct form of double consciousness exists within the Dutch context, uniquely shaping the racial discourse and the experiences of racialized others in the Netherlands. Participants demonstrated a double consciousness characterized by their efforts to reconcile dual identities, adapt their behaviors to conform to societal norms, and navigate the profound psychological challenges that come with it. Furthermore, affirming Gloria Wekker's hypothesis about double consciousness' inhibitory effects

within Dutch racial discourse, this research shows that it inherently stifles discussions on race and racism in the Netherlands. Adapting to Dutch cultural norms, which reinforce color-blindness and White fragility, not only suppresses the vocalization of racial issues but also provokes significant backlash against those who dare to speak out. This backlash often manifests in social ostracism, accusations of being overly sensitive or even outright hostility, serving as a deterrent against raising racial issues.

Additionally, this research has revealed that there is a noticeable shift occurring due to increased anti-racist activism. Activists, by publicly rejecting these normative constraints and reclaiming their identities, have sparked a transformation in the racial discourse, encouraging a wider societal reevaluation of race relations in the Netherlands. Their activism challenges existing social norms while also influencing the landscape of double consciousness. Despite these promising developments, the sustainability of activist efforts remains a concern, particularly due to challenges such as societal polarization and the personal toll on activists. This highlights the need for continuous support to ensure that activists can continue their work effectively without compromising their well-being.

These findings align with existing scholarship on Dutch color-blindness, racial denial, and White fragility. Furthermore, the research contributes to the literature by substantiating Wekker's argument on double consciousness and discourse. It also extends the conversation by examining how the relationship between the two evolves over time, particularly in light of recent surges in anti-racist activism. By correlating the individual experiences of double consciousness with broader societal changes, the study has provided valuable insights into how these identities are negotiated within the context of the Dutch society's colonial legacy. In addition, the study demonstrated how activism plays a significant role in challenging norms and facilitating discussions on race that were previously stifled or avoided.

Despite its contributions, this study has some limitations that should be acknowledged. Firstly, the sample size of twelve participants, while sufficient for qualitative depth, limits total generalizability of the findings. Secondly, the lack of gender diversity among participants, with no representa-

tion from non-cis individuals, may have overlooked important dimensions of how double consciousness and racial discourse intersect with gender identity. This limitation suggests that future research could benefit from a more inclusive approach to participant selection to ensure a broader spectrum of experiences is captured.

In addition, future studies should consider longitudinal research in order to delve deeper into the evolving dynamics of racial discourse and double consciousness within the Dutch context. Given the recent election of a right-wing government in the Netherlands and the increase in polarization in its society, this provides a relevant area of inquiry. Such studies could track how these political and social changes impact public dialogue on race and equality.

Lastly, further research could specifically focus on the outcomes of anti-racist activism, examining the mechanisms through which activism leads to changes in public policies and individual attitudes. An important aspect of this research would be to examine the mental labor involved in activism. This could offer insights into the sustainability of activism and help devise strategies aimed at supporting activists' wellbeing. By exploring these areas, future research can build on the current study's findings, addressing the ever-evolving nature of Dutch societal dynamics. Such studies would not only enrich academic discourse but also inform strategies for fostering racial equality and inclusivity.

Acknowledgments

7 References

Adams, W. C. (2015). Conducting Semi-Structured Interviews. In *Handbook of Practical Program Evaluation* (pp. 492–505). John Wiley & Sons, Ltd. https://doi.org/10.1002/9781119171386.ch19

Andrews, K. (2016). The Psychosis of Whiteness: The Celluloid Hallucinations of "Amazing Grace" and "Belle." *Journal of Black Studies, 47*(5), 435–453.

Archibald, M. M., Ambagtsheer, R. C., Casey, M. G., & Lawless, M. (2019). Using Zoom Videoconferencing for Qualitative Data Collection: Perceptions and Experiences of Researchers and Participants. *International Journal of Qualitative Methods, 18*, 1609406919874596. https://doi.org/10.1177/1609406919874596

Baldwin, J. (1985). *The Price of the Ticket: Collected Nonfiction: 1948–1985*. Beacon Press.

Balkenhol, M. (2021). Tracing Slavery: The Politics of Atlantic Memory in The Netherlands. In *Tracing Slavery*. Berghahn Books. https://doi.org/10.1515/9781800731615

Brondolo, E., Brady ver Halen, N., Pencille, M., Beatty, D., & Contrada, R. J. (2009). Coping with racism: A selective review of the literature and a theoretical and methodological critique. *Journal of Behavioral Medicine, 32*(1), 64–88. https://doi.org/10.1007/s10865-008-9193-0

Bruce, D. D. (1992). W. E. B. Du Bois and the Idea of Double Consciousness. *American Literature, 64*(2), 299–309. https://doi.org/10.2307/2927837

Campbell, S., Greenwood, M., Prior, S., Shearer, T., Walkem, K., Young, S., Bywaters, D., & Walker, K. (2020). Purposive sampling: Complex or simple? Research case examples. *Journal of Research in Nursing, 25*(8), 652–661. https://doi.org/10.1177/1744987120927206

Caradonna, V. (2024). 'These are large ideals that we hope for': Heritagising the past and present of anti-racist activism in the Black Archives. *International Journal of Heritage Studies, 0*(0), 1–16. https://doi.org/10.1080/13527258.2024.2315232

Centraal Bureau voor de Statistiek. (2008). *Al-*

lochtoon en Autochtoon [Webpagina]. Centraal Bureau voor de Statistiek. https://www.cbs.nl/nl-nl/nieuws/2008/09/stijging-emigratie-voorbij/allochtoon-en-autochoon

Centraal Bureau voor de Statistiek. (2016, November 21). Bevolking naar migratieachtergrond. Centraal Bureau voor de Statistiek. https://www.cbs.nl/nl-nl/achtergrond/2016/47/bevolking-naar-migratieachtergrond

Choenni, C., & Harmsen, C. (2007). Geboorteplaats en etnische samenstelling van Surinamers in Nederland. Centraal Bureau voor de Statistiek.

Clarke, J. H. (1991). *African world revolution: Africans at the crossroads*. African World Press.

Dayal, S. (1996). Diaspora and Double Consciousness. *The Journal of the Midwest Modern Language Association, 29*(1), 46–62. https://doi.org/10.2307/1315257

de Jong, A. (2019). Gaza, Black Face and Islamophobia: Intersectionality of Race and Gender in (Counter-) Discourse in the Netherlands. In P. Essed, K. Farquharson, K. Pillay, & E. J. White (Eds.), *Relating Worlds of Racism: Dehumanisation, Belonging, and the Normativity of European Whiteness* (pp. 271–298). Springer International Publishing. https://doi.org/10.1007/978-3-319-78990-3_11

DiAngelo, R. (2018). *White Fragility: Why It's So Hard for White People to Talk About Racism*. Beacon Press.

Dikmans, B. (2020). 'Everyday Racism,' 'White Innocence,' and Postcolonial Society: A Deeper Look into the Dutch Cultural Archive. *Journal of Critical Race Inquiry, 7*(1), Article 1. https://doi.org/10.24908/jcri.v7i1.12798

Driessen, M., & van der Schelde, Asher. (2022). Nederland over (Zwarte) Piet. I&O Research.

Du Bois, W. E. B. (1903). *The Souls of Black Folk*. Blurb.

Dunn, K. (2005). Interviewing. In *Qualitative Research Methods in Human Geography* (2nd ed., pp. 79–105). Oxford University Press.

Durik, A. M., Hyde, J. S., Marks, A. C., Roy, A. L., Anaya, D., & Schultz, G. (2006). Ethnicity and Gender Stereotypes of Emotion. *Sex Roles, 54*(7), 429–445. https://doi.org/10.1007/s11199-006-9020-4

Elliott-Cooper, A. (2019). "Our life is a struggle": Respectable Gender Norms and Black Resistance to Policing. *Antipode, 51*(2), 539–557. https://doi.org/10.1111/anti.12497

Essed, P. (1991). *Understanding Everyday Racism: An Interdisciplinary Theory*. Sage Publications.

Essed, P., & Hoving, I. (2014). Innocence, Smug Ignorance, Resentment: An Introduction to Dutch Racism. *Dutch Racism, 27*, 9–29. https://doi.org/10.1163/9789401210096_002

Essed, P., & Nimako, K. (2006). Designs and (co)incidents: Cultures of Scholarship and Public Policy on Immigrants/Minorities in the Netherlands. *International Journal of Comparative Sociology, 47*(3–4), 281–312.

Eze, E. C. (2011). On Double Consciousness. *Callaloo, 34*(3), 877–898.

Fanon, F. (1952). *Black Skin, White Masks*. Penguin Books.

Fanon, F. (1961). *The Wretched of the Earth*. Kwela Books.

Ghorashi, H. (2023). Taking Racism Beyond Dutch Innocence. *European Journal of Women's Studies, 30*(1_suppl), 16S–21S. https://doi.org/10.1177/1350506820978897

Gilroy, P. (1993). *The Black Atlantic: Modernity and Double Consciousness*. Verso.

Goldberg, D. T. (2006). Racial Europeanization. *Ethnic and Racial Studies, 29*(2), 331–364. https://doi.org/10.1080/01419870500465611

Gonzalez-Sobrino, B., & Goss, D. R. (2019). Exploring the Mechanisms of Racialization Beyond the Black–White Binary. *Ethnic and Racial Studies, 42*(4), 505–510. https://doi.org/10.1080/01419870.2018.1444781

Grell-Brisk, M., Anderson, E., & Chase-Dunn, C. (2020). The Social Evolution of Distant Othering and the Racialized Other. *OSF*. https://doi.org/10.31235/osf.io/f7at8

Gruber, J. (2022). The "Zwarte Piet" Debate in Belgium and the Netherlands: Searching for Racial Reconciliation in Post/Colonial Europe? Theologizing About Social Conflict and Cohesion at the Intersection of Race and Religion. *Louvain Studies,*

45(1), 34–59. https://doi.org/10.2143/LS
.45.1.3290306

Hall, S. (1980). Race, Articulation, and Societies Structured in Dominance. In *Sociological Theories: Race and Colonialism* (pp. 305–345). UNESCO.

Hall, S. (1997). Race the Floating Signifier. Goldsmiths College.

Haddour, A. (2005). Sartre and Fanon: On Negritude and Political Participation. *Sartre Studies International, 11*(1/2), 286–301.

Hammarberg, K., Kirkman, M., & de Lacey, S. (2016). Qualitative Research Methods: When to Use Them and How to Judge Them. *Human Reproduction, 31*(3), 498–501. https://doi.org/10.1093/humrep/dev334

Itzigsohn, J., & Brown, K. (2015). Sociology and the Theory of Double Consciousness: W. E. B. Du Bois's Phenomenology of Racialized Subjectivity. *Du Bois Review: Social Science Research on Race, 12*(2), 231–248. https://doi.org/10.1017/S1742058X15000107

Jean-Marie, V. (2017). Fanon's *Black Skin, White Masks: The Irreducibility of Black Bodies*. *The CLR James Journal, 23*(1/2), 193–210.

Jensen, R. (2020). Whiteness. In *The Routledge Companion to Race and Ethnicity* (2nd ed.). Routledge.

Kiger, M. E., & Varpio, L. (2020). Thematic Analysis of Qualitative Data: AMEE Guide No. 131. *Medical Teacher, 42*(8), 846–854. https://doi.org/10.1080/0142159X.2020.1755030

Köksoy, E., & Demir, S. (2021). The Impact of Social Media on Agenda Setting and Public Opinion Formation: The Black Lives Matter Movement as an Example of Social Activism. *Social Sciences Studies Journal, 7*(82). https://doi.org/10.26449/sssj.3130

Lozada, F. T., Riley, T. N., Catherine, E., & Brown, D. W. (2022). Black Emotions Matter: Understanding the Impact of Racial Oppression on Black Youth's Emotional Development. *Journal of Research on Adolescence, 32*(1), 13–33. https://doi.org/10.1111/jora.12699

Moore, T. O. (2005). A Fanonian Perspective on Double Consciousness. *Journal of Black Studies, 35*(6), 751–762.

Ministry of Interior and Kingdom Relations. (2022). *National Program Against Discrimination and Racism 2022*. https://open.overheid.nl/documenten/ronl-b6fd8ea3cf7bc818c3f73c8944d6bc8d48f8b3f6/pdf

Nimako, K., & Willemsen, G. (2011). *The Dutch Atlantic: Slavery, Abolition and Emancipation*. Pluto Press. https://doi.org/10.2307/j.ctt183p3kr

Noble, H., & Smith, J. (2015). Issues of Validity and Reliability in Qualitative Research. *Evidence-Based Nursing, 18*(2), 34–35. https://doi.org/10.1136/eb-2015-102054

Oostindie, G. (2011). *Postcolonial Netherlands: Sixty-Five Years of Forgetting, Commemorating, Silencing*. Amsterdam University Press. https://www.jstor.org/stable/j.ctt46mvg0

Prins, B. (2002). The Nerve to Break Taboos: New Realism in the Dutch Discourse on Multiculturalism. *Journal of International Migration and Integration, 3*(3), 363–379. https://doi.org/10.1007/s12134-002-1020-9

Rodgers, K. (2010). 'Anger is Why We're All Here': Mobilizing and Managing Emotions in a Professional Activist Organization. *Social Movement Studies, 9*(3), 273–291. https://doi.org/10.1080/14742837.2010.493660

Rose, A. (2022). "Dutch Racism is not Like Anywhere Else": Refusing Color-Blind Myths in Black Feminist Otherwise Spaces. *Gender & Society, 36*(2), 239–263. https://doi.org/10.1177/08912432221075098

Said, E. W. (1993). *Culture and Imperialism*. Vintage.

Sofaer, S. (1999). Qualitative Methods: What Are They and Why Use Them? *Health Services Research, 34*(5 Pt 2), 1101–1118.

Spijkers, C. (2020). Halfjaar na het Damprotest: wat heeft het teweeggebracht? [Photographs]. NOS. https://nos.nl/artikel/2358755-halfjaar-na-het-damprotest-wat-heeft-het-teweeggebracht

Weiner, M. F. (2014a). (E)Racing Slavery. *Du Bois Review: Social Science Research on Race, 11*(2), 329–351. https://doi.org/10.1017/S1742058X14000149

Weiner, M. F. (2014b). The Ideologically Colonized Metropole: Dutch Racism and Racist Denial. *Sociology Compass, 8*(6), 731–744. https://doi.org/10.1111/soc4.12163

Wekker, G. (2016). *White Innocence: Paradoxes of Colonialism and Race*. Duke University Press.

White, S. B. (2005). Releasing the Pursuit of Bouncin' and Behavin' Hair: Natural Hair as an Afrocentric Feminist Aesthetic for Beauty. *International Journal of Media & Cultural Politics, 1*(3), 295–308. https://doi.org/10.1386/macp.1.3.295/1

Wilson, A. N. (1998). *Blueprint for Black Power: A Moral, Political and Economic Imperative for the 21st Century*. Afrikan World InfoSystems.

A   Guiding Interview Questions

Background and general questions:

- Can you share a bit about your background and how you identify racially or ethnically within Dutch society?

- How has your racial or ethnic identity influenced your experiences in the Netherlands? And how did this affect you?

Double consciousness:

- Have you struggled with the internalization of colonial or racist attitudes that you perceive in Dutch society?

- Have you ever felt like changing your behavior and compromising your identity in order to fit in in Dutch society or to adhere to societal norms?

- Can you describe any internal conflicts or challenges you've faced in reconciling different aspects of your identity? How do you navigate this?

Conversations about race:

- Do you feel like we talk enough about race and racism in the Netherlands? Is there enough awareness in society?

- Have you always felt comfortable discussing race and racism openly in your personal, educational, or professional environments? Why or why not?

- Have there been moments or movements within the Netherlands that you feel have successfully challenged or changed the racial discourse? How have you personally engaged with those movements and did they affect your own experiences or willingness to talk about race and identity?

- Looking at the broader population, have you noticed a shift in the willingness of Dutch society to engage with issues of race and racism? Please elaborate.

- What changes do you hope to see in the discourse around race and racism in the Netherlands?

Social Sciences

Towards Effective Climate Mitigation

Creating the Feasibility Klima Index (FKI) for Comprehensive Initiative Assessments

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Abstract

Despite the international agreement to limit global warming to 2.0 °C, global emissions continue to rise. To prevent catastrophic economic and social damages, we need more effective strategies to reduce greenhouse gases. This paper introduces the Feasibility Klima Index (FKI), a comprehensive, multivariable composite indicator that integrates technical, sociopolitical, and behavioural factors into the assessment of mitigation initiatives. Expanding on Nielsen et al.'s (2020) tripartite framework, the FKI operationalises the dimensions of technical potential (TP), initiative feasibility (IF), and behavioural plasticity (BP) into quantifiable indicators. Through a case study of reducing meat consumption in Germany, the article demonstrates how the FKI moves beyond purely technical assessments of mitigation initiatives towards a more holistic, interdisciplinary analysis. By providing a robust methodological tool, the FKI enables researchers and policy-makers to evaluate and compare mitigation options based on a granular understanding of their feasibility and potential impact.

Keywords and phrases: *climate mitigation strategies, composite indicator, Feasibility Klima Index, initiative feasibility, behavioural plasticity, technical potential, emissions reductions, meat consumption*

Contents

List of Abbreviations

BP Behavioural Plasticity

DICE Dynamic Integrated Climate-Economy

FAO Food and Agriculture Organization of the United Nations

FKI Feasibility Klima Index

GHGs Greenhouse Gases

IAMs Integrated Assessment Models

IF Initiative Feasibility

IRA Inflation Reduction Act

IPCC Intergovernmental Panel on Climate Change

OECD Organisation for Economic Co-operation and Development

SCC Social Cost of Carbon

TP Technical Potential

UNEP United Nations Environment Programme

UNFCCC United Nations Framework Convention on Climate Change

1   Introduction

In 2015, 195 parties to the Paris Agreement agreed to take measures to limit global warming to 2.0 °C above pre-industrial levels, with the aspirational goal of 1.5 °C (Visser et al., 2018). Despite these promises, greenhouse gas (GHG) concentrations in the atmosphere remain at levels unprecedented in recent history, sentencing the planet to irreversible climate change damages (Intergovernmental Panel on Climate Change [IPCC], 2023). While emissions targets are set and multiple pathways exist to decarbonise economies (e.g., European Union, 2020; United States Department of State & United States Executive Office of the President, 2021), further emissions reductions require far-reaching changes to current practices. Hence, understanding the specific adjustments needed to meet large-scale climate goals remains a significant challenge.

This paper aims to address this challenge by creating a composite indicator, called Feasibility Klima[1] Index (FKI), based on the theoretical framework by Nielsen et al. (2020). Nielsen et al.'s framework consists of three dimensions: technical potential (TP), initiative feasibility (IF), and behavioural plasticity (BP). The dimension TP captures the potential GHG emissions reductions that a mitigation initiative could achieve, while IF and BP concentrate on sociopolitical, economic, and behavioural factors. These factors affect change agents, like policy-makers, who adopt and implement mitigation initiatives, alongside target actors, like consumers, who react to said initiatives. Hence, they play a pivotal role in determining an initiative's effectiveness in achieving tangible climate mitigation.

While Nielsen et al. (2020), along with other researchers (e.g., Stern et al. 2023), propose theoretical frameworks to analyse the achievability of climate mitigation, they fall short of making them operational. This research gap motivates the guiding question of this paper: How can the integration of technical potential, sociopolitical factors, and behavioural changes enable the holistic assessment of mitigation strategies and enhance the predictive accuracy of policies in achieving the Paris Agreement goals? This thesis posits that the detailed evaluation of these three dimensions through a composite indicator is essential to identifying the

multi-layered challenges to lowering GHG emissions and enabling informed decision-making on initiatives, ultimately advancing climate mitigation efforts.

The significance of this research is twofold: On the one hand, operationalising Nielsen et al.'s (2020) framework leads to a practical tool—the FKI–that researchers can use to assess the dimensions TP, IF, and BP in detail. This operationalisation involves subdividing the dimensions into individual indicators with specific variables, making them quantifiable, and then aggregating them into a composite indicator using methodologies endorsed by the Organisation for Economic Co-operation and Development (OECD, 2008). This systematic index assessment provides researchers and sustainability consultants with a more granular understanding of technical, sociopolitical and behavioural factors, enabling them to refine mitigation initiatives and improve their chances of success.

On the other hand, the FKI can serve as a benchmark for policy-makers and other decision-makers to compare different mitigation initiatives. Such comparisons are particularly valuable for policy-makers, as they allow for the selection of the most promising options. Since rising GHG emissions risk intensifying environmental damages over time (IPCC, 2023), prioritising the most effective mitigation initiatives is imperative to addressing the urgency of the climate crisis.

This paper first provides a detailed background in mitigation research and subsequently explains the theoretical framework developed by Nielsen et al. (2020). Next, I explain the methodology needed to develop the FKI as a composite indicator. A case study of reducing meat consumption in Germany illustrates the operationalisation of Nielsen et al.'s framework, highlighting the significance and challenges of applying the FKI to a specific mitigation initiative. Finally, the article discusses the findings of the case study and the FKI's strengths and limitations, alongside offering suggestions for future research and policy-making.

1.1   Key Terms

To ensure clarity throughout the paper, it is essential to define the key terms underpinning climate mitigation research. For the purpose of this article, GHG emissions, consisting of a mix of carbon dioxide, methane, and other gases, are

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[1]German for 'climate'

measured in kilograms or tons of CO2-equivalents. These GHG emissions are typically captured in inventories, which are tools used to identify and quantify a community's current and projected GHG emissions. As such, these inventories provide a baseline for creating mitigation pathways and tracking progress in climate action (Boswell et al., 2010).

Plans to achieve climate mitigation, also called mitigation opportunities, target both supply- and demand-side solutions. This paper focuses on demand-side mitigation initiatives, as they are aimed at reducing GHG emissions by changing consumption patterns and behaviours among end-users. From now on, the terms initiative, strategies, and options, are used interchangeably to refer to technologies, practices, and policies aimed at reducing GHG emissions (IPCC, 2022). Research on demand-oriented strategies is inherently interdisciplinary and involves economists, psychologists, political scientists, and legal analysts (Creutzig et al., 2018). Prevalent examples of such initiatives include reducing motorised transport and home energy use, dietary changes like reducing meat intake, and energy-efficient or zero-energy buildings (Steg et al., 2022).

As suggested by the contrasting definitions of initiative and opportunity in Table 1 (taken from Nielsen et al., 2020), mitigation opportunities and the potential trajectories to reach GHG reductions do not automatically translate into action. They often encounter financial, institutional, human, and economic barriers, which are central to understanding the feasibility of initiatives aimed at realising mitigation opportunities. The Intergovernmental Panel on Climate Change (IPCC, 2018) defines this feasibility as the capacity of a system to accomplish a specific outcome, such as reducing GHG emissions. However, the IPCC mainly discusses this capacity at a global level, which can overlook local and country-level feasibility issues.

2 Background

Following the landmark United Nations Framework Convention on Climate Change (UNFCCC) Paris Agreement in 2015, governments around the world have issued net-zero targets, including the USA and the EU's goal of reaching this target by 2050, along with comprehensive decarbonisation plans (European Union, 2020; United States Department of State & United States Executive Office of the President, 2021). Scientific assessment reports by the IPCC inform these plans and continue disseminating research on pathways to mitigate disastrous future global warming while adapting to already disruptive environmental effects (e.g., IPCC, 2014; IPCC, 2023). Despite widespread consensus within the scientific community that urgent climate action is needed, global GHG emissions are not declining (Stoddard et al., 2021).

Bending the GHG emissions curve requires an unprecedented, concerted effort across industries, national borders, and change agents, counting on individuals, social movements, governments and private organisations to reduce or substitute environmentally harmful practices (Dietz et al., 2003). Considering the scale of this transformation, questions about its feasibility arise.

2.1 Modelling Climate Mitigation Effects

As a review by Krey (2014) demonstrates, a large body of model-based scenario literature provides data for the IPCC reports and examines feasibility considerations by focusing on economic and technological aspects of GHG mitigation strategies. Central to the IPCC reports are integrated assessment models (IAMs), which are analytical frameworks that integrate human and natural systems to explore GHG mitigation scenarios. IAMs are often bound by conventional economic assumptions—such as perfectly functioning markets, rationality, and complete foresight—and face critiques for oversimplifying actor heterogeneity, socio-economic dynamics, and imperfect competition. Despite these critiques, they produce valuable insights into climate change risks and the costs of GHG reduction pathways. Hence, they play a key role in policy debates, guiding decision-making processes (Keppo et al., 2021).

Specifically, the Dynamic Integrated Climate-Economy (DICE) model, first published by Nordhaus in 1992 and often revised since then (e.g., Nordhaus, 2008; Nordhaus, 2017), is known as the most influential economic cost-benefit framework. It attempts to assess how damaging global warming will be by modelling the relationship between climate change and economic growth over time. Notably, Hänsel et al. (2020) use the DICE model to show that limiting global warming to below 2.0 °C

Table 1: Glossary of Key Terms (quoted verbatim from Nielsen et al. (2020))

Term	Definition
Adoption	A choice to undertake an initiative, to shift to a different technology, or to alter a behavior.
Actual Mitigation	Degree of mitigation, typically expressed as CO2 equivalents, resulting from an initiative.
Behavioural Plasticity	The extent to which the target of a mitigation initiative, as implemented, responds to it as intended. Behavioral plasticity is a function of attributes of the targets, their contexts, and the ways mitigation initiatives are implemented
Change Agent	An individual, social movement, or public or private organization that undertakes initiatives to mitigate harmful environmental changes
Implementation	The degree to which an initiative, once adopted, is supported by providing adequate resources and monitoring and designed for optimal influence on the target actors
Initiative Feasibility	The likelihood that a change agent will adopt and then implement a mitigation initiative
Mitigation Initiative	An action by a change agent, such as an individual, government, corporation, non-governmental organization, or social movement, that could realize mitigation opportunities. These might include public laws, policies, or programs, or corporate supply policies, community agreements, and other activities of a change agent to influence a governmental or private actor to mitigate climate change.
Mitigation Opportunity	A pathway toward achieving mitigation of climate change. Opportunities can be seen in emerging technologies that enable mitigation (e.g., electric vehicles, meat substitutes, carbon capture and storage) or in domains or types of human activities where mitigation can happen (e.g., travel, meat consumption, energy use in manufacturing, reforestation). The extent to which an opportunity results in actual mitigation depends on the initiatives undertaken to realize the opportunity and on responses to the initiatives
Target Actor	An individual, community, organization, or government entity that might respond to a mitigation initiative
Technical Potential	The reduction in the drivers of climate change—typically expressed as emissions reductions in CO2 equivalents—that would result if a mitigation opportunity were completely realized or an initiative fully achieved its objectives

above pre-industrial levels by 2100 is economically viable. The IPCC (2023) also states that the costs of economic and social damages from an increase of more than 2.0 °C would far surpass current mitigation costs. This collective evidence substantiates the urgent need for intensified mitigation efforts to decelerate the world's current trajectory towards a 2.9 °C temperature increase, as the United Nations Environment Programme (UNEP, 2023) projects.

Against this backdrop of conceptual and practical difficulties, climate researchers attempt to model the real mitigation effects of specific strategies. In creating climate goal scenarios, a critical question that Nielsen et al. (2020) identify is which specific mitigation initiatives are feasible to effectuate actual reductions of GHGs. In this context, feasibility is multi-faceted. While IAMs, such as DICE, predominantly examine economic and technical questions and offer insights into which initiatives reduce climate change risks and their cost implications, questions about actual feasibility go beyond these considerations. Such questions explore,

for instance, whether adopting mitigation strategies in governmental bodies or implementing them in broader society is possible.

Several studies that examine the different elements of holistic feasibility illustrate why this inquiry is a difficult undertaking. For instance, Nordhaus (2008) shows that a carbon tax is an economically beneficial strategy to lower emissions by internalising the social cost of carbon (SCC). Internalising the SCC means incorporating the external costs of carbon emissions—such as health impacts, environmental degradation, and economic losses—into the price of carbon-emitting goods and services. Yet, its proven economic viability does not warrant that a carbon tax would be widely accepted by the public. Carattini et al. (2019) use surveys to show that a carbon tax is more popular if the revenue is distributed to citizens. With clear benefits for the constituents of a country, such a strategy may enjoy more societal and political support.

A practical example is the Inflation Reduction Act (IRA) in the United States. As Stern et al. (2023) state, this act based on financial incentives trumped previous failed attempts at establishing American cap-and-trade programmes (i.e., market-based systems where a limit is set on emissions and companies can trade allowances to meet reduction targets (UNFCCC, 2022)) and carbon taxes, similar to those in the European Union. "[Adopting such a law] might have happened sooner if the scientific community had provided policy-makers with feasibility assessments of different climate policy designs and laws," postulate Stern et al. (2023, p. 6). The IRA's attributed potential to reduce US GHG emissions by 40% compared to 2005 levels will hinge on the intricacies of implementing it (Stern et al., 2023). Furthermore, its effectiveness will depend on how the target actors, including organisations and individuals, respond to the initiative. These two factors—the implementation and behavioural changes—will ultimately determine its impact on reducing GHG emissions.

To address these challenges, climate mitigation researchers take insights from modelling analyses of future potential reductions and combine them with analyses of what is required to move from a hypothetical scenario to actual mitigation. As expected, numerous factors complicate the real-world application of these strategies, rendering the process far more challenging than theoretical models suggest. The result of combining these insights is a better understanding of feasible mitigation strategies and the highly context-specific challenges to their effectiveness (Stern et al., 2023).

To illustrate, Boswell et al. (2010) and Loughlin et al. (2011) have made strides in addressing the need for an in-depth, transparent analysis of mitigation opportunities and accountability concerns. Boswell et al. link emissions inventories with municipal climate action plans, demonstrating the importance of attributing quantitative data to policies. They illustrate how inventories can serve as foundational tools for setting and evaluating the goals of climate strategies. Similarly, Loughlin et al. introduce the Emission Scenario Projection (ESP) methodology, a comprehensive approach to simulate future air quality under varying scenarios. Their work depicts how scenario-based methodologies can integrate emission inventories with energy and policy modelling to address long-term environmental challenges.

Both studies provide valuable contributions by quantifying emissions inventory data and connecting it to mitigation research to model future scenarios. These approaches align with Pacala and Socolow's (2004) stabilisation wedges concept, which provides a practical framework for identifying and implementing scalable mitigation options to stabilise carbon emissions over various time frames. Despite these advancements, quantifications of critical dimensions like IF and BP, in addition to TP, remain underexplored, often resulting in stylised and hypothetical scenarios instead of detailed, actionable assessments.

To address this gap, this paper introduces the FKI assessment to evaluate the holistic feasibility of mitigation initiatives, such as regulatory, financial, and behavioural strategies. Building on Nielsen et al.'s (2020) tripartite framework, it asks how integrating technical potential, sociopolitical factors, and behavioural changes can comprehensively assess mitigation strategies and improve the predictive accuracy of these strategies in meeting emission targets. This article contributes to mitigation research by critically examining the academic literature on mitigation assessments and developing a methodology that makes a concrete attempt at operationalising Nielsen et al.'s theoretical framework.

This feasibility assessment serves two key objectives: first, to gain insights into maximising the actual mitigation effectiveness of initiatives and

second, to compare different initiatives and identify the most promising ones (Stern et al., 2023). By offering a systematic and holistic analysis of achievability, the FKI enables researchers, sustainability consultants, and policy-makers to dissect the sociopolitical and behavioural aspects of initiatives besides their GHG reduction potential. Additionally, in providing a practical tool for comparing initiatives, this study contributes to stakeholders' objective to prioritise the most effective mitigation strategies. Since sociopolitical and behavioural aspects are highly context-specific, the FKI's capacity for country-level analysis allows stakeholders to tailor their research to specific constituencies or target actors. In sum, this paper not only advances the theoretical understanding of mitigation feasibility but also delivers actionable knowledge and a comprehensive policy tool to support progress towards achieving the Paris Agreement goals.

3   Theoretical Framework

Mitigation pathway assessments and modelling studies often struggle to account for all aspects of feasibility and traditionally focus on technical aspects such as reduced GHG emissions. To expand on technical approaches, Nielsen et al. (2020) propose a peer-reviewed framework that considers technical potential (TP), initiative feasibility (IF), and behavioural plasticity (BP). TP includes reducing GHGs and the actual mitigation of global warming. IF, comprised of sociopolitical factors, refers to the possibility of a mitigation strategy being adopted and implemented by change agents. BP examines how the initiative would affect target actors once it is implemented, specifically in terms of behavioural changes. This tripartite concept offers a holistic perspective drawing on interdisciplinary insights and, thus, a deep analysis of feasibility.

Nielsen et al. (2020) stipulate that their framework could better integrate various social science disciplines into mitigation research beyond traditional technical analysis. They argue that such an approach would allow for a detailed examination of the context in which specific mitigation strategies could occur by considering sociopolitical and behavioural factors. These context-specific aspects shape the actions of both change agents and target actors, directly influencing the success of mitigation initiatives. Therefore, understanding these

factors is essential for assessing the overall achievability of such strategies.

Despite its strengths, Nielsen et al.'s (2020) framework lacks detailed instructions for its implementation. Given that Nielsen et al.'s contribution is primarily the inclusion of sociopolitical and behavioural aspects in mitigation assessments, this paper further subdivides the dimensions IF and BP into concrete indicators and enables the practical application of the framework. Thus, this research extends their conceptual definition of the tripartite framework by proposing operational definitions for each of the three dimensions and four novel indicators to facilitate the detailed assessment of mitigation options. Ultimately, aggregating these dimensions and their indicators into a single measure—-a composite indicator—-allows for easy comparability between different mitigation strategies.

The following sections explain each dimension and its distinct indicators before systematically aggregating them into an index. By grounding the option-level mitigation assessment in the two novel dimensions proposed by Nielsen et al. (2020), it is possible to examine both IF and BP in detail, break them into specific indicators, and quantify each indicator based on available evidence. Finally, each indicator contributes to a consolidated index by normalising the data and computing the aggregated feasibility into a single index per mitigation option (see Table 2). In brief, these steps operationalise and systematise the tripartite framework.

In practical terms, Nielsen et al. (2020) provide a comprehensive framework that is particularly useful for understanding how different contexts influence the effectiveness of mitigation strategies. The three straightforward yet broad dimensions simplify the quantification of relevant factors, which, according to Nielsen et al., is needed to offer a more detailed assessment of net-zero trajectories than currently available stylised and hypothetical analyses. Different strategies can be more easily compared by quantifying the mitigation potential, and policy-makers can then prioritise strategies that offer the highest potential within their specific contexts.

This paper adopts two additional indicators-–political support and public acceptance-–from Steg et al.'s (2022) framework for implementing mitigation options. Steg et al.'s framework differs from Nielsen et al.'s (2020) because it examines the main barriers to and enablers of the at-

scale implementation of certain mitigation strategies. Broad indicators, such as environmental-ecological feasibility and geophysical feasibility, allow Steg et al. to undertake a detailed analysis of mitigation options in their respective sectors, as demonstrated in their supplemental information. In contrast, Nielsen et al. focus on examining the overall mitigation potential of strategies through three dimensions that assess the eventual impact on climate mitigation and the contexts in which these strategies are adopted, implemented, and ultimately affect target actors.

Although Steg et al.'s framework, which consists of six dimensions with at least three indicators each, is more comprehensive than Nielsen et al.'s (2020), some indicators, like geophysical feasibility, are irrelevant to demand-side options like reducing meat consumption. Therefore, and on the grounds of simplicity, this paper mainly focuses on Nielsen et al.'s framework and objective of assessing a strategy's mitigation potential.

Nevertheless, the indicators of political support and public acceptance from Steg et al. (2022) remain useful operational indicators that complement Nielsen et al.'s dimensions IF and BP, respectively, because their conceptual definitions align closely. This synthesis not only enhances the operationalisation of the tripartite framework but also ensures a more comprehensive evaluation of the feasibility and effectiveness of mitigation strategies.

To further strengthen the framework, two additional economic indicators—cost-effectiveness and demand elasticity—are included under IF and BP, respectively. These indicators represent established economic concepts widely used in empirical studies (e.g., Funke et al., 2022; Roosen et al., 2022).

In summary, this paper combines different strands of literature—including climate mitigation research (e.g., Nielsen et al., 2020; Steg et al., 2022; Stern et al., 2023), economic analyses (e.g., Nordhaus, 2017; Hänsel et al., 2020), and measurement methodologies (OECD, 2008)—in identifying the indicators. This synthesis makes the operationalisation of the tripartite framework and the resulting systematic FKI assessment more robust. Moreover, all selected indicators satisfy the data selection guidelines from the *Handbook on Constructing Composite Indicators: Methodology and User Guide* by the OECD (2008), which emphasise

"analytical soundness, measurability, [and] relevance to the phenomenon being measured" (p. 15).

3.1 Technical Potential (TP)

The TP dimension focuses on the strategy's maximum mitigation potential (Nielsen et al., 2020), which requires calculating the current GHGs the activity emits and the effects resulting from reducing this activity by a certain percentage. This calculation is facilitated by connecting GHG emission inventories with data on the activity at the national level. In brief, this indicator reflects actual GHG reductions.

3.2 Initiative Feasibility (IF)

According to Nielsen et al. (2020), IF assesses the factors determining the government's or private entity's ability to adopt and implement a mitigation strategy successfully. Incorporating the cost-effectiveness of a mitigation option can offer helpful information about IF because economic costs are intricately linked to institutional capacity. To illustrate, large economic costs could present significant barriers to the implementation of a mitigation initiative (Jewell & Cherp, 2019). Moreover, this indicator could reflect how likely governments or other budget-constrained entities are to endorse a mitigation strategy. Ample academic literature on the economic costs of climate change (e.g., Tavoni & Tol, 2010; Nordhaus, 2017; Hänsel et al., 2020) further underscores the importance of cost-effectiveness as a parameter for evaluating the feasibility of a mitigation option, which is why it is essential to include under IF.

The second indicator in this dimension, political support, reflects the extent to which governments, institutions, or politicians support the mitigation option. This factor assesses whether the necessary institutional capacity, governance frameworks, and political backing exist. It is crucial for IF because institutional barriers are often critical in determining the success of climate action, according to Steg et al. (2022). Furthermore, Jewell and Cherp's (2019) exploration of the political feasibility of mitigation pathways underscores how political capacity can significantly influence the implementation of climate strategies. By incorporating political support into IF, the index ensures that the feasibility analy-

Table 2: Tripartite Framework Index Scheme

Dimension	Indicator
Technical potential	Real reduction of GHG
Initiative feasibility	Cost-effectiveness
	Political support
Behavioural plasticity	Public acceptance
	Demand elasticity

sis accounts for the practical challenges of securing backing for policy adoption and implementation.

3.3 Behavioural Plasticity (BP)

The success of mitigation options, measured in reduced GHG emissions, also depends on their effectiveness in inciting target actors to respond to the strategy with the intended behaviour once it is implemented. Nielsen et al. (2020) call this BP. Nielsen et al. refer to both supply- and demand-side responses with BP. Steg et al. (2022) identify a conceptually similar dimension, sociocultural feasibility, which includes public acceptance as one of its indicators. Public acceptance stands for "the extent to which the public supports the option and will change their behaviour accordingly" (Steg et al., 2022, p. 1218). Therefore, this indicator is akin to Nielsen et al.'s definition of BP and can serve as an indicator within this dimension.

Finally, demand elasticity can be incorporated into behavioural plasticity to introduce another widely used economic indicator. It quantifies the responsiveness of consumer demand to changes in price (Nicholson & Snyder, 2007). Demand elasticity complements the sociocultural indicator of public acceptance because it provides a precise measure of how price changes resulting from fiscal policies such as taxes or subsidies may influence the behaviour of target actors. This indicator increases the predictive accuracy and policy relevance of the index. Roosen et al. (2022) demonstrate that empirical data from consumer panel studies can enable the computation of this indicator.

4 Methodology

In this section, I explain the construction of the FKI assessment in detail and describe how the methodology aligns with the internationally re-

spected technical guidelines in the *Handbook on Constructing Composite Indicators: Methodology and User Guide* by the OECD (2008). While this paper follows many of the steps outlined in the handbook, its limited scope prevents the implementation of all of them.

A significant challenge of this approach is determining how to operationalise the framework effectively. Nielsen et al. (2020) extensively describe the conceptual research implications of their framework but do not provide clear instructions for its application. As a result, it was unclear whether a qualitative approach based on subjective judgements or an alternative method would be most appropriate and useful. Transforming the framework into a composite indicator offers a promising solution, as it enables a holistic and systematic analysis of the feasibility of mitigation options through indicators. These indicators draw on results from existing empirical studies and thereby quantify the dimensions. Since Nielsen et al. repeatedly mention the shortcomings of stylised analyses, quantifying the dimensions appears to be an appropriate strategy to operationalise the framework for real-world application.

Composite indicators, also known as indices or synthetic indicators, have become an increasingly popular tool for bridging academic insights with practical policy indications (Greco et al., 2018), as they transform a theoretical framework into a palpable benchmark number. Both academics and practitioners consider them useful measurements that convey more than merely "the sum of its parts" (OECD, 2008, p. 23). Hence, it is widely used in policy-making contexts and public communication, attracting media attention.

However, composite indicators can have significant shortcomings, such as oversimplification or irrelevance. Their construction requires several qualitative judgments about the characteristics that may impact other steps along their creation, their informative value, and, ultimately, their relevance to those who use or are affected by them—namely, the stakeholders and constituency. Target stakeholders, like policy-makers, use the index as an indicative measurement that informs their decision-making, while the constituency of an index consists of those affected by the decisions taken based on it. How useful it is for the constituency depends on its instrumental value in effectuating the desired outcome and its relevance

to target stakeholders.

The construction of composite indicators involves contested qualitative and subjective decisions, such as variable selection, normalisation, and weighting. While these debates are discussed extensively in the academic literature (e.g., Beccari, 2016; Dobbie & Dail, 2013; Greco et al., 2018; Kwatra et al., 2020;), this paper primarily relies on the OECD (2008) guidelines, which emphasise transparency and robustness in indicator selection and computation. These guidelines are integral to ensuring the credibility of the index.

The existing disagreements in the scientific community do not render the method of composite indicators invalid. Rather, the authors of the OECD (2008) handbook underscore the need for transparency in every step of the construction process to ensure credibility and robustness. This effort involves explaining the rationale behind the methodological choices made, their strengths and weaknesses, and potential trade-offs. Detailed documentation of each step, including data sources, normalisation methods, and weighting schemes, allows for reproducibility in other mitigation strategies. Each step informs the next step and enhances the overall coherence of the composite indicator (OECD, 2008). Plus, making the underlying reasoning for selecting and evaluating the indicators explicit is essential for this study's goal of enhancing informed decision-making based on its results.

4.1 Definitions

According to the OECD (2008), a clearly defined theoretical framework consisting of dimensions that are divided into distinct indicators is the foundation of any composite indicator. The dimensions aim at certain outcomes, called objectives. The objective of a dimension overarches the individual indicators, which form a "basis for evaluation in relation to a given objective" (OECD, 2008, p. 51). These indicators align with the objectives and are expressed through variables that measure a real-world state at a certain point in time. To facilitate the integration of different metrics into a unified framework, all indicators are standardised to make them comparable. While indicators such as political support and public acceptance are already expressed through percentages and do not require further transformation, others-–such as TP, cost-effectiveness, and

demand elasticity—are converted into a standardised scale of 0 to 1 through normalisation. This step uses specific ranges for the respective values, which are explicitly stated in the case study to maintain transparency. This flexible approach ensures that the composite indicator appropriately incorporates all indicators, whether transformed or not (OECD, 2008).

The tripartite framework by Nielsen et al. (2020) purports a clear structure for a composite indicator with its three dimensions, TP, IF, and BP, making it particularly suitable for constructing the FKI. The nested structure within the dimensions IF and BP—composed of the indicators cost-effectiveness (Tavoni & Tol, 2010; Nordhaus, 2017; Hänsel et al., 2020), political support (Steg et al., 2022; Jewell & Cherp, 2019), public acceptance (Steg et al., 2022), and demand elasticity (Nicholson & Snyder, 2007; Roosen et al., 2022)—is created in an effort to quantify the dimensions and provide more specific, operational definitions of the dimensions. These indicators were selected by drawing on authoritative frameworks in climate mitigation research, economics, and other social sciences that closely align with Nielsen et al.'s definition of the three dimensions and their outlined objectives.

According to Nielsen et al. (2020), the objective of TP is to quantify the maximum possible reduction in GHG emissions if a mitigation opportunity is fully realised. For IF, the objective is to evaluate the likelihood that governments or private entities can successfully adopt and effectively implement a mitigation initiative. For BP, the objective is to understand how the target actors will respond to the mitigation initiative and the extent to which they will change their behaviour exactly as intended. These objectives also indicate the desired direction of change (OECD, 2008), which, in this case, is to be maximised—maximising the reduction of GHG emissions, the potential success of adoption and implementation, and the alignment of behavioural changes with the intended response (Stern et al., 2023).

4.2 Criteria for Selecting Mitigation Initiatives

The primary criteria for selecting relevant mitigation strategies for the FKI assessment are a) available empirical quantifications of these strate-

gies, and b) clear links between the strategies and high GHG emissions.

If some indicators are well-substantiated but others lack sufficient evidence, the overall index could still be calculated to examine at least some of a strategy's feasibility. In such cases, lacking or limited indicators will be left blank or filled with proxy variables, similar to Steg et al.'s assessment (2022) and the OECD handbook (2008). While this hampers the direct comparability of mitigation options, an incomplete assessment could still highlight valuable gaps for future research with these omitted or partially assessed factors.

According to Steg et al. (2022), it is sensible to assess the feasibility of mitigation strategies that, first, exhibit a significant capacity for emissions reduction when scaled and, second, are integral to established net-zero plans. For instance, dietary shifts are included in the IPCC (2022, p. 111) and are prevalent strategies in climate policy. These criteria ensure that the mitigation strategies considered are likely to be prioritised by decision-makers in efforts to curb global warming.

5 Case Study: Reducing Meat Consumption in Germany

Dietary considerations offer intriguing case studies for comprehensive mitigation assessments as they involve multiple target actors, such as consumers and supermarkets, and change agents, such as policymakers and farmers. Furthermore, many existing studies (e.g., Bundesanstalt für Landwirtschaft und Ernährung, 2024; Poore & Nemecek, 2018) investigate and quantify different aspects essential for determining the feasibility of dietary mitigation strategies and specific data, even by meat type, are publically available (Food and Agriculture Organization of the United Nations [FAO], 2023). These studies lay a rich foundation enabling an in-depth analysis of the dietary change of reducing meat consumption. I chose Germany for this case study due to the high volume of Germany-specific studies on meat consumption, the free accessibility of nationwide data from, for example, the Federal Ministry of Food and Agriculture, and my ability to read German.

Internationally, empirical research demonstrates the environmental impacts of the meat industry, with climate change being a primary envi-

ronmental externality of livestock farming (Poore & Nemecek, 2018). A substantial portion of emissions in this sector arises from fertiliser use and manure management, leading to nitrous oxide emissions. Additionally, direct land use changes for feed production and energy consumption result in carbon dioxide emissions (Gerber et al., 2013).

Unlike emissions from industries such as transportation and energy, which are likely to decrease with the adoption of renewable fuels and electricity sources, emissions from meat production remain challenging to reduce. Realistically, not all meat consumption can be eliminated, given that meat is a common source of protein in the human diet. Due to cultural and preferential attachments, a certain baseline of meat consumption is likely to persist in society despite mitigation efforts and the increasing popularity of meat substitutes. That is why full eradication of GHG emissions with this mitigation strategy is unlikely. Conversely, fossil fuel vehicles could be fully substituted by electric vehicles, serving as an example of a good that could undergo a full transition.

The level of reduction of meat consumption in this case study aligns with public health recommendations, highlighting the dual advantages for both human well-being and environmental protection. The German Nutrition Society (Deutsche Gesellschaft für Ernährung, 2019) recommends a consumption of 300g of meat per week. According to a World Health Organization report (WHO, 2023), the World Cancer Research Fund-American Institute for Cancer Research suggests under 71 grams of meat per day, while the EAT-Lancet Diet Index advises less than 28 grams per day, totalling 196 grams per week. A reasonably studied threshold along these lines is two meals per week, equalling 240 grams of meat with 120 grams as one portion (Deutsche Gesellschaft für Ernährung, 2024).

The following sections tackle each indicator separately. I describe the studies that form the empirical basis for this case study and evaluate them, addressing the strengths and limitations of their underlying research. This procedure ensures a robust and transparent assessment of the feasibility of reducing meat consumption in Germany.

5.1 TP: Meat Consumption in Germany

For assessing the TP of reducing meat consumption in Germany, readily available data from the

Table 3: External Environmental Costs

	Consumption volume per capita in Germany in kg (2021) (Bundesanstalt für Landwirtschaft und Ernährung, 2024)	**Average environmental external cost in US$ per 1 kg of meat (Funke et al., 2022)**	**GHG emissions per 1 kg of meat (Poore & Nemecek, 2018; Ritchie et al., 2022)**	**External Environmental Cost in US$ per GHG ton**
Sheep and goat	0.571	3.70	39.72	93.15
Beef	10.20	7.46	99.48	74.99
Pig	30.60	1.94	12.31	157.60
Poultry	13.31	1.50	9.87	151.98
Total	54.68			
Weighted average		2.88	40.35	101.94

website Our World in Data proves particularly useful (Ritchie, Rosado, et al., 2023). They source and process data from the Global Carbon Budget (2024) to visualise per capita CO_2 emissions. Our World in Data is a free-access, internationally trusted data distributor; hence, the retrieved datasets are considered highly reliable.

This case study analyses the potential GHG emissions reduction resulting from limiting people's meat consumption to a maximum of two meals per week. This consumption level was chosen to reflect the behavioural change studied by Koch et al. (2021), which provides the empirical basis for assessing the indicator of public acceptance under BP.

Koch et al. (2021) find that 76.1% of non-vegetarians are willing to reduce their consumption to two meals of meat per week. Assuming that people willing to change their behaviour have an average consumption of 1.051 kg of meat per week (Bundesanstalt für Landwirtschaft und Ernährung, 2024), such dietary change represents a decrease of 77.18% in meat intake. Accounting for the vegetarians and vegans in Germany (Bundesministerium für Ernährung und Landwirtschaft, 2021), this reduction in meat consumption in 76.1% of the non-vegetarian population may lead to a decrease of 58.73% of GHG emissions coming from meat consumption. The population data of Germany in the year 2021 comes from Our World in Data by Ritchie, Rodés-Guirao, et al. (2023).

This reduction is adjusted by the consumption matrix of different meat types (see Table 3) for Germans. The total human consumption of meat, comprising the meat types of sheep and goat, beef, pork, and poultry (Bundesanstalt für Landwirtschaft und Ernährung, 2024), was 54.68 kg per capita for 2021. This figure is cross-checked with the FAO's (2023) data published on Our World in Data (2023). Within this yearly sum, pork accounts for most at 55.96%, followed by poultry at 24.35%, beef at 18.65%, and sheep and goat at 1.04%. Other meat types available in the datasets are excluded from this paper due to insufficient data to evaluate these types across all relevant indicators. These other meat types make up only 1.71% of the total human consumption of meat in Germany (Bundesanstalt für Landwirtschaft und Ernährung, 2024).

The total reduction of meat consumption by 58.73% would reduce GHG emissions by 66 million tons of CO_2-equivalents, which amounts to 9.81% of total GHG emissions in Germany. The result is set relative to the global Paris Agreement goal of reducing emissions by 43% by 2030 (UNFCCC, 2023) to enhance its sensitivity to differences between the impacts of various mitigation initiatives. Computing this value by positioning the impact relative to the 2030 goal leads to a final result of 0.2282 for TP. This global goal facilitates comparison between countries, even though some countries have more ambitious goals than others. For instance,

Germany has set a target to lower its overall emissions by 55% by 2030 (Press and Information Office of the Federal Government, 2024).

5.2 IF: Meat Consumption in Germany

5.2.1 Cost-Effectiveness

The cost-effectiveness of reducing meat consumption in Germany is evaluated using external environmental cost savings per ton of GHG reduced. This assessment leverages data from studies by Funke et al. (2022), and Poore and Nemecek (2018), processed on Our World in Data by Ritchie et al. (2022).

The primary metric used in this case study is the total average global environmental external cost of meat. Funke et al. (2022) find that the lower bound for this cost is between "US\$5.75-US\$9.17 per kilogram for beef (depending on the production of dairy by-products), US\$3.70 per kilogram for lamb and mutton, US\$1.94 per kilogram for pork, and US\$1.50 per kilogram for poultry" (p. 224). Funke et al.'s category of lamb and mutton is combined with Ritchie et al.'s (2022) category of sheep and goat. Weighted by the consumption matrix from Bundesanstalt für Landwirtschaft und Ernährung (2024), the average environmental cost of meat in Germany is US\$2.88 per kilogram.

Using the GHG emissions per kilogram for each meat type from Ritchie et al. (2022) and adjusting by the consumption matrix for Germans (Bundesanstalt für Landwirtschaft und Ernährung, 2024), the average environmental external cost of per capita meat consumption in Germany was US\$101.94 or €94.27 per ton of GHG in 2021 (see Table 3).

This value can be normalised with the minimum-maximum formula (1) from the OECD (2008) handbook. The range is based on the SCC, with a lower bound of US\$44 and an upper bound of US\$185 per ton. These thresholds are substantiated in Rennert et al.'s review (2022) of DICE calculations. The application of this formula results in a normalised value for cost-effectiveness of approximately 0.4109.

$$Normalised\ Value = \frac{Actual\ Cost - Min\ Value}{Max\ Value - Min\ Value} \qquad (1)$$

The two articles by Funke et al. (2022) and

Ritchie et al. (2022) used for this assessment refer to the robust empirical evidence of the connection between animal protein production and environmental effects established by Poore & Nemecek (2018). However, there are some limitations to be considered. Funke et al. provide average global cost estimates, but the focus on global averages may not fully capture Germany-specific differences. Furthermore, due to limited data, the study does not consider external costs resulting from the negative effects of meat production on human health through air pollution or biodiversity loss. Moreover, Ritchie et al. offer detailed emissions data, which are crucial for precise calculations, but their underlying data, sourced from the meta-analysis by Poore & Nemecek, relies on studies with a median reference year of 2010. In recent years, production practices are likely to have become more carbon efficient and environmentally friendly, which could potentially render some of Poore & Nemecek's and Ritchie et al.'s data on the GHG emissions per kg of meat outdated.

5.2.2 Political Support

Given the wide variety of political systems worldwide, it may be challenging to conduct surveys on policy support that produce comparable results, especially in non-democratic countries. This indicator is ideally assessed on a country- and policy-specific level to accurately account for different kinds of political backing required for the successful adoption and implementation of a mitigation strategy.

In a systematic literature review on meat consumption intervention effectiveness, Kwasny et al. (2022) identify a range of studies examining personal and public factors surrounding meat consumption patterns. For instance, Whitley et al. (2017) investigate public receptiveness to policies promoting plant-based diets and the framing effects of such policies in the USA, offering insights into political support. However, their findings may not directly apply to this case study due to cultural differences between the USA and Germany.

Perino & Schwickert (2023) conducted a comprehensive study in Germany, aiming to unveil the drivers behind support for different levels of a meat tax. They consulted a representative sample of 2,855 German adults through an online referendum choice experiment. These participants knew that

the results would be shared with German politicians working on environmental and agricultural policy, which increased the consequentiality of the experimental design. With this anthropocentric research design, the authors only examined the preferences and values of the respondents and no other economic validity or normative concerns. The tested tax levels ranged from €0.19 kg^{-1}, equivalent to a carbon price of €25 t^{-1} CO2, to €1.56 kg^{-1}, equivalent to €200 t^{-1} CO2.

They find a 62% support rate at the lowest tax level, with the percentage of votes monotonically decreasing by 2.6 percentage points (-2.49 pp, -2.78 pp with a 95% confidence interval) for every €0.10 kg^{-1} raise in the proposed tax rate on meat. These results are especially suited for this case study because Perino & Schwickert's (2023) study focuses on a random, representative sample of the German population. Their findings might also help to fill data gaps for political support in countries with similar political systems, cultural preferences, and meat consumption patterns, such as Austria, because referendum choice experiments are externally valid (Vossler et al., 2003; Johnston, 2006).

Given that Perino & Schwickert (2023) provide a scale of political support for varying tax levels, the examined level of support in this case study aligns with the calculated value for cost-effectiveness. I examine the political support for Perino & Schwickert's set carbon price of €100, which corresponds to a tax level of €0.78 kg^{-1}. This value is reasonably close to the external environmental cost of meat consumption of US\$101.94 or €94.20 per capita. According to Perino & Schwickert's results, 45.6% of the German population would support this tax level. The result for this indicator does not need to be normalised as it represents the percentage of people expressing support for a policy. The alignment of the carbon price and the external environmental cost is crucial because it ensures an accurate reflection of political support for a specific policy that aligns with the value of the external environmental costs of meat production.

5.3 BP: Meat Consumption in Germany

5.3.1 Public Acceptance

Under the BP dimension, public acceptance can be examined through Koch et al.'s (2021) comprehensive study with 1807 participants aged 20 to 80 years on attitudes, behaviours, and perceptions regarding meat consumption in Germany. This study analyses data on consumption patterns collected through interviews in 2012/13.

As mentioned earlier in the TP section, Koch et al. (2021) examined public acceptance of changing consumption patterns among non-vegetarians and found that 76.1% of participants are willing to reduce their meat consumption to two meals per week. Since this figure represents a percentage value, it does not need to be normalised for the index, resulting in a value of 0.761. This high level of public acceptance is indicative of a strong behavioural plasticity for this mitigation strategy.

The results from Koch et al. (2021) warrant caution, as the data stems from 2012/13 and may be outdated. In the past years, perceptions of meat consumption and the willingness to resort to alternative forms of protein have likely increased, given that the proportion of vegans and vegetarians in Germany has also risen (Bundesministerium für Ernährung und Landwirtschaft, 2021). Therefore, current studies might find higher levels of public acceptance than the one examined in this assessment.

5.3.2 Demand Elasticity

Integrating the demand elasticity results from Roosen et al. (2022) into the index computation offers insights into consumer responsiveness to price changes. To illustrate, Roosen et al. show that the uncompensated price elasticity of -0.960 for beef implies that a 1% increase in the price of beef leads to a 0.96% reduction in the quantity demanded, assuming no compensation for income changes.

Roosen et al.'s (2022) study uses data collected from the ConsumerScan FreshFood panel, managed by GfK in Nuremberg, Germany. This dataset comprises a nationally representative sample of German households who record their purchases and provide the information to GfK. The study examines data on quantities purchased and expenditures for fresh meat from 21,656 households between 2012 and 2014. However, its data may be outdated and may not fully capture current consumer preferences and market conditions. Additionally, the focus on fresh meat excludes processed meat and out-of-home consumption, which could lead to underestimating overall meat demand and the full impact of price changes. Despite

Table 4: Price Elasticities of Demand in Germany (Roosen et al., 2022)

	Consumption volume per capita in Germany in kg (2021) (%)	Uncompensated price elasticities
Sheep and goat	0.571 (1.04)	-0.929
Beef	10.20 (18.65)	-0.960
Pig	30.60 (55.96)	-0.966
Poultry	13.31 (24.35)	-0.861
Total	54.68	
Weighted average		-0.939
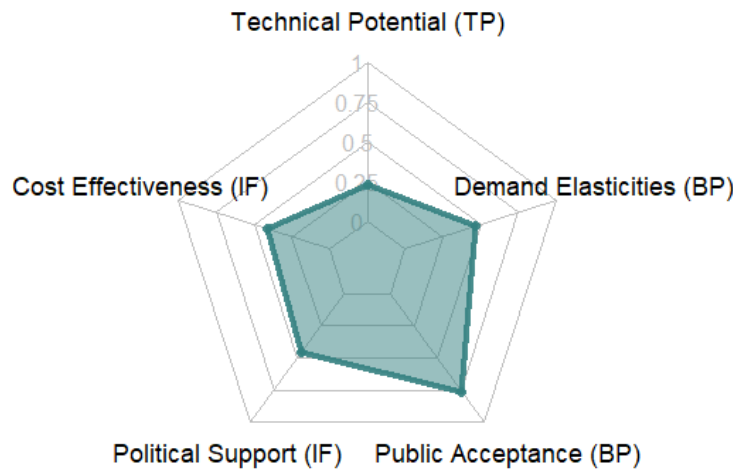
Figure 1: Radar chart visualising the FKI for the case study.

these limitations, the study is relevant to this case study due to its robust methodology and specific focus on German households.

To calculate the score for the demand elasticity, I use the reported uncompensated price elasticity results for different meat categories and combine them into a single score by computing the weighted average based on the consumption matrix for Germans in 2021 (Bundesanstalt für Landwirtschaft und Ernährung, 2024; see Table 4). The value for the category "sheep and goat" is not accounted for by Roosen et al. (2022) but is imputed in the indicator by using the average elasticities from the other meat types. Roosen et al.'s "meat mixtures" category is omitted in this case study because it does not align with any category studied in the other indicators.

$$Normalised\ Value = 1 - \frac{Uncompensated\ Price\ Elasticity - Min\ Value}{Max\ Value - Min\ Value} \quad (2)$$

The elasticity score is normalised using the inverse of the minimum-maximum function (2) (OECD, 2008), resulting in 0.4695. In this inverse function, the minimum value is -2, representing very high elasticity, and the maximum value is 0 because elasticity cannot be positive. This value is then subtracted from 1 because a lower elasticity (below -1) is more desirable as it indicates higher demand changes based on price changes. Hence, the lower the value of demand elasticity, the more elastic the good is, resulting in a greater impact on the overall index. In other words, a value closer to zero, i.e., a low elasticity, implies that price-based interventions might not be very effective for lowering meat consumption. Consumers might continue to buy meat even if prices increase, which would require higher tax rates to achieve the desired reduction in consumption and a concomitant reduction of GHG emissions.

Table 5: Index of Reducing Meat Consumption in Germany.

	Dimension	**Indicator**	**Weight**	**Value**	**Normalised**
Percentage	TP		0.20	9.81	0.288
US$ per ton of GHG	IF	Cost-Effectiveness	0.20	101.94	0.411
Percentage		Political Support	0.20	45.6	0.456
Percentage	BP	Public Acceptance	0.20	76.1	0.761
Elasticity Ratio		Demand Elasticities	0.20	-0.939	0.469
Aggregated Result					0.465

5.4 End Results

In summary, Table 5 presents the indicators from all three dimensions and their respective normalised values. The aggregated index score of 0.4651 indicates that the feasibility of reducing meat consumption in Germany is moderate. Each dimension contributes significantly, with behavioural plasticity having the highest impact due to strong public acceptance. This case study illustrates how the FKI assessment can be applied to a mitigation initiative, integrating technical, political, and behavioural factors.

6 Discussion

This paper demonstrates the utility of Nielsen et al.'s (2020) tripartite framework for assessing the feasibility of climate mitigation strategies. My research augments this framework with two indicators from Steg et al. (2022), political support and public acceptance, and two widely used economic indicators, cost-effectiveness and demand elasticity. By quantifying the dimensions of TP, IF, and BP through a composite indicator called FKI, the framework provides a comprehensive assessment of reducing meat consumption as a case study, integrating technical, sociopolitical, and behavioural factors. In the following sections, I first discuss the results and their contextual challenges. Second, I analyse the strengths and limitations of the FKI as an assessment of different mitigation initiatives and a tool for comparing them.

6.1 Analysis of the Results and Contextual Challenges

In this subsection, I discuss the significance of each dimension and its indicators. I also examine what the intensity of an indicator implies for overall mitigation feasibility and effectiveness, alongside potential barriers.

In the first dimension, TP, the observed result indicates that reducing meat consumption in Germany could lead to significant GHG reductions, quantified at 9.81% of total emissions in Germany. This high value aligns with previous research on the enormous environmental effects of the food system, including studies by Kwasny et al. (2022) and Poore & Nemecek (2018). The robust empirical basis provided by sources like the Global Carbon Budget (2024), Our World in Data (Ritchie, Rosado, et al., 2023), the FAO (2023), and national inventories (Bundesanstalt für Landwirtschaft und Ernährung, 2024; Bundesministerium für Ernährung und Landwirtschaft, 2021) supports the reliability of this finding. A high TP score, signalling significant GHG reduction potential, could compensate for weaker values in the other dimensions. For instance, a strong TP result might counterbalance the greater efforts needed to improve the IF and BP scores of a mitigation strategy and, consequently, persuade decision-makers to prioritise a particular strategy.

However, the result in TP is contingent on the accuracy of the emission inventories and consumption data used. GHG emission inventories are especially contested due to inconsistent approaches and data limitations, as evidenced by Boswell et al. (2010) and Bajželj et al. (2013). These peer-reviewed articles underscore that coherent and standardised GHG inventories are indispensable for creating and adopting accurate measures. Hence,

the availability of robust data on GHG emissions underpins the assessment of TP.

The second dimension, IF, which shifts focus from technical aspects to the economic and political feasibility of adopting and implementing a strategy, reveals moderate results. In cost-effectiveness, the external environmental cost of meat is close to the median in the range of a SCC of US$44 to US$185 (Rennert et al., 2022). At US$101.94, the cost of meat consumption is considerable and indicates the amount of economic savings that could be achieved by preventing damages associated with meat consumption. A higher external cost would indicate even more savings and prevented damages, which might help gather more political backing among policy-makers and the general population for an initiative.

Similarly, political support for a carbon tax on meat consumption is relatively moderate, with 45.6% of the German population in favour of a €0.78 kg^{-1} tax level (Perino & Schwickert, 2023). This level of support, while significant, suggests potential challenges in policy adoption and implementation, especially since it is below the majority threshold in democratic countries.

The third dimension, BP, has the highest impact on the feasibility index among the three dimensions. A normalised value of 0.761 for public acceptance suggests a considerable fraction of the German population is open to decreasing their meat intake to two meals per week. This finding reflects widespread responsiveness to the dietary changes intended by the mitigation strategy. However, it is crucial to note that eating patterns are highly habituative, which could pose challenges to sustained behaviour change. Conversely, meat consumption is not an isolated behaviour, as social perceptions of a certain acceptable level of consumption could influence individual preferences. Therefore, a high level of public acceptance of a mitigation initiative could generate ripple effects through social pressure and ultimately accelerate the intended behaviour changes. Such a scenario would make a mitigation strategy even more feasible and effective at reducing environmental harm.

The observed demand elasticity of -0.939, normalised to 0.4694 for the index aggregation, shows that meat products are not highly elastic goods, which might be due to cultural norms, personal preferences, or habitual tendencies that override economic incentives like price changes. This find-

ing suggests that additional or alternative measures, such as public awareness campaigns, might be necessary to achieve the desired mitigation outcomes. However, if the demand for meat were highly elastic, significant price increases from policies like taxation would likely lead to intended behavioural changes, such as substantial reductions in meat consumption. This scenario indicates that price-based policies like taxes are effective in reducing consumption and GHG emissions.

6.2   Strengths and Limitations

This paper leverages a robust methodological framework by integrating technical, sociopolitical, and behavioural dimensions to assess the feasibility of mitigation strategies comprehensively. By employing a systematic index, it provides a quantitative baseline that facilitates the comparison of different mitigation options and informs policy-makers. The focus on detailed, empirical data specific to Germany allows for a country- and context-specific understanding. Further research can build on this insight to identify barriers and enablers unique to Germany.

However, the study operates under several assumptions, such as the relevance of empirical data from the 2010s and the validity of findings across contexts. The reliance on available data may not fully capture recent trends or regional variations in meat consumption and GHG emissions. While the focus on Germany demonstrates the FKI assessment for a specific case, it limits the generalisability of the findings to other countries with different cultural and dietary practices.

Furthermore, interrelationships between the indicators and dimensions, especially between political support under IF and public acceptance under BP, could skew the assessment in ways that the FKI does not fully capture. The index is unable to account for interactions between the dimensions, which IAMs are designed to do (Keppo et al., 2021). Thus, IAMs might be better suited for studies that focus on investigating the dynamics between sociopolitical and behavioural factors.

In addition, a limitation of this study is the absence of substitute effects, which account for how changes in one behaviour may lead to compensatory actions elsewhere, potentially diminishing the overall impact of a mitigation strategy. Expanding the index to include these effects would provide

a more comprehensive assessment of demand-side mitigation strategies. Another shortcoming lies in the limited consideration of demographic and psychological variables, which are critical for effective policy framing and ensuring the acceptance and longevity of mitigation initiatives (Whitley et al., 2017). Future research should address this gap by incorporating both quantitative and qualitative methods to better understand IF and BP dynamics.

Moreover, the indicators of political support and public acceptance are difficult to quantify as they observe very subjective judgements and perceptions of mitigation initiatives. These challenges might result in oversimplification or inaccuracy. To mitigate these caveats, qualitative discussions that gauge different perspectives on these strategies might offer additional insights.

Ultimately, this paper applies the FKI to only one mitigation initiative due to its limited scope. This limitation somewhat restricts the proper implementation of the OECD (2008) methodology, which typically requires data from multiple initiatives. Therefore, future research should apply the FKI assessment to a range of mitigation strategies to effectively compare them and ensure full alignment with the OECD approach. Additionally, studies should explore the applicability of the index across national jurisdictions by applying it to the same mitigation strategy for several countries. These approaches would expand the index's relevance to diverse geographical, social, and cultural contexts and improve its predictive accuracy of climate policy success.

7 Conclusion

This paper introduces the Feasibility Klima Index (FKI), a comprehensive tool that operationalises Nielsen et al.'s (2020) framework by integrating technical potential (TP), initiative feasibility (IF), and behavioural plasticity (BP) into a detailed and systematic assessment of mitigation initiatives. Applying the FKI to reducing meat consumption in Germany as a case study demonstrates how this composite indicator provides evaluations beyond traditional technical analyses. In essence, this research offers a dual contribution: first, it provides researchers with a practical tool to assess the achievability of initiatives with high granularity, thereby enabling them to enhance the predictive

accuracy of policies; second, it offers policy-makers a benchmark to compare and prioritise mitigation strategies, allowing for more effective responses to the climate crisis.

Trust and accountability constitute the cohesive fabric underpinning successful climate action. They are vital for ensuring truthful GHG inventories to accurately gauge the TP of initiatives; for fostering belief that policy-makers act in the best interests of people and the planet; and for providing assurance that target actors enact intended changes. However, if emissions continue to rise and commitments to climate action—such as those outlined in the Paris Agreement (Visser et al., 2018)—are broken, both decision-makers and researchers risk eroding public trust. This erosion may be detrimental to tackling climate change, as trust significantly influences the interplay between public support, political commitment, and institutional capacity. To elucidate these dynamics, future research should integrate insights from political science, legal analysis, economics, and the behavioural sciences, examining governance structures, market dynamics, and sociological factors. Such interdisciplinary efforts would allow stakeholders to further contextualise feasibility analyses and investigate the interdependencies between the dimensions IF and BP.

In closing, while this paper concentrates on climate mitigation, escalating environmental impacts underscore the necessity for complementary adaptation efforts. Researchers and policy-makers should not focus solely on mitigation, since global warming is already causing disruptions to ecosystems and societies (IPCC, 2023). Emerging issues, such as food insecurity due to crop failures, highlight the need to adapt to the current climate even as we strive to prevent future damages through mitigation. Addressing the multi-layered challenges of both climate mitigation and adaptation demands decisive, integrated action; only when researchers ensure accountability and decision-makers embrace responsibility can we foster the trust essential for securing a viable future.

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8 References

Bajželj, B., Allwood, J. M., & Cullen, J. M. (2013). Designing Climate Change Mitigation Plans That Add Up. *Environmental Science & Technology, 47*(14), 8062–8069. https://doi.org/10.1021/es400399h

Beccari, B. (2016). A Comparative Analysis of Disaster Risk, Vulnerability and Resilience Composite Indicators. *PLoS Currents, 14*(8). https://doi.org/10.1371/currents.dis.453df025e34b682e9737f95070f9b970

Boswell, M. R., Greve, A. I., & Seale, T. L. (2010). An Assessment of the Link Between Greenhouse Gas Emissions Inventories and Climate Action Plans. *Journal of the American Planning Association, 76*(4), 451–462. https://doi.org/10.1080/01944363.2010.503313

Bundesanstalt für Landwirtschaft und Ernährung. (2024, April 4). *BLE - Fleisch - Fleisch und Geflügel: Versorgung mit Fleisch in Deutschland im Kalenderjahr 2010-2023 (Neuberechnung).* www.ble.de.https://www.ble.de/DE/BZL/Daten-Berichte/Fleisch/fleisch.html

Bundesministerium für Ernährung und Landwirtschaft. (2021). *Deutschland, wie es isst - der BMEL-Ernährungsreport 2021.* BMEL. https://www.bmel.de/DE/themen/ernaehrung/ernaehrungsreport2021.html

Carattini, S., Kallbekken, S., & Orlov, A. (2019). How to Win Public Support for a Global Carbon Tax. *Nature, 565*(7739), 289–291. https://doi.org/10.1038/d41586-019-00124-x

Creutzig, F., Roy, J., Lamb, W. F., Azevedo, I. M. L., Bruine de Bruin, W., Dalkmann, H., Edelenbosch, O. Y., Geels, F. W., Grubler, A., Hepburn, C., Hertwich, E. G., Khosla, R., Mattauch, L., Minx, J. C., Ramakrishnan, A., Rao, N. D., Steinberger, J. K., Tavoni, M., Ürge-Vorsatz, D., & Weber, E. U. (2018). Towards Demand-Side Solutions for Mitigating Climate Change. *Nature Climate Change, 8*(4), 260–263. https://doi.org/10.1038/s41558-018-0121-1

Deutsche Gesellschaft für Ernährung. (2019). *Die Aussagen der NutriRECS Experten zum Verzehr von rotem und verarbeitetem Fleisch.* DGE. https://www.dge.de/wissenschaft/fachinformationen/die-aussagen-der

-nutrirecs-zum-verzehr-von-fleisch/#:~:
text=(DGE)%20empfiehlt%20als%20Teil%
20der

Deutsche Gesellschaft für Ernährung. (2024). *DGE-Ernährungskreis.* DGE. https://www.dge.de/gesunde-ernaehrung/gut-essen-und-trinken/dge-ernaehrungskreis/

Dietz, T., Ostrom, E., & Stern, P. (2003). The Struggle to Govern the Commons. *Science, 302*(5652), 1907–1912. https://doi.org/10.1126/science.1091015

Dobbie, M. J., & Dail, D. (2013). Robustness and Sensitivity of Weighting and Aggregation in Constructing Composite Indices. *Ecological Indicators, 29,* 270–277. https://doi.org/10.1016/j.ecolind.2012.12.025

European Union. (2020). *Long-Term Low Greenhouse Gas Emission Development Strategy of the European Union and Its Member States.* UNFCC. https://unfccc.int/documents/210328

Food and Agriculture Organization of the United Nations. (2023). *Per Capita Meat Consumption by Type. Our World in Data.* Our World in Data. https://ourworldindata.org/grapher/per-capita-meat-consumption-by-type-kilograms-per-year

Funke, F., Mattauch, L., Bijgaart, I. van den, Godfray, H. C. J., Hepburn, C., Klenert, D., Springmann, M., & Treich, N. (2022). Toward Optimal Meat Pricing: Is It Time to Tax Meat Consumption? Review of Environmental Economics and Policy, 16(2), 219–240. https://doi.org/10.1086/721078

Gerber, P. J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., Falcucci, A., & Tempio, G. (2013). *Tackling Climate Change through Livestock. A Global Assessment of Emissions and Mitigation Opportunities.* Food and Agriculture Organization of the United Nations (FAO). https://www.fao.org/policy-support/tools-and-publications/resources-details/en/c/1235389/

Global Carbon Budget (2024); Population based on various sources (2024) – with major processing by Our World in Data. "Annual CO_2 emissions (per capita) – GCB" [dataset]. Global Carbon Project, "Global Carbon Budget"; Various sources, "Population" [original data]. https://ourworldindata.org/co2-and-greenhouse-gas-emissions

Greco, S., Ishizaka, A., Tasiou, M., & Torrisi, G. (2018). On the Methodological Framework of Composite Indices: A Review of the Issues of Weighting, Aggregation, and Robustness. *Social Indicators Research, 141*(1), 61–94. https://doi.org/10.1007/s11205-017-1832-9

Hänsel, M. C., Drupp, M. A., Johansson, D. J. A., Nesje, F., Azar, C., Freeman, M. C., Groom, B., & Sterner, T. (2020). Climate Economics Support for the UN Climate Targets. *Nature Climate Change, 10,* 781–789. https://doi.org/10.1038/s41558-020-0833-x

Intergovernmental Panel on Climate Change. (2014). Climate Change 2014 Synthesis Report. https://www.ipcc.ch/site/assets/uploads/2018/05/SYR_AR5_FINAL_full_wcover.pdf

Intergovernmental Panel on Climate Change. (2018). *Summary for Policymakers — Global Warming of 1.5 oC.* IPCC. https://www.ipcc.ch/sr15/chapter/spm/

Intergovernmental Panel on Climate Change. (2022). *Climate Change 2022 - Mitigation of Climate Change: Working Group III Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* In P. R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, & R. Fradera, et al. (Eds.), Cambridge University Press. Cambridge University Press. https://www.cambridge.org/core/books/climate-change-2022-mitigation-of-climate-change/2929481A59B59C57C743A79420A2F9FF

Intergovernmental Panel on Climate Change. (2023). Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (pp. 35–115). IPCC. https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_LongerReport.pdf

Jewell, J., & Cherp, A. (2019). On the Political Feasibility of Climate Change Mitigation Pathways: Is It Too Late to Keep Warming Below 1.5°C?. *Wiley Interdisciplinary Reviews: Climate Change, 11*(1). https://doi.org/10.1002/wcc.621

Johnston, R. J. (2006). Is Hypothetical Bias Universal? Validating Contingent Valuation Re-

sponses Using a Binding Public Referendum. *Journal of Environmental Economics and Management, 52*(1), 469–481. https://doi.org/10.1016/j.jeem.2005.12.003

Keppo, I., Butnar, I., Bauer, N., Caspani, M., Edelenbosch, O., Emmerling, J., Fragkos, P., Guivarch, C., Harmsen, M., Lefèvre, J., Le Gallic, T., Leimbach, M., McDowall, W., Mercure, J-F., Schaeffer, R., Trutnevyte, E., & Wagner, F. (2021). Exploring the Possibility Space: Taking Stock of the Diverse Capabilities and Gaps in Integrated Assessment Models. *Environmental Research Letters, 16*(5), 053006. https://doi.org/10.1088/1748-9326/abe5d8

Koch, F., Krems, C., Heuer, T., & Claupein, E. (2021). Attitudes, Perceptions and Behaviours Regarding Meat Consumption in Germany: Results of the NEMONIT Study. *Journal of Nutritional Science, 10*(39). https://doi.org/10.1017/jns.2021.34

Krey, V. (2014). Global Energy-Climate Scenarios and Models: A Review. *Wiley Interdisciplinary Reviews: Energy and Environment, 3*(4), 363–383. https://doi.org/10.1002/wene.98

Kwasny, T., Dobernig, K., & Riefler, P. (2022). Towards Reduced Meat Consumption: A Systematic Literature Review of Intervention Effectiveness. *Appetite, 168,* 105739. https://doi.org/10.1016/j.appet.2021.105739

Kwatra, S., Kumar, A., & Sharma, P. (2020). A Critical Review of Studies Related to Construction and Computation of Sustainable Development Indices. *Ecological Indicators, 112*, 106061. https://doi.org/10.1016/j.ecolind.2019.106061

Loughlin, D. H., Benjey, W. G., & Nolte, C. G. (2011). ESP v1.0: Methodology for Exploring Emission Impacts of Future Scenarios in the United States. *Geoscientific Model Development, 4*(2), 287–297. https://doi.org/10.5194/gmd-4-287-2011

McCoy, J., Rahman, T., & Somer, M. (2018). Polarization and the Global Crisis of Democracy: Common Patterns, Dynamics, and Pernicious Consequences for Democratic Polities. *American Behavioral Scientist, 62*(1), 16–42. https://doi.org/10.1177/0002764218759576

Nicholson, W., & Snyder, C. M. (2007). Microeconomic Theory. Basic Principles and Extensions. South Western Educational Publishing.

Nielsen, K. S., Stern, P. C., Dietz, T., Gilligan, J. M., van Vuuren, D. P., Figueroa, M. J., Folke, C., Gwozdz, W., Ivanova, D., Reisch, L. A., Vandenbergh, M. P., Wolske, K. S., & Wood, R. (2020). Improving Climate Change Mitigation Analysis: A Framework for Examining Feasibility. *One Earth, 3*(3), 325–336. https://doi.org/10.1016/j.oneear.2020.08.007

Nordhaus, W. D. (1992). The "Dice" Model: Background and Structure of a Dynamic Integrated Climate-Economy Model of the Economics of Global Warming. *Cowles Foundation Discussion Papers, 1252*. https://elischolar.library.yale.edu/cowles-discussion-paper-series/1252/

Nordhaus, W. D. (2008). *A Question of Balance: Weighing the Options on Global Warming Policies.* Yale University Press. https://ebookcentral-proquest-com.proxy.uba.uva.nl/lib/uvanl/detail.action?pq-origsite=primo&docID=3420417

Nordhaus, W. D. (2017). Evolution of Modeling of the Economics of Global Warming: Changes in the Dice Model, 1992-2017. *Climatic Change, 148*(4), 623–640. https://doi.org/10.1007/s10584-018-2218-y

Organisation for Economic Co-operation and Development. (2008). Handbook on Constructing Composite Indicators: Methodology and User Guide. OECD Publishing. https://doi-org.proxy.uba.uva.nl/10.1787/9789264043466-en

Pacala, S., & Socolow, R. (2004). Stabilization Wedges: Solving the Climate Problem for the Next 50 Years with Current Technologies. *Science, 305*(5686), 968–972. https://doi.org/10.1126/science.1100103

Perino, G., & Schwickert, H. (2023). Animal Welfare is a Stronger Determinant of Public Support for Meat Taxation than Climate Change Mitigation in Germany. *Nature Food, 4*(2), 160–169. https://doi.org/10.1038/s43016-023-00696-y

Poore, J., & Nemecek, T. (2018). Reducing Food's Environmental Impacts through Producers and Consumers. *Science, 360*(6392), 987–992. https://doi.org/10.1126/science.aaq0216

Press and Information Office of the Federal Government. (2024). *Climate Action Programme 2030.* Die Bundesregierung. https://www.bundesregierung.de/breg-en/issues/climate-action

Rennert, K., Errickson, F., Prest, B. C., Rennels, L., Newell, R. G., Pizer, W., Kingdon, C., Wingenroth, J., Cooke, R., Parthum, B., Smith, D., Cromar, K., Diaz, D., Moore, F. C., Müller, U. K., Plevin, R. J., Raftery, A. E., Ševčíková, H., Sheets, H., & Stock, J. H. (2022). Comprehensive Evidence Implies a Higher Social Cost of CO2. *Nature, 610*(687–692). https://doi.org/10.1038/s41586-022-05224-9

Ritchie, H., Rodés-Guirao, L., Mathieu, E., Gerber, M., Ortiz-Ospina, E., Hasell, J., & Roser, M. (2023). *"Population Growth". Data adapted from PBL Netherlands Environmental Assessment Agency, Gapminder, United Nations.* Our World in Data. https://ourworldindata.org/grapher/population

Ritchie, H., Rosado, P., & Roser, M. (2023). *CO2 and Greenhouse Gas Emissions.* Our World in Data. https://ourworldindata.org/co2-and-greenhouse-gas-emissions

Ritchie, H., Roser, M., & Rosado, P. (2022). *Environmental Impacts of Food Production.* Our World in Data. https://ourworldindata.org/environmental-impacts-of-food

Roosen, J., Staudigel, M., & Rahbauer, S. (2022). Demand Elasticities for Fresh Meat and Welfare Effects of Meat Taxes in Germany. *Food Policy, 106,* 102194. https://doi.org/10.1016/j.foodpol.2021.102194

skigh_tv. 2022. *Group of People Doing a Demonstration on Global Climate and Environmental Issues* [Photograph], https://www.pexels.com/photo/group-of-people-doing-a-demonstration-on-global-climate-and-environmental-issues-12111230/

Steg, L., Veldstra, J., de Kleijne, K., Kılkış, Ş., Lucena, A. F. P., Nilsson, L. J., Sugiyama, M., Smith, P., Tavoni, M., de Coninck, H., van Diemen, R., Renforth, P., Mirasgedis, S., Nemet, G., Görsch, R., Muri, H., Bertoldi, P., Cabeza, L. F., Mata, É., & Novikova, A. (2022). A Method to Identify Barriers to and Enablers of Implementing Climate Change Mitigation Options. *One Earth, 5*(11), 1216–1227. https://doi.org/10.1016/j.oneear.2022.10.007

Stern, P. C., Dietz, T., Nielsen, K. S., Peng, W., & Vandenbergh, M. P. (2023). Feasible Climate Mitigation. *Nature Climate Change, 13*(6-8). https://doi.org/10.1038/s41558-022-01563-7

Stoddard, I., Anderson, K., Capstick, S., Carton, W., Depledge, J., Facer, K., Gough, C., Hache, F., Hoolohan, C., Hultman, M., Hällström, N., Kartha, S., Klinsky, S., Kuchler, M., Lövbrand, E., Nasiritousi, N., Newell, P., Peters, G. P., Sokona, Y., & Stirling, A. (2021). Three Decades of Climate Mitigation: Why Haven't We Bent the Global Emissions Curve?. *Annual Review of Environment and Resources, 46*(1). https://doi.org/10.1146/annurev-environ-012220-011104

Tavoni, M., & Tol, R. S. J. (2010). Counting Only the Hits? The Risk of Underestimating the Costs of Stringent Climate Policy. *Climatic Change, 100*(3-4), 769–778. https://doi.org/10.1007/s10584-010-9867-9

United Nations Environment Programme. (2023). *Emissions Gap Report 2023: Broken Record – Temperatures Hit New Highs, Yet World Fails to Cut Emissions (Again).* https://doi.org/10.59117/20.500.11822/43922

United Nations Framework Convention on Climate Change. (2023). The Paris Agreement. UNFCCC. https://unfccc.int/process-and-meetings/the-paris-agreement#:~:text=To%20limit%20global%20warming%20to%201.5%C2%B0C%2C%20greenhouse%20gas

United States Department of State, & United States Executive Office of the President. (2021). *The Long-Term Strategy of the United States: Pathways to Net-Zero Greenhouse Gas Emissions by 2050.* United States Department of State and the United States Executive Office of the President. https://www.whitehouse.gov/wp-content/uploads/2021/10/US-Long-Term-Strategy.pdf

Visser, H., Dangendorf, S., van Vuuren, D. P., Bregman, B., & Petersen, A. C. (2018). Signal Detection in Global Mean Temperatures After "Paris": An Uncertainty and Sensitivity Analysis. *Climate of the Past, 14*(2), 139–155. https://doi.org/10.5194/cp-14-139-2018

Vossler, C. A., Kerkvliet, J., Polasky, S., & Gainutdinova, O. (2003). Externally Validating Con-

tingent Valuation: An Open-Space Survey and Referendum in Corvallis, Oregon. *Journal of Economic Behavior & Organization, 51*(2), 261–277. https://doi.org/10.1016/s0167-2681(02)00097-5

Whitley, C. T., Gunderson, R., & Charters, M. (2017). Public Receptiveness to Policies Promoting Plant-Based Diets: Framing Effects and Social Psychological and Structural Influences. *Journal of Environmental Policy & Planning, 20*(1), 45–63. https://doi.org/10.1080/1523908x.2017.1304817

World Health Organization. (2023). *Red and Processed Meat in the Context of Health and the Environment.* https://iris.who.int/bitstream/handle/10665/370775/9789240074828-eng.pdf?sequence=1

Humanities

Towards a Decolonial Exhibition Space:

The Refusal of Imperial Visuality Through Sensorial Engagement in Exhibitions by Ernesto Neto and Maria Nepomuceno

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Abstract

   This paper considers two solo exhibitions in São Paulo by Brazilian installation artists Ernesto Neto and Maria Nepomuceno. Contrary to usual ways of experiencing artworks, where the visitor is demanded to keep their distance, contemplate and "master," these artists encourage us to engage differently. By using many textures, textiles and local materials, they ask us to sense and interact with their artworks. Although these artworks have been previously discussed as sources of sensorial exploration that oppose the dominant visual mode of engagement, in this paper I will argue that this different sensorium they provide us with should also be seen as a refusal of the colonial thought that has perpetuated the primacy of vision since early modernity. In an interview Ariella Aïsha Azoulay argues, "if the colonial injunction of morality is to look, the anti-colonial one is to look for the truth" (Azoulay & Dimitrakaki, 2024). For this reason, I offer a reading method based on the politics of refusal, phenomenology and the practice of queering to show that multisensorial exploration offers the potential to displace imperial visuality and to decolonize the exhibition space. Through this theoretical framework, I also demonstrate that vision is resignified and reclaimed altogether with the other senses. Overall, I argue that Neto's and Nepomuceno's artworks disrupt common ways of being and offer us the possibility to "redistribute the sensible," thus claiming exhibition spaces as ones that refuse the hierarchization of the senses and, by extension, of bodies and of the world.

 Keywords and phrases:*Brazilian installation art, decoloniality, the senses, queering, refusal, imperial visuality*

Contents

1 Introduction

It was not long ago that I began to question and resent my own inability to sense and feel the materiality of artworks displayed at exhibition spaces around the world. Working at a cultural space and thus, for the first time, touching objects that all the visitors were supposed to maintain a "safe" distance from, I recognized the artificiality of institutional rules and regulations. These rules determine the ways in which exhibition spaces require visitors to interact, or better said, to not interact with their artworks, privileging sight over other senses. Precisely because I experienced the exhibition space in this way, it inspired me to explore the works of Ernesto Neto and Maria Nepomuceno as they offer the potential to engage with art in a decolonial way that refuses imperial modes of visuality. Both Neto and Nepomuceno are contemporary Brazilian artists whose installations nurture multisensoriality and corporeal exploration. Their works not only propose different ways to experience art, but also influence the ways in which exhibition spaces work and mediate relations between visitors and artworks.

Exhibition spaces originated through colonial violence and Western intellectual supremacy and are, to this day, institutions that maintain imperialism by reproducing Eurocentric ways of being with art (Azoulay, 2019). A key theorist when it comes to shedding light onto both these violent origins and contemporary realities is Ariella Aïsha Azoulay. In her book *Potential History: Unlearning Imperialism*, she foregrounds the fact that museums are built on colonial looting as a violent practice of physically distancing people from cultural objects and prohibiting their manipulation (2019, p. 54). Moreover, they are active perpetrators of violence by displaying artworks in ways that force visitors to relive this physical separation (Azoulay, 2019, p. 54). Azoulay says that these imperial ways of displaying happen in Western museums. Other theorists, such as Luiz Guilherme Vergara (2018, p. 143) and Alírio Karina (2022, p. 668), show that this also happens in non-Western exhibition spaces, where imperialist conservation "conserves nowhere near as much as it 'produces' a particular order of things" (Howes, 2006, p. 168). The artists I focus on have nevertheless found fruitful ways of challenging these institutionalized orders of separating people from artworks and desensitizing ways of being in the world,

which is why I regard their artistic practices as profoundly worthwhile of exploration.

First, I would like to emphasize that my thesis is not the first time that these two artists have been associated. For instance, both were part of the exhibition *Brasiliana: Installationen von 1960 bis heute* (Brazillian: Installations from 1096 to the present) at Schirn Kunsthalle Frankfurt (Alzugaray, 2013; Volz, 2013). Furthermore, both of their artistic practices are discussed in the book *Vitamin T: Threads and Textiles in Contemporary Art*, in which Claudio Iglesias (2019) makes particular mention to the idea that "Nepomuceno's work is comparable to the immersive use of textiles pioneered by Ernesto Neto" (p. 198).

The first exhibition that I will analyze is *Sopro* (Blow) by Ernesto Neto, which was curated by Jochen Volz and Valéria Piccoli (2019). It was exhibited at the *Pinacoteca do Estado de São Paulo* (Pinacoteca of the State of São Paulo, henceforth referred to as Pinacoteca) from March 30th to July 15th of 2019 and it was a solo exhibition with a retrospective character. The collection of exhibited artworks emphasized prevalent elements in Neto's oeuvre, such as the use of stretchy translucent textile materials, crocheted environments, instruments, herbs and spices that filled up the exhibition space in unexpected, alluring ways. Similarly astonishing, the exhibition *Big Bang Boca* (Big Bang Mouth) by Maria Nepomuceno, curated by Danniel Rangel (2023), was presented at the *Instituto Artium de Cultura* (Artium Cultural Institute, henceforth referred to as Instituto Artium), also located in the city of São Paulo, from August 27th until November 4th of 2023. It consisted of a single large-scale site-specific work made from a large array of mediums including beads, ropes, gourds, ceramics, wood and straw, which are all materials that largely compose Nepomuceno's oeuvre and are representative of Indigenous Brazilian artistic techniques (Alzugaray, 2013; Fonseca, 2023, p. 228).

What is especially remarkable about these two exhibitions are the ways in which they foreground the senses as a method of engaging with art and being in an exhibition space. Neto and Nepomuceno create works that expect more from us than a state of fixed and distanced visual contemplation; rather, the artworks demand corporeal participation of the visitor. They ask us to walk around their extremities and through their insides, to see *other-*

wise, to touch them, to smell, hear and even embrace the imaginative potential for the presence of taste. Most of all, the works ask us to physically relate, to engage in a multisensorial relationship with them and to not fear mutating or transfigurating their materiality. Thus, I make use of phenomenological texts that foreground bodies and senses to explore the workings of these different experiences produced by Neto's and Nepomuceno's artworks. Consequently, I demonstrate that it is through the plural employment and interweaving of different objects, mediums and senses that these artworks welcome candid sensorial experiences, producing a space that refuses imperial ways of being.

This refusal occurs by means of a displacement of the Western hierarchical position of vision. According to Jonathan Crary (1988), vision became the dominant sense in modernity and in the imperial exhibition space, hence structuring the ways in which visitors seek to "master" the single meaning of the artwork through visual rational thinking. Neto and Nepomuceno deny these forms of engaging with art that are legitimized and explained by Western primacy of vision. Therefore, I suggest their artistic practices should be characterized as decolonial. But that is not the only thing they do to decolonize. Their practices go even further to reimagine vision as a corporeal, affective and creative way of sensing the exhibition space, stripping it from its imperial condition. In order to explain how they do so, I apply the practice of *queering*, understood as being and engaging with the world in such a way that subverts the normative, in a way that is powerfully dissident. To do this, I analyze senses, bodies, matters, and relationalities through the framework of queer theory, specifically focusing on the works of Judith Butler (1993) and Paul B. Preciado (2018). This allows me to further explore the decolonial potential of sensorial experiences with the artworks. What is achieved by this is a queer visuality that is decolonial in the sense that it actively deconstructs and rejects any kind of decorporeal, dominating, or cisheteronormative gaze.

Thus, my thesis will be guided by the research questions: How are colonial practices historically embedded in exhibition spaces perpetuating the primacy of vision displaced by the artworks in Ernesto Neto's exhibition *Sopro* and by Maria Nepomuceno's installation in *Big Bang Boca*? But also, how are these artists reaching the deconstruction

of vision as an imperialist tool? How can this sense be *queered* within a decolonial order of engagement?

Through the exploration of these questions, I want to further suggest that a decolonial way of engaging has a twofold aim: 1) to offer potentials that were refused to us as spectators and visitors, and 2) to disrupt the exhibition space itself. If exhibition spaces have historically been places of imperial thought and behavior, I propose that with the inclusion of these multisensorial artworks, we manage to transform them into more decolonial and affective spaces. This is also relevant for issues of inclusivity and accessibility, as the visually-centered character of these spaces deeply harms and prejudices against those with visual impairments. Considering that I propose the intersection between decoloniality and queering, another field which becomes of great interest is that of *crip theory*, understood as a line of disability studies which strongly converges with queer identities, bodies, and ways of being. Although this will not be prevalent within my thesis, I consider it a representation of a fruitful approach for future research and the exploration of powerfully dissident sensorial experiences, needs, and desires.

In this paper, I will first offer a reading on how exhibition spaces have been structured around imperialist ideas, yet I will also demonstrate that artists have the possibility to refuse these practices. My literature review and methodology section will explain how my reading method of the exhibitions is constructed through the combination of decolonial, phenomenological, and queer theories. Secondly, each exhibition will be individually explored through analyses of the formal, material, and sensorial characteristics of the artworks that compose them, as well as some architectural features and regulations of the exhibition spaces themselves. To do so, I mainly draw on photographs from the exhibitions. For Ernesto Neto's *Sopro* the images were taken by Isabella Matheus (2019) and for Maria Nepomuceno's *Big Bang Boca* the photographer was João Caldas Filho (2023). I also occasionally make use of videos of visitors interacting with these exhibitions, available online (Instituto Artium De Cultura, 2023a, 2023b, 2023c; Metrópolis, 2019) and interviews with either Neto (Langhammer, 2018; Meistere 2020; Jordan 2023; Limorte-Menchón, 2018) or Nepomuceno (Rigamonti di Cutò, 2017; The Brooklyn Rail

2022). By reading this material in relation to my theoretical framework, I propose that a powerful, decolonial redistribution of the sensible takes over these exhibition spaces.

2 Literature Review and Methodology

2.1 *What is the Issue with the Exhibition Space?*

The aim of my thesis is to theorize, refuse, and displace colonial and imperial ways of engaging with art in exhibition spaces. From this starting point, no other author seemed more fitting for this exploration as the curator, filmmaker and visual culture theorist Ariella Aïsha Azoulay. Her works have, to a great extent, been determinant factors in the solidification of my academic fields of interest and research. Thus, I am going to look at Azoulay's denunciation of the problematic origins of the exhibition space, as well as other theorists who condemn the workings of different Eurocentric hierarchies, to acquire a holistic answer to the question: *what is the issue with the exhibition space?*

In "Plunder, Objects, Art, Rights," Azoulay (2019) argues that Western museums are institutions and entities of imperialism and violence as they (re)produce imperial knowledge and modes of being in the world. Based on this reality, she calls out art for to this day "being one of imperialism's preferred terrain," for example by working through evaluations, expertise, praise, and intellectual understanding rather than affective relations of care (Azoulay, 2019, pp. 58, 102, 109). Through this argument, Azoulay (2019) demonstrates how exhibition spaces established the "transcendental condition of art" (p. 54). Meaning that art "became" transcendental in the sense that it is a detached commodity, without material, corporeal, sensorial, or emotional ties to people and places. This detachment thus becomes inextricably linked to histories of military conquest and colonial looting, from which exhibition spaces destructively acquired non-European objects. This forcefully made them into tamed, agency-less spectacles for the European spectators' imposing, patronizing, taxonomic, and desensitized gazes.

A vast amount of literature from museum studies, visual culture, and decolonial theory draws attention to these violent histories. It stresses Eurocentric and colonialist civilizing missions, which shaped the objective of exhibition spaces as places created to study "the Other" and take "better care" of their objects than they supposedly would (Goldstein & Caiuby Labate, 2017, pp. 442-443; Vergara, 2018, pp. 143-144). It is essential to note that this specific idea of "care" is deeply rooted in the Western transcendental condition of art. Therefore, it is determined by a model of visuality based on physical distance and conservational primacy (Azoulay, 2019). Consequently, knowledge creation in this context works through European Enlightenment ideals of "privileging vision (the eye) in Western art and Western thought" (Wesseling, 2017, p. 169), to such an extent that other senses have been historically inhibited and punished by exhibition spaces.

The transcendental condition of art has also dictated, in many ways, how we make sense of art through hierarchies and canonical structures and positions. For example, exhibition spaces have been responsible for establishing and perpetuating violent taxonomies in the artistic realm, such as the hierarchical binary categories of art/craft, primitive/modern and high/low (Azoulay, 2019, p. 3; Porcel & Artexte, 2020, p. 176). Textile art, for instance, has been originally categorized in the West as "crafts" due to its historically gendered portrayal and thus was for a long time unworthy of belonging in exhibition spaces (Porcel & Artexte, 2020, p. 174). Alongside categorizations of artistic mediums and techniques, exhibition spaces have also enforced a clear hierarchy between artists and visitors. Within this hierarchy only the artists have creative and subjective freedom, whereas the visitors are subjected either to what Rancière defines as "modes of exhibition and explanatory labels that tell them what they must see" or to expectations of previous thematic knowledge that allows them to independently rationalize the artwork (Arnall et al., 2012, p. 293). Regardless of which of these forms of engagement are employed, museums are unequivocally conceived of as "rational spaces" (Buggeln, 2012, p. 35), in which "the rationalization of sight" is consistently privileged (Wesseling, 2017, p. 203).

The primacy of vision in European thought is founded on imperial ways of being, and perpetuates a type of imperial visuality. To show this, I make use of the work of the art critic and theo-

rist Jonathan Crary. In "Modernizing Vision," Crary's (1988) main argument is that, in modernity, a decorporealized, rational, and scientific form of vision became the primary sense. He explains that with the collapse of the camera obscura as a model of visuality "embedded in a much larger and denser organization of knowledge and of the observing subject" (1988, p. 31), the hegemonic condition of film and photography led to a particular fascination with the perception of vision as "incorporeal, veridical, and 'realistic'" (1988, p. 43). This type of modern vision thus fixates, subjugates, and consumes the image that it gazes at; it works through a one-way gaze to the object or the Other that *does not look back*. This is also significantly representative of the type of objectification that has been strongly criticized by feminist theorists through the concept of *male gaze*, as coined by the film critic Laura Mulvey (1975).

Overall, Crary's arguments demonstrate how spectatorship happens through an imperial position of dominance and unattainability, which is precisely why I combine them with Azoulay's theory on the transcendental condition of art. In this way, I highlight how the primacy of vision that pervades and structures the exhibition space is a multi-layered, historical, and institutionalized phenomenon that both operates through and reproduces imperial visuality. This imperial visuality is the main issue with the exhibition space that must be refused through a decolonial approach.

2.2 *Decolonization Through the Redistribution of the Sensible*

In view of the arguments delineated in the previous subsection, I am going to examine the process of decolonization of exhibition spaces by drawing on theorists who challenge the primacy of vision. It is important to clarify that the fact that these theorists are challenging the primacy of vision does not *necessarily* mean I am classifying them or their writing as decolonial. Rather, their works offer me foundational knowledge of that which must be and is displaced in the two exhibitions I will analyze: *Sopro* and *Big Bang Boca*. Decoloniality in this context thus characterizes the ability of colonized bodies and matters to reclaim their senses and their agency in the exhibition space through artistic practices that displace European ways of understanding, displaying, and ex-

periencing art.

I want to draw attention to theorists who refuse this sensorial hierarchization by showing how other senses offer us different possibilities. They demonstrate how to create experiences and understandings that are not based solely on the act of seeing with the objective of "mastering" the fixed meaning and value of an artwork. Azoulay (2019), for example, suggests that touch should not be perceived as destructive, but rather constitutive, desired, and most importantly: decolonial (p. 25). The sense of touch allows for a latent bodily and material experience of the artwork to emerge, resignifying orders of engagement in the exhibition space both in relation to the visitors and to principles of "care" and conservation.

The engagement with other senses is also the primary focus of analysis for the art historian Janneke Wesseling (2017) in her book *The Perfect Spectator*. Wesseling (2017) complicates experiences of art through the notion of relationality by arguing that "not only does the spectator perceive the art work, but, perception is also 'the other way round'" (pp. 76-77). Through these relational perceptions, she proposes the personification of artworks which, alongside the body of the spectator, also have the "ability to act" (Wesseling, 2017, p. 17). For Wesseling (2017), embodiment also plays a crucial role in these relational acts of perceiving because, in her words, "the contemplation of art...is an embodied and situated perception, an experience of the entire body" (p. 10). In this sense, she foregrounds the sensorial potentials of *all* bodies, which is precisely why I take her work as an essential phenomenological account. Her approach will thus be useful for my analysis as I intend to focus precisely on how visitors and artworks sensorially interact and relate to one another as the central element in the refusal of imperial visuality. Therefore, also refusing the agency-less state of artworks within the transcendental condition of art and opening up space for the reclaiming of what Azoulay (2019) defines as the rights inscribed in objects. A shift undoubtedly takes place in the exhibition space.

As Jacques Rancière (2010) writes, the museum is "not merely a specific type of building, but a form of framing of common space and a mode of visibility" (p. 138). This view is based on his theorization of the "distribution of the sensible," in which the *sensible* is comprised of both "the senses," includ-

ing hearing, touching, smelling, seeing and tasting, and of "sense making," or, in other words, meaning-making (Dasgupta, 2019, p. 104). Two important concepts arise from this theorization; the *police*, who seeks to preserve the *status quo* of the distribution of the sensible—imperial ways of being and seeing—and *politics*, that which opens space for new sensorial orders through a *redistribution* (Rancière, 2010; Rancière, 2013). Therefore, I propose to read the artworks of Neto and Nepomuceno through how they promote the inclusion of the senses as a way of doing politics in exhibition spaces.

The concept of "redistribution of the sensible" helps open up a theoretical exploration of the senses, through which I can, in my analysis, prioritize bodily knowledge that emerges directly from our senses over conscious thoughts and rationalizations. In this sense, Rancière's theoretical arguments provide a terminological framework to describe decolonial sensorial experiences of art. Cultural geographer Divya Tolia-Kelly (2017) emphasizes that Rancière is not a postcolonial nor a non-Eurocentric theorist, yet she makes visible the usefulness of appropriating his theories when it comes to demonstrating how decolonization can materialize in the context of the contemporary exhibition space. Thus, I shall do the same with the specific workings of my case-studies. I will focus on how the different ways in which we sense and exist in the world are interwoven, creating and shaping our experiences with artworks.

I want to emphasize that the exploration of other senses does not mean that vision completely ceases to be valuable. I do not disregard vision as such, rather, I refuse the way vision has been thought of and desensitized in modernity. Consequently, I propose to deconstruct this condition, establishing a different type of visual engagement through which imperial modes of being can be further displaced. For that, I make use of the interchangeable concepts of *haptic visuality* and *hapticity* coined by the philosopher and media art theorist Laura U. Marks (1988). In the article "Video Haptics and Erotics," Marks (1988) uses the term "haptic" to characterize a type of visuality that is embodied and corporealized. As vision is engaged through an inherently multisensorial order, "the eyes themselves function like organs of touch" (Marks, 1998, p. 332). This concept thus counters Western visual rationality insofar as it "tends not to distinguish

form so much as discern texture" (Marks, 1998, p. 338), hence subverting "the power of 'form' over 'matter'" (Rancière, 2007, as cited in Davis, 2010, p. 137). Rancière (2007, as cited in Davis, 2010, p. 137) has compared this original hierarchization to "the power of the class of intelligence over the class of sensation," which interestingly shows that fixation on form as a property that is "mastered" leads to the dematerialization of bodies. Consequently, to return to the matter, I explore the "class of sensation" which denies fixed classifications of form.

2.3   *Queering Theory*

Finally, I want to propose the potential of understanding sensorial experiences through queer theory. The discussion of hierarchical relationships between form and matter naturally inspired me to reflect upon cisheteronormative signification of matter through gendered forms and heteronormative orders of pleasure. Hence, I am going to look at the work done by queer theorists to emphasize the essential notion that exhibition spaces are not just structured by the primacy of any vision, but that this vision is based on desensitized cisheteronormative structures, taxonomies, and rationalizations. In this sense, the practice of queering works as an efficient tool in the deconstruction of the imperial condition of visuality, thus becoming a source of decolonization.

Two fundamental texts that deeply incited and shaped my affinity and approach to queer theory were Butler's *Bodies That Matter* (1993) and Preciado's *Countersexual Manifesto* (2018). Both theorists make visible that "that which matters about an object is its matter" (Butler, 1993, p. 31) and counter the fixed intelligibility of bodies through "naturalized sexual practices and the gender system" (Preciado, 2018, p. 21). Butler (1993) demonstrates how the ego or the idea of "I" necessarily comes to exist through this gender system, therefore bodily materiality is immediately constrained by a categorization that fixates form to matter (pp. 7, 17). Yet, Butler's (1993) work resists these oppressive, cisheteronormative taxonomies of the body by exploring the queer corporeal potential that lies within the possibility for the *transferability of the phallus*. This concept draws on Freud's discussion that all organs are defined by erotogenicity, or the ability to be a site for sexual pleasure. For Butler (1993) this means that "to be a prop-

erty of all organs is to be a property necessary to *no* organ, a property defined by its very *plasticity*, *transferability*, and *expropriability*" (p. 61). In this way, there is a refusal of fixed genital-oriented orders, ultimately emphasizing how sites of pleasure, desire, and sensoriality are constantly negotiated, signified, and transferred.

Butler's (1993) exploration strongly aligns with Preciado's (2018) analysis of the dildo, which he describes as "postidentitary" (p. 9), as belonging "to an economy of multiplicity, connection, sharing, transference, and usage" (p. 7). Butler's phallus and Preciado's dildo call for the displacing of fixed identitarian delimitations of bodily wholeness. Thus, I will apply this queer displacement to relational sensorial experiences in Neto's and Nepomuceno's exhibitions, in which artworks' bodies and the visitors' bodies merge, transform, and expand. In this way, Butler's and Preciado's arguments build upon Wesseling's (2017) phenomenological explorations of the notions of relationality and embodiment, because visitors and artworks sensorially interact and relate to one another in ways that are inherently queer. Bodily forms are thus further destabilized, whereas corporeal desires, materialities, and pluralities become an integral decolonial component of the exhibition space by nurturing different forms of engagement.

Although Rancière does not address queerness in his work, I suggest that the notion of the redistribution of the sensible offers me an opportunity to engage with it in several ways. I will demonstrate how the queering of bodies and matters present in *Sopro* and *Big Bang Boca* has great potential as a source of decolonization by displacing the primacy and rationalization of vision within a Western, imperial framework that values form over matter and over-stresses fixed and intelligible bodily boundaries. Previous literature has argued that Neto's artworks move beyond the gendering of bodies and matters (Teixeira Filho & Cruz, 2017, p. 137). I will explore how both Neto and Nepomuceno make mixed media works composed of various textures, shapes, and colors that invite bodily activation and reminisce of anamorphic and corporeal forms that transcend the stable gendering of bodies, matters, sexualities, and ontologies. In this sense, I discuss how the queering of visuality works as a source of redistribution of the sensible in the exhibition space by provoking much more plural and transformative bodily and embodied experiences.

3 *Sopro*: A Retrospective for the Future

3.1 *(De)Regulation, Multisensoriality, and Healing*

A foundational practice in exhibition spaces involves the act of determining the minimum distance a visitor must keep from an artwork through markings on the floor and protective glass vitrines. Through labels and wall texts the visitor is asked to be mindful of the fragility of artworks and to *preserve* and *care* for them by avoiding touch. When such methods of display design fail, observant, alert, and often distressed museum workers will remind the visitors of the importance of adhering to these globally used institutional rules and regulatory procedures. I begin my analysis by spotlighting this reality and its workings because this is precisely what Ernesto Neto refuses in his retrospective exhibition *Sopro*. Considering that "social norms are sensory norms" (Howes, 2006, p. 163), Neto proposes a multisensory way of engaging with his artworks that, in contrast to the usual ways of seeing and being in an exhibition space, both disrupts the way we are used to experiencing our visits to exhibitions and, by extension, transforms the exhibition space itself.

The first sense I want to draw our attention to here is Neto's use and engagement with touch. Touch, for him, becomes not just tolerated and accepted, but rather is highly regarded as a constitutive and desirable sense. This is seen in the formal element of artworks, as it is the case with *Velejando entre Nós* (Sailing between Us, 2012, Fig. 1 and 2), an installation made from six cocoon-like crochet environments that are interconnected. The sculpture is suspended above the ground, but it is also accompanied by six round crocheted cushions that are placed in front of each cocoon's entrance. The cushions work as a reassurance for the visitor that they are supposed to climb up, to inhabit that at once safe and fragile space. Here touch is experienced not only through the hands, but through the whole body which becomes immersed and quite literally encapsulated. In this way, the artwork completely displaces traditional orders of institutional rules and regulations. This sensorial engagement offers multiple possibilities to the visitors of this exhibition; not only does it allow us to question why art is placed as that which cannot be touched, but

Figure 1: *Velejando entre Nós*

Figure 2: *Velejando entre Nós*

Note. From *Blow, Installation Views* by I. Matheus, 2019, Galerie Max Hetzler.

it also employs senses other than sight to feel and sense otherwise.

From this different sensorium, what we could conceptualize as "new regulations" may also arise, such as the fact that visitors must first take off their shoes before entering the artwork, as we see from the shoe rack that is placed to the left of the artwork in Figure 2. Still, I argue that this rule is intrinsically different from, for example, protective barriers, because it is flourishing our senses rather than concealing them. It makes visitors activate their bodies from the tips of their toes, which push against the cushion, to the top of their heads, which may rest against the soft, malleable textile that surrounds them. Furthermore, as Neto himself discussed in an interview, this requirement "causes us to stop and think whether we really want to go through the trouble of taking off our shoes just to

enter the installation" (Langhammer, 2018). I find this point particularly powerful and beautiful as it emphasizes that engagement with art is an active choice and process, rather than a passive state of visual contemplation. It gives agency to visitors over their bodies and their sensorial experiences in exhibition spaces. The crucial element here is that the possibility for interactive and tactile experiences in Neto's exhibition holds the potential to penetrate the visitors' subjective conception of exhibition spaces, encouraging them to no longer accept "please do not touch" signs as a given. *Why can I not touch this? Why is my engagement restricted to vision? How much deeper would my experience of this artwork be if I could engage with it in different ways?* That is, looking simply becomes not enough as both visitors and artworks make demands for a different kind of engagement that displaces coloniality and imperial visuality. Little by little, these demands, emerging from an embodied desire for touch and real, sensed engagement, will have the power to heal the exhibition space from the imposition of regulated imperial ways of being with art.

I propose that touch is one element, one sense within an array of possibilities for redistribution, re-corporealization, and healing. Alongside touch, hearing unexpectedly takes up space through the rattles and seeds of *A Borda [Telepassagem]* (The Edge [Telepassage], 2012, Fig. 3), which produce sound as bodies pass through what could be considered the installation's wings, curtains or veils, gently rubbing and caressing the soft crocheted material that, in turn, embraces and shelters the visitors. The rattles and seeds are attached to the ends of the warm-toned textile, creating a sonorous trim that overflows with Brazilian rhythm and *gingado*, some sort of waddle, swing or samba. Therefore, touch and hearing support one another in the displacement of the primacy of vision. For this artwork, vision is also mobilized, but not to a higher degree than these other senses.

This is also the case with *Circleprototemple...!* (2010, Fig. 4), an artwork that is based on the centrality of the drum, inviting sound to be created through tactile activation. *Circleprototemple...!* is a heart-shaped enclosed installation made from stretchy translucent red tulle. The wooden steps at the entrance of the artwork and the round seating arrangement with red cushions on its interior fulfill a similar function to the round cushions

Figure 3: *A Borda [Telepassagem]*

Note. From *Blow, Installation Views* by I. Matheus, 2019, Galerie Max Hetzler.

Figure 4: *Circleprototemple...!*

Note. From *Blow, Installation Views* by I. Matheus, 2019, Galerie Max Hetzler.

of *Velejando entre Nós*. They emphasize that visitors should climb up and make themselves comfortable to connect with the space and with one another. The drum is placed in the center with a drumstick hanging from above. It is no coincidence that a beating heart is the result of the engagement with touch in this work, perhaps a metaphor or meta-mechanism to illustrate and connect the beating hearts of the visitors that beat together inside of the installation. In addition, the drum is often present in music and celebrations rooted in Afro-Brazilian traditions, thus embedding such artwork with affective sonorities and materialities. Furthermore, the presence of the instrument and the possibility and potential for sound creates an awareness of the materialization of silence when the drum is not played. This silence is also, in a way, felt and "heard," becoming part of the sensorial experience.

Moreover, Neto has also recurrently shown a deep connection to the sense of smell in his art. "Scents may trigger particular emotions, memories, and fantasies in us. And they can be quite powerful in attracting or repelling us, or in directing our actions," he shared in an interview (Langhammer, 2018). Neto applies this technique of attraction in the piece *O Sagrado é Amor* (The Sacred is Love, 2017, Fig. 5), where visitors' sense of smell is mobilized by bay leaves as well as other herbs and spices. They are scattered around the bright red carpet and inside the fructiferous bulbs of the crocheted red tree, inviting the visitors to come closer and closer, to sit under the tree and to take time
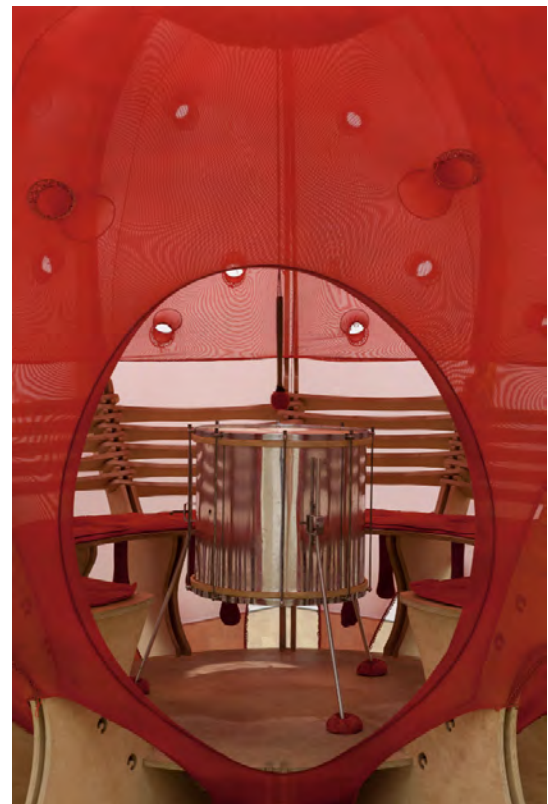
to connect with its sensorial and healing powers. These bodily routes and movements align with literature on olfactory art which reveals that "visiting a scented exhibition forces us to be present in the scent, to slow down, and go where the fragrance takes us" (Kjellmer, 2021, p. 85). Alongside the branches with fructiferous bulbs, the inviting and even sensuous tree also has a couple of longer crocheted branches that reach the ground. Their ends have a halo-like shape, meant to crown the visitors who choose to become part of the tree; one of its precious fruits. Through this physical coming together, *O Sagrado é Amor* offers the potential for an intimate relationality in which there is a blurring of boundaries between its own body and the bodies of the visitors. This potential is also similarly present in *Circleprototemple...!* as the visitors and the installation come together as a being with one single passionately and vibrantly pulsating heart. These artworks produce, through tactile and either olfactory or sonorous experiences, the embodiment of a collective and simultaneous material existence. In other words, this could be understood as the destabilization of fixed and intelligible delimitations of bodily wholeness, which, through Butler (1993) and Preciado (2018), I propose as inherently queer or dissident. It allows for the overcoming of "the idealization of the body as a spatially bounded totality" (Butler, 1993, p. 76), encouraging deeper and more intimate affective exchanges in the exhibition space. In Butler's (1993) words, "this unsettling of 'matter' can be understood as initiating new possibilities, new ways for bodies to matter" (p. 30). A promising decolonial space opens up.

Even though I have been discussing the senses individually, they are activated altogether— amalgamated and in symbiosis—as visitors engage with and inhabit the artworks. This multisensoriality which resists any kind of sensorial hierarchization and promotes full embodiment is specially explored in a work that was commissioned by the Pinacoteca for this exhibition, that is *Cura Bra Cura Té* (Heal Brazil Heal Yourself, 2019, Fig. 6, 7 and 8). *Cura Bra Cura Té* is energetically and affectively building on everything that Neto's previous artworks have created. It is, at once, crocheted textiles, soft textures, embodied immersions, instruments, sounds, activations, herbs, smells, attractions, colors, patterns, and contrasts, but, most of all, it is multisensorial engagement in the presence of others. The negotiation of intimacy between the visitors is thus

Figure 5: *O Sagrado e Amor*

Note. From *Blow, Installation Views* by I. Matheus, 2019, Galerie Max Hetzler.

best understood in sensorial terms since different visitors share the space and their experiences. In this process, they cross paths, produce sounds in each other's presence, work out who sits where and possibly converse about the smells they are trying to decipher. This was further nurtured and flourished by *Cura Bra Cura Té* through its hosting and welcoming of four gatherings throughout the exhibition cycle (Volz & Piccoli, 2019). These gatherings, described in the exhibition space's website as *ações/rituais participativos* (participative actions/rituals) (Volz & Piccoli, 2019), took the form of a *roda de dança or ciranda*, a circle dance in which individuals hold hands with the two people on both of their sides and move around forming a long-interconnected chain of vibrantly rhythmic, dancing bodies (Metrópolis, 2019). Audiovisual documentation of one of these gatherings (Metrópolis, 2019) shows how many visitors watch from outside of the circle-shaped blue carpet of the installation, being free two join the playful dance at any moment, while many others take up space in the installation, dance together to the sound of *maracas* and actively heal the exhibition space through embodied, multisensorial togetherness.

Overall, the multisensorial approach of *Sopro* refuses (self-)regulated experiences of exhibition spaces in which visitors walk around in straight lines, avoid close proximity with one another and make as little sound as possible. By displacing these desensitized experiences, Ernesto Neto's artworks create possibilities for visitors to choose their own unique and personal bodily paths, to become

Figures 6, 7, 8: *Cura Bra Cura Té*

Note. From *Blow, Installation Views* by I. Matheus, 2019, Galerie Max Hetzler.

creative with the places and ways they touch, look, search for smell and produce sound. A bodily and embodied healing begins to take place after all. As I have already argued in the literature review,

this multisensorial engagement should be characterized as decolonial because it refuses the Western primacy of vision on which the imperial hierarchization of the senses of modernity is built upon (Azoulay, 2019; Crary, 1988). This refusal is achieved by how the materials and mediums which compose Neto's artworks, as well as the artworks' formal characteristics and de-regulated uses, employ different senses and promote embodied desire for corporealized interactions. Rather than becoming artificially fragmented and subsequently hierarchical, the bodies of visitors exist and experience the exhibition space through the multisensorial capabilities of its wholeness and interconnectedness. In this sense, returning to Azoulay's condemnation of imperial visuality as a mode of violent engagement, I stress my refusal of the hierarchization of vision in relation to other senses, due to which bodies in exhibition spaces grow profoundly disconnected not only from the artworks, but also from one another.

3.2 *The Political Ephemerality of Malleable Matter*

I have, in the previous analytical subsection, been largely focusing on the processes, encounters and sensations that are experienced by the bodies of the visitors of *Sopro*. My focus will now shift specifically to the body of the artwork, which I explore primarily in relation to *Nave Voadora* (Flying Group Nave, 1999, Fig. 9 and 10) and to the concept of ephemerality, understood as the quality of impermanence, of the fleeting and evanescent. I chose this concept as a guiding framework for my analysis in this section to shed light on the different ways in which Neto successfully brings into play the transient and the impermanent as defining characteristics of the malleable, interactive matter of his works. I argue that this ephemerality results in what Rancière (2010, 2013) defines as the enactment of politics because the exhibition space has precisely depended upon notions of preservation, care, and everlastingness for the purpose of legitimizing colonial looting and its Western savior complex (Azoulay, 2019; Goldstein & Caiuby Labate, 2017; Vergara, 2018). Therefore, ephemerality as a counterforce to the eternality of conservation might be our best strategy when it comes to redistributing the role of the exhibition space and promoting its decolonization.

Figure 6: Figures 9 and 10: *Nave Voadora*
Note. From *Blow, Installation Views* by I. Matheus, 2019, Galerie Max Hetzler.

Nave Voadora is part of a series of artworks titled *Naves* made using translucent, elastic fabric and herbs, amongst other materials. This artwork, elongated and stretched, is certainly intriguing with what Neto describes as its multiple "arms" attached to the ceiling and its six two-toed "feet" laying heavy on the ground (Scholte, 2022, p. 123). Another striking element of this installation is the long but narrow slit that is present in one of the ends of the artwork, representing a single entrance and exit point. This orifice is particularly engaging because although it quite literally allows the visitor to see the artwork's insides, the different overlapping shapes and planes of the translucent material colored and illuminated by Pinacoteca's white walls and bright lights make it so that the interior of *Nave Voadora* becomes indistinct. A sort of optical illusion with no beginning, middle or end. This lack of trust in vision, combined with the inherently alluring and tempting peculiarity of the artwork's materiality, naturally intrigues the visitors for an immersive bodily engagement. Interestingly, a parallel can be built between the optical illusion created by *Nave Voadora* and the exhibition view of differ-

Figure 11: Exhibition view

Note. From *Blow, Installation Views* by I. Matheus, 2019, Galerie Max Hetzler.

ent rooms of *Sopro* (Fig. 11). Due to their symmetry and patterned placing of the open passages between each room, they create the illusion of a never-ending corridor filled with colorful, tempting snippets of *Circleprototemple...!* (Fig. 4), *Velejando entre Nós* (Fig. 1 and 2) and O *O Sagrado é Amor* (Fig. 5). This is especially the case because *O Sagrado é Amor* is exhibited in the furthest room. When entering the exhibition, all the visitor sees in the distance is a black, unintelligible space, as seen in Figure 11. Therefore the visitor does not know where they are going to or what their destination is, creating an embodied desire for exploration of the entire exhibition space.

Coming back to Figure 10, we can see how a shoe-rack is placed in the corner of the room, just as it was with *Velejando entre Nós*, unquestionably inviting the visitors to choose if they would like to take off their shoes and to step into the body of the *Nave Voadora*. From the moment a person steps in, the fabric lets itself be pulled and stretched all the way down to the floor by the visitor's body, meaning that the malleable character of the artwork is immediately sensed and felt. As it is visible in video documentation of the artwork (Metrópolis, 2019), this is the case for both children and adults who, independently of weight differences, struggle to balance, feel embraced, and partake in a relational tactile experience with the artwork in which they constantly touch and are touched. Any and everybody who enters the internal space of *Nave Voadora* will constantly shape and re-shape the artwork's body in a never-ending process of

stretching and *de*-forming, or even form-*becoming*. The main point here is that whatever form *Nave Voadora* takes on, it is ephemeral, thus destabilizing the possibility and notion of a fixed body. In this sense, Neto proposes bodily engagement with the materiality of his work that aims for distortion and mutation, resulting in the refusal of form as a stable identitary and cisheteronormative order of classification that can be mastered through vision (Butler, 1993; Preciado, 2018). Ephemeral anamorphic forms of *Nave Voadora* thus partake in a process of queering, opening up a multiplicity of possibilities for what Preciado (2018) conceived of as the "postidentitary" condition in which the body is ever-transforming (p. 7, 9). Consequently, *Nave Voadora* is always "becoming rather than being" (Weinhart, 2013, p. 39).

Here comes a crucial point of institutional tension and friction; *Nave Voadora* will indispensably experience a process of deterioration resulting from its ever-becoming interactions, stretches, and physical transformations. As literature on contemporary textile art and conservation has described, the extremely tactile and immersive character of Neto's works makes them especially susceptible to deterioration and require recurrent measures of conservation (Porcel & Artexte, 2020, p. 184). Art historian and conservation scholar Tatja Scholte (2022), who explores *Célula Nave* (2004)—another artwork from Neto's *Naves* series—argues that a substantially de-regulated approach towards the interactions with the artwork is "unsuccessful" (p. 137). It eventually leads to a "deadlock" or "total loss" of the artwork (Scholte, 2022, p. 136), as it would also be the case with the *Nave Voadora* at the Pinacoteca. This means that the entire body of *Nave Voadora* is ephemeral, since its malleable matter will eventually deteriorate to the point that it can no longer be conserved, restored, or exhibited.

Rather than unsuccessful, I argue that this result is powerful and decolonial because, like Azoulay (2019), it criticizes and refuses an *imperial temporality* which functions through the Western "mastery of time" and desire to "develop," make "progress" and infallibly look towards the perpetual future (pp. 60, 134). The deteriorating, ephemeral artwork rejects the way in which the imperial trope of conservation attempts to make it completely untouchable and unaffected by the passing of time. This artwork is inherently dissident because it can-

not "master" time as it has no future. Furthermore, it requires us to *look back* at the sensorial experiences which informed such a real and material deterioration; to discover genealogies rather than to solemnly *look straight ahead* at a supposed illusion of progress. By aligning with these methods of refusal of imperial temporality, I propose that *Nave Voadora* promotes a *queering of time* in the exhibition space. Considering that queering is a subversion of the norm, time is queered as it no longer works through the normative imperial orders and standards that are condemned by Azoulay (2019). Accordingly, when we are dealing with Neto's artworks, such as the *Nave Voadora*, I propose that we begin from the primordial consideration that they will not last forever, and that this reality does not have to be characterized as positive or negative; it may be simply a material reality. We fight aging, we fight death—all the time—in such a way that we must understand that matter is not just about existence, conservation and perpetuation, it is also about decay. There is an urgent need to normalize *the death of the physical artwork* that may continue to live on in the visitors' memories and embodied lived experiences.

Alongside the queering of time, I argue that *Nave Voadora* also promotes a *queering of space*. This artwork, whose material body is constantly manipulated and transformed by touch, comes about precisely through these ephemeral and deregulated, corporealized experiences with visitors in a space in which untouchability has always been synonymous with desirability, intellectuality, and value, both monetary and socio-cultural (Langhammer, 2018; Meistere, 2020). Yet, Neto refuses such ideas through his artworks and opines that "in an ideal world everything would be touchable" (Langhammer, 2018). From this point of view, relationality becomes the most appropriate and useful concept to theorize decolonial sensorial experiences in the exhibition space. He emphasizes that "Art is not at the art object or at the human being. Art is in between; the art is the mediation" (Jordan, 2023). This understanding promotes a further decolonization of art as it can "displace assumptions of single authorship" in artistic production (Venancio Filho, 2015, p. 55), actively refusing what Azoulay (2019) recognizes as "the imperial persona of the artist" who is glorified and singled out as a genius (p. 105). *Nave Voadora*, for example, encourages the artistic and authorial par-

ticipation of the visitors, thus "rejecting the role of the artist as one who seeks to create a complete individual expression" (Maroja, 2019, p. 4). As Neto himself has said: "Llegará el día en que todos empecemos a ser artistas" [The day will come when we will all start to be artists] (Limorte-Menchón, 2018, p. 215).

Returning to the theoretical framework, I pose the argument that the elements of ephemerality and the processes of queering resultant from bodily interaction with *Nave Voadora* are representative of what Rancière conceptualizes as the redistribution of the sensible in the exhibition space and should be conceived of in political terms. As I have demonstrated in my exploration of *Nave Voadora*, Neto's work strongly speaks to Rancière's (2010) claim that "doing art means displacing art's borders, just as doing politics means displacing the borders of what is acknowledged as *the* political" (p. 149). This is seen by how the physical engagement with the body of the artwork challenges Western modern assumptions of how art should be seen, experienced and cared for, thus "displacing art's borders." A redistribution of the sensible that refuses what we can see, hear, and feel in exhibitions spaces is achieved, which in turn means that everbecoming, deterioration and embodied relationality become unexpected enactments of politics on the basis of "new distributions of space and time" which queer the exhibition space (Rancière, 2010, p. 139).

3.3 *Queer Visuality, Queer Bodies*

Based on the process of queering which I began to conceptualize in the previous subsection, I now want to formulate a queer visuality as a way to further challenge the primacy of vision. As mentioned earlier, my goal with this thesis is not to refuse visuality as such, but rather to explore and propose different orders of visuality which work in symbiosis with other senses and reject imperial ways of being and seeing. As it has been shown by Crary (1988), in modernity vision became the primary sense. This primacy does not encompass any and all kinds of visual engagements, but rather relies on one specific type of vision that is inseparable from the realms of science, economics, and body politics and locates the spectator in a privileged position based on rationalization, intellectuality, and taxonomy (Crary, 1992, pp. 5, 15, 85). Consequently,

a different order of visuality must rely on sensorial engagements and techniques that actively refuse these stable, disembodied and classificatory experiences of the exhibition space and of the world. I propose to explore this refusal through the artwork *Copulônia* (Copulony, 1989, Fig. 12, 13 and 14), thus generating a conceptualization of queer visuality which can be applied to other works and exhibitions.
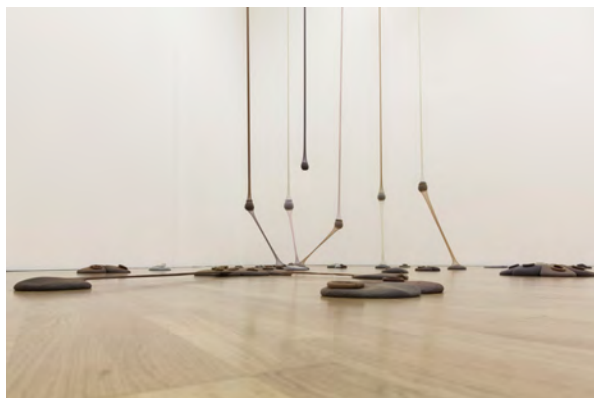
Figures 12, 13 and 14: *Copulônia*

Note. From *Blow, Installation Views* by I. Matheus, 2019, Galerie Max Hetzler.

Copulônia is an installation made from numerous earthy-toned nylon stockings filled with lead beads, making them acquire some sort of stretched and flattened doughnut, testicle, and breast like shapes. The molded stockings are placed around the room's wooden flooring in irregular, asymmetrical arrangements. Some stand on their own whereas some form either abstract or distorted geometric shapes when seen in relation to the bodies of the other stockings placed around it. As we can see in the comparison between Figure 12, 13, and 14, this installation arrangement causes every angle, height, or position from which the visitor looks at the work to produce a very different visual composition, affecting the perceptive tridimensionality and silhouettes of the stocking bodies. Consequently, *Copulônia* encourages the visitor to move their bodies up and down, from side to side, and forward and backward, physically inhabiting irregular pathways and traversing the peculiar, unfamiliar insides of the installation. As Wesseling (2017) discusses in the book *The Perfect Spectator*, these different acts of "looking *in*, looking *down at*, looking *straight at*, standing *in front of*, walking *through* . . . determine the way the art work is received" (p. 144). Through this embodied exploration, the forms of the artwork are thus visually experienced as ever-changing and *becoming*. In this way, the visuality present in *Copulônia* is both based on corporealized vision, since it relies on creative and immersive bodily movements, and on non identification, meaning that the visitor does not have a singular fixed-form image that they can rationalize within a stable system visual of classification.

By incorporating theory, it becomes clear that the artwork's visuality deeply resonates with Marks' (1998) notion of "hapticity," which she determines as an order of visuality that is sensorially engaged and located in the body, thus leading to a corporealization of the eye and of the sense of vision. Another element speaking to haptic visuality in *Copulônia* is how the presence of the lead beads gives a dense look to the sculptures, which in turn contrasts with the translucent, delicate and elastic appearance of the nylon fabric. The contrast is even bigger in relation to the stockings that have their ends rolled-out and attached to another bulbous stocking body that hangs from the ceiling, both of which become more see-through and fragile-looking, giving the impression of being almost at the point of ripping. Therefore, the ability

to visually sense the tactility and textures of the surface of *Copulônia* further encourages the embodied quality of its haptic visuality.

Another element of this artwork that strongly spoke to me in this regard is that each of the hanging bodies are quite literally engulfed and encapsulated by one of the bodies that rest on the floor. However, at the same time, we could argue that it is the hanging bodies that have the "active" role by penetrating the floor-placed resting bodies. These visually ambiguous relations between pairs of bodies within *Copulônia* give rise to half of the artwork's title explained by Volz (2013), co-curator of *Sopro*, as "a neologism composed of *cópula* (copulation), which describes the two penetrating parts, and *colônia* (colony), which identifies a whole composed of parts" (p. 97). It becomes clear that Neto intentionally desired to bring attention to these illusive, inconclusive, and carnal sexual localities to destabilize our perception of form-dependent genitalia and penetrative objects. These localities powerfully illustrate how "transforming any body (organic or inorganic, human or not) into a possible pleasure center defers the origin, troubles the center" and, that being so, "all is dildo. And all becomes orifice" (Preciado, 2018, p. 71). Consequently, the experience of the artwork is aligned with Preciado's (2018) refusal of cisheteronormative territorialization of pleasure, of prosthetic gendering of bodily matter and the idea of "sex organs" as a whole (pp. 27-29, 71). Therefore, a different kind of visuality which is inherently queer is encouraged. Based on my analysis of Neto's *Copulônia*, I argue that, to refute the rationalized intelligibility of imperial ways of being and seeing, we must engage with a queer visuality that is altogether plural, corporealized, and ever-becoming.

4   Big Bang Boca: An Explosion of Becomings

4.1 *Visceral Occupation*

Differently from Ernesto Neto's exhibition, where a great array of artworks was displayed, *Big Bang Boca* is made up of a single site-specific installation (Fig. 15, 16, 17 and 18) commissioned from Maria Nepomuceno by the Instituto Artium. Nepomuceno's interconnected braided straw sculptures, rope tentacles, ceramic pots and spheres,

Figures 15, 16, 17 and 18: Large-scale exhibition view

Note. From *Big Bang Boca, Installation Views* by J. Caldas Filho, 2023, Danniel Rangel Inc.

wood spoons, beads and gourds, among other materials and objects, explosively and expansively take up space in the Instituto Artium, like the Big Bang. Expanding itself from the indoor exhibition rooms through the window and into the gardens, and occupying other unusual spaces such as a fireplace, columns, windowsills, the ceiling and passways, this installation comes to life through a direct relationship with the museum's floor plan and architecture. Nepomuceno herself has shared, "I want to dominate the space so I have to understand the space" (Rigamonti di Cutò, 2017). In this regard, it is important to note that the architecture of this exhibition space is quite particular because it is in a mansion built in the 1920s. Therefore, it does not follow the "white cube" design unlike most modern and contemporary art museums such as the MoMA, giving Nepomuceno a great variety of possibilities and potentials for artistic occupations of the exhibition space. These occupations will be analyzed through the framework of queer visuality. As I have previously argued, queer visuality should be understood as the refusal of imperial visuality through plurality, corporealization, and ever-becomingness of the visual realm.

To get the sense of occupation from Nepomuceno's installation, visitors have to physically move away, getting a zoomed-out perspective. They must also allow the artwork to guide their bodies around the exhibition space, thus giving up their privileged position of spectatorship and incorporating a corporealized visuality. Such an engagement also reclaims the agency of the artwork and refuses the institutionalized taming and forced pacification of objects from the moment that they enter the exhibition space (Azoulay, 2019). It also destabilizes the notion that the spectator is all-perceiving and unperceived. For Wesseling (2017) the artwork is never merely perceived, but the object perceives back. Moreover, another essential characteristic of this occupation is the infinity of objects which compose it. All have different materialities, colors, textures, shapes, weights, and positions, meaning that the visitor can never see everything at once and "master" the whole work through vision. I argue that this generates a displacement of the eye as this scientific, all-knowing tool (Crary, 1988, 1992). It stimulates the visitors to enter the realm of multiplicities, sensibilities and sensations more than that of decorporealization, stability, and classification of sight. In doing so, the artist offers us a

different way of thinking about seeing in relation to artworks; one that rejects the male gaze (Mulvey, 1975). Namely, a way of seeing that refuses the oppressive visual dynamics explained by Mulvey (1975) as the combination of the spectator's domination and the passive *to-be-looked-at-ness* of the object.

Figures 19 and 20: Small-scale exhibition view

Note. From *Big Bang Boca, Installation Views* by J. Caldas Filho, 2023, Danniel Rangel Inc.

Embracing their embodied desire to engage closely with the materiality of the work, the visitors may let themselves be guided to specific areas of the installation. Such as those of Figure 19 and 20, through which veins, roots, vines, arms, legs, tentacles, umbilical cords, mouths, ears, flowers, vulvas, clitorises, phalluses, tongues, breasts, fruits, and seeds *become* "visible." Zooming into some of these biomorphic and anamorphic bodies

that compose the installation gives a visceral condition to the artwork's occupation and allows visitors to delve into an queer paradox between familiarity and estrangement, discernment and instability. This is the case for example with the sturdy pink ceramic sculpture in Figure 19 and both the glossy metallic red gourd and the sparkly pink beaded cylinder in Figure 20. They flow between the categories of phalluses and tongues, and thus are constantly becoming rather than being one fixed image or representation. This same condition applies for many of the objects in the installation. All of its malleable conical braided straw sculptures, which are shaped and folded in different ways and filled with beads and varying objects, become mouths, ears, flowers, vulvas, anuses, and undefined penetrative localities depending on the position from which they are seen, but also from the expectations and pre-conceptions informing someone's sight. In this sense, Nepomuceno's artwork is open-ended; it proposes different experiences and routes rather than presenting the visitor with a singular signification. This sense of plurality also comes from the great multitude of textures, surfaces and materialities of the different objects that occupy the exhibition space because the visitors engage with an ever-changing visual tactility, meaning that, as Marks (1998) would understand it, their eyes endlessly act as organs of touch towards plural material bodies. The installation is thus best understood as uncountable, relational bodies that bring to life a different order of ever-becoming wholeness.

I have been discussing the visual ways in which the visitors engage with the installation, yet it is impossible to understand these small-scale interactions without conceiving of the bodily movements and pathways that the visitors take. In the same way that the body of the artwork occupies and inhabits the exhibition space, the body of the visitor viscerally occupies and inhabits the artwork, as well as the exhibition space as a whole. In exploring and moving around, visitors bend to ground-level, walk over ropes laying on the floor and squeeze through tight passways in between different object-concentrated areas. Intensively corporeal engagements arise from these negotiations of space and balance. What is interesting about them is that there is no correct path or indicated way to go about it, therefore visitors become creative and learn to explore their freedom, their imagination, and even their own bodies. Furthermore, in doing

these unregulated, creative bodily movements and routes, visitors must be actively careful to not trip or fall, as that would mean both the possibility of getting hurt and "hurting" the artwork. Dare I to say, the visitors are in greater danger since the objects which compose Nepomuceno's artworks are, like the phallus for Butler (1993), "rendered transferable, substitutable, plastic" within a much greater symbiotic amalgamation of object-bodies (p. 89). Overall, this two-way chance of physical and material damage establishes an egalitarian condition in the visceral relationship between the artwork and the visitor. This then generates a redistribution of the sensible considering that exhibition spaces foundationally see and treat visitors as a one-sided threat to the preservation and care of artworks. Thus it polices bodies in such a way that perpetuates both this hierarchical relationship and the taming of artworks, whose bodies are destitute of any sense of agency. Such hierarchization is hence refused in *Big Bang Boca*.

4.2 *Multisensoriality, Movement, and Muscular Memory*

As I have discussed in the previous subsection, many objects from Nepomuceno's installation are reminiscent of body parts. This naturally encouraged me to think about the attribution of sensoriality to certain bodily organs, as well as the ways in which representations of these organs can promote sensorial experiences with art. Firstly, as the braided straw sculptures can be perceived as mouths and as both the beaded cylinders and phallic metallic gourds can be viewed as tongues, these objects become vessels through which taste is activated as a potential realm of imaginative and creative sensorial exploration in the exhibition. When asked about the presence of these metallic gourds in a previous exhibition during an interview, shared "I see very much like tongues," to which she further explained "one of the effects of COVID was to lose the taste, so I wanted to make many tongues in this exhibition, like all the organisms of the show are feeling taste again" (The Brooklyn Rail, 28:29). The tongues and mouth-shaped sculptures offer the visitor the potential to think of how it would be like to taste and viscerally engage with objects that, growing up, they have learned not to put in their mouths. Alongside these objects, the wooden spoons further encourage the reference to

the sense of taste. Another sense that can be creatively and metaphorically engaged with through the installation is sound, especially in relation to the braided straw sculptures that can also be perceived as ears. Literature discusses these "strange ear-like shapes that almost look as though they could listen to our conversations" (Iglesias, 2019, p. 198), demonstrating how the bodies of the artwork become material localities for sensorial engagement through affective and visceral processes of signification.

Touch is another sense which the visitors are allowed to engage with in this particular exhibition due to the rules established by Instituto Artium. Not only is this tactile interaction allowed, but it was specifically encouraged by the institution through various posts on their Instagram page during the exhibition cycle which showed visitors touching and "playing" with different elements of the installation (Instituto Artium De Cultura, 2023a, 2023b, 2023c). In addition to that, Nepomuceno's artwork is, on its own, a very appealing and enchanting explosion of colors, textures and materialities which holds a seductive expansiveness that immediately feeds into an embodied desire for touch as a mode of engagement. Especially since "every artefact embodies a particular sensory mix" (Howes, 2006, p. 166), visitors were allowed to caress, rub, and gently knock against objects of the installation to feel and discover the properties of their surfaces. This tactile interaction can, in turn, generate a sonorous activation that varies depending on which object is manipulated and how. An element of the installation which is particularly prone to tactile engagement are the great number of blue spherical beads of slightly different sizes and shades which fill a clay pot placed at the outdoor section of the installation (Fig. 18). Since the clay pot is not filled up to the brim, as is the case with some pots in the indoor section of the installation (Fig. 17), a specific type of touch that is more immersive and enthusiastic is invited. Dipping their entire hands into the deep sea of beads, the visitors are encouraged to engage with elements of playfulness that can be reminiscent of childhood. These can for example include the practice of jewelry making or even games of marble, known in Brazil as *bolinha de gude*, which, even though done with glass spheres of a very different material, can be quite similar in terms of hand movements done for grabbing and holding the different spheres.

This element of hand movements, both for jewelry making and for game-based actions, is quite interesting since it acts as a connector between sensorial experiences in the exhibition space and notions of revival and reclaiming of muscular memory which Azoulay (2022) explores in her film *the world like a jewel in the hand* . Azoulay (2022) understands this concept as the embodiment of practices through which we can look back, connect with our ancestralities and "be reminded where and to whom we belonged" (44:51). When it comes to this decolonial, emancipatory practice of reenactment, another crucial element from Nepomuceno's work is braiding. In an interview, Nepomuceno shared that she has always been interested in textiles and that, at the age of eleven, she was taught by her stepmother how to make spirals from crocheted braids (The Brooklyn Rail, 7:38). As the visual representation of spirals is still very much present in her work and all throughout this exhibition this symbol gains even more power. In addition, since 2009, Nepomuceno has been working with a group of artisans who do an Indigenous "ancestral work of braided straw" from *carnaúba* tree in Ceará, the state in Northeast Brazil from where the artist's ancestors came from (The Brooklyn Rail, 10:50). Therefore, the sculptures of braided straw being used in her installation is very much related to a process of becoming reconnected to her Indigenous roots and origins, which are often strongly and violently obscured in the Brazilian socio-cultural and political context (Vergara, 2018). The installation thus supports Azoulay's (2019) refusal of Western ideas of progress which are embedded and intertwined with the imperial temporality that always looks to the future and violently deceives people into forgetting the past (p. 134). Azoulay (2022), by powerfully claiming "Here we are reviving this world. Inhabiting it. Here we are!" (56:56), reclaims ancestral rights, sensorialities and sensibilities. Nepomuceno does the same by opening up space for visitors to become aware of the memory of their own bodies, hands and muscles. In this way, her artwork is weaving together experiences in exhibitions spaces, ancestral histories and corporeal memories. Consequently, a redistribution of the sensible is promoted as new orders of that which can be felt, seen, touched, embodied, remembered and reenacted come to belong in the exhibition space.

5 Theoretical Reflections: Neto and Nepomuceno in Conversation

Up to this point, I have been discussing the two exhibitions independently, but it is important to put Neto and Nepomuceno in conversation to reach an all-embracing reflection. Therefore, I will now present a comparison of the sensorial engagements that take up space in each of the exhibitions. On one hand, in most artworks exhibited in *Sopro*, the visitor is quite literally inside of them, encapsulated by Neto's stretchy environments. The space and bodies of these artworks are more clearly delimited, creating an experience that is constructed around deeper feelings of healing, safety, comfort, embrace and even togetherness, since different visitors can simultaneously share these spaces. On the other hand, in *Big Bang Boca*, the installation is itself unbounded, taking the position of an ever-expanding occupation. Accordingly, the experience of the visitor has a similar sense of occupation, viscerality and carnality, which is therefore more aligned with the sensorial engagement of *Copulô-nia*. Still, alongside these harsher sensations and prickly embodied perceptions, *Big Bang Boca* also strongly promotes joyous and heart warming experiences of play, reenactment and revival of muscular memory. This is seen in the way that the weaving together of visitors' personal ancestralities and bodily interactions with the beads and the braided straw sculptures creates a space of healing and remembrance. Similarly, I want to add that the artworks in *Sopro* also have this sensorial potential to revive ancestral corporeal memories through, for instance, the sounds of drums, rattles and seeds and the ever traveling smells of various herbs and spices. Therefore, artworks in both exhibitions offer engagements with the senses in transformative, political ways.

It is also important to foreground how the artworks in *Sopro* and *Big Bang Boca* simultaneously open space for movement and multiplicity. As I have previously illustrated, they do so in two ways; firstly, through the presence of malleable mediums that invite material distortions, mutations and transformations through the visitors' tactile engagements. This is primarily the case in *Sopro*, with the presence of the elastic body of *Nave Voadora* and of countless crocheted textiles, cocoons, wings

and branches. For that reason, these artworks have an ever becoming character, in such a way that visual engagement with them is constructed *relationally* and through the destabilization of fixed forms. This leads to the nurturing of a queer visuality that relies on a powerful lack of mastery over the image and, moreover, on the refusal of the dominant order of vision and spectatorship in modernity. Furthermore, I propose that these tactile engagements represent collective refusals of the institutionalized denaturalization of the ephemerality of art which commonly overrules the relational intentions of artists, additionally to the embodied desires of visitors (Etienne, 2021; Porcel & Artexte, 2020).

Secondly, another way in which movement and multiplicity come to be stimulated and experienced in these exhibitions is through the inclusion and resignification of vision within a corporealized order of engagement. In Nepomuceno's installation in *Big Bang Boca*, but also in *Copulônia* and other artworks by Neto, visitors are incited to start looking from different positions and distances. Plunging into different textures and materialities, potentially at different times, they accompany a process of deterioration and material ephemerality. In conclusion, these overarching orders of engagement work through what I characterize as queer notions of plurality, corporealization, and ever-becomingness, hence highlighting that the sense of vision is not inherently imperial and can be deconstructed.

6 Conclusion

Throughout this thesis, I have explored how the artworks made by Ernesto Neto and Maria Nepomuceno subvert imperial ways of being with art and the decorporealized state of vision in modernity through the employment of other senses and bodily ways of perceiving. What is unique about *Sopro* and *Big Bang Boca* is that, for example, the desires for healing, inhabitation, togetherness, movement, multiplicity, occupation, play and reenactment suddenly become much more powerful than the habit of rationalizing a fixed meaning of art from a privileged position of spectatorship. The use of herbs and spices mobilizes the sense of smell, while instruments, beads and ceramics hold the possibility of sound through tactile activation. Even mouth and tongue-shaped sculptures flourish the poten-

tial for taste. In addition, the artworks invite us to walk through them, opening space for embodied sensorial experiences and relational bodily multiplicities. Therefore, what ultimately takes place is a refusal of the physical separation between artworks and visitors, of the prioritization of conservation techniques and of the desensitization of any ability to touch, smell, hear or taste in the exhibition space.

In my analysis, I have importantly highlighted how, in both exhibitions, the refusal of imperial visuality is deeply intertwined with the notion of creativity since no singular way or path of how artworks should be experienced is proposed by either Neto or Nepomuceno. As a result, visitors always engage with a recurrent and ever-becoming choice of whether and where to touch, what sounds to make and pay attention to, how to look for smells and tastes, as well as what directions to move in and look from. This means that they are constantly asking themselves: *how is it that I am going to engage?* Through these active self-reflections, the visitors can better understand their own multisensorial desires, wants and needs, thus having a much more embodied and affective experience in the exhibition space. Here it becomes crucial to emphasize that this type of experience has been refused to us as spectators and visitors, yet Neto's and Nepomuceno's artworks create space for a reclamation. This reclamation disrupts the exhibition space itself, which after all becomes a locality for the refusal of hierarchical, desensitized and decorporeal ways of being that constitute, legitimize and uphold imperial visuality.

Overall, a visitor will never create the exact same paths, routes and bodily movements in these exhibitions and every experience of the artworks will be different. This means that art is no longer something that we see and master. Rather it is something that we experience and engage with, something which is affected by our mood, by how our bodies feel, by our desires, our interests, the amount of time we have, our level of comfort with that space, among other decisive affective and sensorial factors. Consequently, the artist is never the sole creator, and the exhibition space is never the sole mediator and regulator of the experiences that take place within it. Throughout the course of their experience of *Sopro* and *Big Bang Boca* the visitors are constantly sensorially engaging in changing ways that never cease to be creative, embod-

ied, political and nonhierarchical, thus guaranteeing a decolonial redistribution of the sensible in these exhibition spaces.

These findings and the decolonial potentials offered by these artworks must not be regarded as isolated or discrete issues. Instead, I strongly encourage us to regard them through a processual perspective, acknowledging their roles as steps in the gradual and consistent move towards a decolonial exhibition space; as opposed to their current state founded on colonial violence, Eurocentric ideals and imperial visuality. These findings can, for instance, be used on a personal level to help individuals reflect on how they think of themselves and their engagements in exhibition spaces. For instance, we must first recognize our desires to sensorially engage with artworks and sit with the frustrations towards artificial and desensitized rules and regulations of exhibition spaces to then be able to begin resisting them.

A shift must also happen institutionally with more exhibition spaces worldwide starting to *really* question and rethink their practices and origins; from conservational foundations to modes of exhibiting, displaying and framing artworks and collections. A shift does not solely depend on artists who employ the senses, but also on institutions who may choose or not to allow and encourage multisensorial experiences. Exhibition spaces can also transcend the perception that artworks that were made without the consideration of multisensoriality must be seen as finished products, rather creating and inventing alongside artists; adding a smell, a playful seating arrangement, or tactile, flavorful and sonorous elements.

As I have shown from the beginning of this thesis, the interconnections and ties between exhibition spaces and imperialism are so powerful that dominant imperial structures cannot be dismantled overnight. Yet, little by little, we can intervene in these spaces and change them. We can gradually decolonize them through our experiences and engagements. In conclusion, the personal and the institutional level should support each other for a faster, more collaborative, effective and affective process of refusal, of redistribution of the sensible and, most importantly, of the general decolonization of the exhibition space.

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7   References

Alzugaray, P. (2013). On attachments and affections. In M. Weinhart & M. Hollein (Eds.), *Brasiliana: Installationen von 1960 bis heute* [Brasiliana: Installations From 1960 to Today] (pp. 84–87). Schirn Kunsthalle Frankfurt.

Arnall, G., Gandolfi, L., & Zaramella, E. (2012). Aesthetics and politics revisited: An interview with Jacques Rancière. *Critical Inquiry,* 38(2), 289–297. https://doi.org/10.1086/662743

Azoulay, A. A. (2019). Plunder, objects, art, rights. *Potential history: Unlearning Imperialism* (pp. 55-119). Verso.

Azoulay, A. A. (Director). (2022). the world like a jewel in the hand [Film].

Azoulay, A. A., & Dimitrakaki A. (2024, March 1). Gaza, Truth, and the Anti-colonial Injunction: An Interview with Ariella Aïsha Azoulay. *Third Text: Critical Perspectives on Contemporary Art and Culture.* http://www.thirdtext.org/thinkinggaza-azoulay

Buggeln, G. T. (2012). Museum space and the experience of the sacred. *Material Religion*, 8(1), 30–50. https://doi.org/10.2752/175183412x13286288797854

Butler, J. (1993). *Bodies that matter: On the discursive limits of "sex."* Routledge.

Caldas Filho, J. (2023). *Big Bang Boca, Installation Views* [Photographs]. Danniel Rangel Inc. https://dannielrangel.com/work/big-bang-boca/

Crary, J. (1988). Modernizing Vision. In H. Foster (Ed.), *Vision and Visuality: Discussions in Contemporary Culture* (Vol. 2, pp. 29–50). Bay Press.

Crary, J. (1992). *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century.* MIT Press.

Dasgupta, S. (2019). Fuocoammare and the Aesthetic Rendition of the Relational Experience of Migration. In B. Dogramaci & B. Mersmann (Ed.), *Handbook of Art and Global Migration: Theories, Practices, and Challenges* (pp. 102-116). Berlin, Boston: De Gruyter. https://doi.org/10.1515/9783110476675-007

Davis, O. (2010). *Jacques Rancière.* Polity.

Etienne, N. (2021). Who cares? Museum conser-

vation between colonial violence and symbolic repair. *Museums & Social Issues, 15*(1-2), 61–71. https://doi.org/10.1080/15596893.2022.2057413

Fonseca, R. (2023). *Latin American artists: From 1785 to now.* Phaidon.

Goldstein, I., & Caiuby Labate, B. (2017). Encontros artísticos e ayahuasqueiros: Reflexões sobre a colaboração entre Ernesto Neto e os Huni Kuin [Artistic and ayahuasca encounters: Reflections on the collaboration between Ernesto Neto and the Huni Kuin]. *Mana, 23*(3), 437–471. https://doi.org/10.1590/1678-49442017v23n3p437

Howes, D. (2006). Scent, sound and synaesthesia: intersensoriality and material culture theory. In C. Tilley, W. Keane, S. Küchler, M. Rowlands, & P. Spyer (Eds.), *Handbook of Material Culture* (pp. 161-172). SAGE Publications Ltd, https://doi.org/10.4135/9781848607972

Iglesias, C. (2019). Maria Nepomuceno. In R. Morrill, L. Elderton, & C. Imizcoz (Eds.), *Vitamin T: Threads and Textiles in Contemporary Art* (pp. 198–199). Phaidon Press.

Instituto Artium De Cultura [@institutoartium]. (2023a, September 15). *Já veio visitar a exposição BIG BANG BOCA? A grande obra de Maria Nepomuceno é um sucesso de público e [Have you been to the BIG BANG BOCA exhibition? The great work of Maria Nepomuceno is a success with audiences and] [Video].* Instagram. https://www.instagram.com/reel/CxOiv1ZvMPL/?igsh=

Instituto Artium De Cultura [@institutoartium]. (2023b, September 22). *A @pambarja veio curtir a exposição BIG BANG BOCA, de Maria Nepomuceno, aqui no Instituto Artium. Tá esperando o que? [@pambarja came to enjoy the exhibition BIG BANG BOCA, by Maria Nepomuceno, here at the Artium Institute. What are you waiting for?] [Video].* Instagram. https://www.instagram.com/reel/CxgfA3hPVTL/?igsh=Mmw1ZDNpMnhzZ2Fm

Instituto Artium De Cultura [@institutoartium]. (2023c, October 6). *A exposição BIG BANG BOCA, de Maria Nepomuceno, está encantando quem passa pelo Instituto Artium, como bem mostra esse vídeo [The BIG BANG BOCA exhibition, by Maria Nepomuceno, is delighting those who pass by the Artium Institute, as shown in this video] [Video].* Instagram. https://www.instagram.com/reel/CyEfD0NPOFK/?igsh=MWRlY29iZjJ0MTdjbg%3D%3D

Jordan, E. (2023, July). *Ernesto Neto creates an offering of art that sparks joy* [Interview]. Whitewall. https://whitewall.art/art/ernesto-neto-creates-anoffering-of-art-that-sparks-joy/

Karina, A. (2022). Against and beyond the Museum. *Third Text, 36*(6), 651–662. https://doi.org/10.1080/09528822.2022.2145049

Kjellmer, V. (2021). Scented scenographics and olfactory art: Making sense of scent in the museum. *Konsthistorisk Tidskrift/Journal of Art History, 90*(2), 72–87. https://doi.org/10.1080/00233609.2020.1775696

Langhammer, F. (2018, July). *In the studio: Ernesto Neto* [Interview]. In Collectors Agenda. https://www.collectorsagenda.com/en/in-the-studio/ernesto-neto

Limorte-Menchón, C. (2018). Pensar con el cuerpo, una conversación con Ernesto Neto [hinking with the body, a conversation with Ernesto Neto]. *Arte, Individuo Y Sociedad, 30*(1), 211–217. https://doi.org/10.5209/aris.58781

Marks, L. U. (1998). Video haptics and erotics. *Screen, 39*(4), 331–348. https://doi.org/10.1093/screen/39.4.331

Maroja, C. (2019). The persistence of primitivism: Equivocation in Ernesto Neto's A sacred place and critical practice. *Arts, 8*(3), 1–13. MDPI. https://doi.org/10.3390/arts8030111

Matheus, I. (2019). *Blow, Installation Views* [Photographs]. Galerie Max Hetzler. https://www.maxhetzler.com/exhibitions/ernesto-neto-blow-2019

Meistere, U. (2020, May). *From Homo sapiens to Homo solidarius* [Interview]. Spiriterritory. https://spiriterritory.com/conversations/interviews/25139-from_homo_sapiens_to_homo_solidarius/

Metrópolis. (2019). *Exposição "Sopro" | Ernesto Neto* ["Blow" exhibition | Ernesto Neto] [Video]. YouTube. https://www.youtube.com/watch?v=FNHRkFRqNRk

Mulvey, L. (1975). Visual Pleasure and Narrative Cinema. *Screen, 16*(3), 6–18. https://doi.org/10.1093/screen/16.3.6

Porcel, A., & Artexte, E. (2020). Los textiles en el arte contemporáneo y su conservación. Estado de la cuestión [Textiles in contemporary art and their conservation. State of art]. *Arte, Individuo Y Sociedad, 32*(1), 173–194. https://doi.org/10.5209/aris.62865

Preciado, P. B. (2018). *Countersexual manifesto*. Columbia University Press.

Rancière, J. (2010). The paradoxes of political art. In S. Corcoran (Ed. & Trans.), *Dissensus: On Politics and Aesthetics* (pp. 134–150). Continuum.

Rancière, J. (2013). *The politics of aesthetics: The distribution of the sensible* (G. Rockhill, Ed.). Bloomsbury Academic.

Rangel, D. (2023). *Maria Nepomuceno - Big Bang Boca* [Exhibition]. Instituto Artium de Cultura, São Paulo, Brazil. https://www.institutoartium.com/exposicao/maria-nepomuceno-big-bang-boca

Rigamonti di Cutò, A. (2017, January). *Maria Nepomuceno: "I want to create a place where people can be suspended in time"* [Interview]. Studio International. https://www.studiointernational.com/maria-nepomuceno-interview

Santana, U. 2022. *Tarp-covered Sculpture Under a Brick Arch of Pinacoteca Art Museum in Sao Paulo* [Photograph]. https://www.pexels.com/photo/tarp-covered-sculpture-under-a-brick-arch-of-pinacoteca-art-museum-in-sao-paulo-13105508/

Scholte, T. (2022). Ernesto Neto's Célula Nave: Extending the lifespan of a temporary, site specific installation in a museum context. In *The Perpetuation of Site-Specific Installation Artworks in Museums: Staging Contemporary Art* (pp. 115–156). Amsterdam University Press. https://doi.org/10.2307/j.ctv25wxbgr.7

Teixeira Filho, F. S., & Cruz, M. G. A. (2017). Reflexões para a prática clínica ética-estética política a partir da arte de Ernesto Neto [Reflections for an ethical-aesthetic-political clinical practice through Ernesto Neto's work of art]. *Estudos Interdisciplinares Em Psicologia, 8*(2), 126–145. https://doi.org/10.5433/2236-6407.2017v8n2p126

The Brooklyn Rail (2022, January 21). *NSE #478 | Maria Nepomuceno with Ksenia M. Soboleva* [Video Interview]. YouTube. https://www.youtube.com/watch?v=agZ9eOFsG9o

Tolia-Kelly, D. P. (2017). Rancière and the redistribution of the sensible: The artist Rosanna Raymond, dissensus and post-colonial sensibilities within the spaces of the museum. *Progress in Human Geography, 43*(1), 123–140. https://doi.org/10.1177/0309132517739141

Venancio Filho, P. (2015). *Possibilities of the object: Experiments in modern and contemporary Brazilian art.* The Fruitmarket Gallery.

Vergara, L. G. (2018). Utopia antropofágica das raízes do Brasil [Anthropophagic utopia of the roots of Brazil]. *Poièsis, 8*(11), 135–152. https://doi.org/10.22409/poiesis.811.135-152

Volz, J. (2013). Life is a river. In M. Weinhart & M. Hollein (Eds.), *Brasiliana: Installationen von 1960 bis heute* [Brasiliana: Installations From 1960 to Today] (pp. 94–100). Schirn Kunsthalle Frankfurt.

Volz, J. & Piccoli, V. (2019). *Ernesto Neto: Sopro* [Exhibition]. Pinacoteca do Estado de São Paulo, São Paulo, Brazil. https://pinacoteca.org.br/programacao/exposicoes/ernesto-neto-sopro/

Weinhart, M. (2013). The Brazilian experience: An introduction. In M. Weinhart & M. Hollein (Eds.), *Brasiliana: Installationen von 1960 bis heute* [Brasiliana: Installations From 1960 to Today] (pp. 13–41). Schirn Kunsthalle Frankfurt.

Wesseling, J. (2017). *The perfect spectator: The experience of the art work and reception aesthetics.* Valiz.

Humanities

(Re)Building Nationality

a Comparative Study of Rijksmuseum in Amsterdam and National Theatre in Prague as Shaping National Memory

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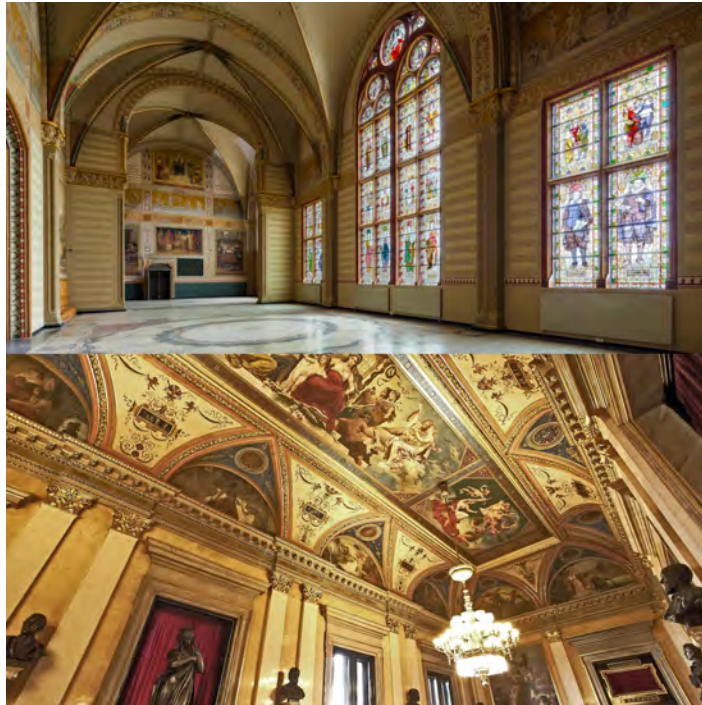
Rijksmuseum (top image; "The Great Hall"),
Národní Divadlo (bottom image; "An image").

Abstract

This capstone will compare Rijksmuseum in Amsterdam and National Theatre in Prague, more specifically, their decorative elements such as wall paintings and sculptures, as objects shaping national memory of respectively Dutch and Czech nation. To analyse their effects on collective memory, I will use Pierre Nora's, Aleida and Jan Assmann's, Joep Leerssen's, and Benedict Anderson's concepts relating to memory studies. I will apply their concepts to a visual analysis of a number of artefacts chosen from each building. The project will highlight the importance of art in creating national collective memory, as well as showcase memory studies' usefulness in analysing artworks.

Keywords and phrases: *cultural memory, nationalism, Rijksmuseum, Národní Divadlo, lieux de memoires*

Contents

Chapter I – Introduction

Nineteenth-century European architecture was dominated by one tendency – historicism (Gombrich 499). Especially in Western Europe, major cities became populated with monumental buildings attempting to replicate the style of eras past, such as Classicism, Renaissance, or Gothic (Gombrich 499). Many of them were both spaces open for the public, and places of national significance, such as 'museums, libraries, archives, and university institutes' (Jensen et al. XV). This trend in architecture can be seen as poised between three major shifts of the 19th century: firstly, the increased opening up of the public sphere and access to cultural institutions in public spaces (Jensen et al. XVIII), secondly, the change in the perception of history, and lastly, the perception of nation. The last two are closely intertwined. History became a matter of public interest in the 19th century, but the fascination with it often had a distinctly nationalistic angle, as the narratives from the past became primarily a celebration of national virtues that came to be seen as a representation of national character. (Jensen et al. XVIII).

Architecture reflected this perception of the nation, especially in the case of buildings representing governmental authority — the historical style emulated was meant to represent a specific era of a country, conjuring up a memory through its aesthetics (Gombrich 500). Perhaps the most recognizable example of this is the Westminster Palace, designed by Pugin and Barry (Gombrich 500), but there are many more in various countries that came to play a significant role in nations' identity, culture, and self-perception. I argue that this phenomenon represents a form of cultural memory, manifesting differently depending on the political situations of a community. Therefore, I believe that to understand 19th century European historicism, one needs to consider it from a memory studies angle: to grasp and articulate the connections between nations, nationalism, memory, and art, as well as to explain how these buildings reflected the community they were meant for.

In order to explore that, I will first establish crucial theories from the realm of memory studies, tracing the connections between the factors listed above, and then apply the concepts to two case studies – one located in the Netherlands, and one in Czechia. These two countries are rarely compared to one another, as they found themselves in diametrically different states during the second half of the 19th century – one of them, The Netherlands, a powerful colonial empire, and the second, Czechia, absorbed into Austro-Hungary along with many other nations. However, both of them produced monumental buildings in historicist styles, which came to occupy a major role in their self-image — the Rijksmuseum in Amsterdam and The National Theatre in Prague, in this paper referred to by its Czech name, *Národni Divadlo* (Hüttel et al. 12; Reynaerts 260). By comparing them, I aim to show how buildings depict the nation they are meant to represent and thus interact with cultural memory, interpreting, shaping, and influencing it. Through this analysis, I will attempt to show the usefulness of looking at art history from a memory studies standpoint and intrinsic connections between the two, especially in the 19th century.

Chapter II – National Character and Memory

Before attempting to retrace the relationship between art, nationalism, and memory in the light of case studies it is necessary not just to establish these key terms but also ground them in the 19th century context. Both the Rijksmuseum and *Divadlo* seek to portray a nation, but that on its own is a famously abstract and complex idea (Leerssen, *National Thought* 15). To some extent, it relies on a metaphor, as a nation is an imagined community. Despite the fact that even in the smallest nation, its members cannot know all of their fellow countrymen personally, they still feel connected to them (Anderson 6). Joep Leerssen describes the concept of a nation as hovering between 'three poles' of shared elements (Leerssen, *National Thought* 16). The first one is society (based on shared communication and conditions), second culture (shared language, habits, and history), and third race (shared descent) (Leerssen, *National Thought* 16).

However, national identity is not only composed of shared characteristics. Another crucial factor is the perception and articulation of external differences, as every country sees itself as explicitly different from all other nations (Anderson 7). National identity arises from perceived similarities to each other and divides with external communities. Both of these features are visible in the case studies

analysed in later chapters. For example, the decorations of the *Divadlo* portray characteristics of Czechs that are not just inherent to the nation, but also distinctly separate from the rest of the Austro-Hungarian empire.

Since a construction of self image is a vital factor creating a need for identity and sovereignty, it often coincides with nationalism (Howlett-Martin, 13). It can be seen as 'an ideology (or ideologies), a political movement, a symbolic language, and a type of national sentiment and national consciousness' (Smith, *The Nation Made Real* 7). According to Benedict Anderson, the key elements of national imagery are perceiving the nation as limited, sovereign, and as a community, since it will always think of itself as an equal comradeship, despite the factual discrepancies (7). It is that last aspect that makes nationalism powerful enough for people to willingly die for it (Anderson 7). The fact that such abstract notions can have this much power and influence on a nation's citizens might be surprising, but this force, Anderson believes, stems from 'the cultural roots of nationalism' (7). This assertion is crucial when considering cultural objects depicting national and nationalistic themes, like the two buildings in question. One might think of them as just decorative artefacts, but, according to Anderson, they can have palpable influence over entire nations.

Nationalism overall can be seen as a 'cultural phenomenon,' something that stems from people's view and description of the world and relates to both political and material growth, as well as intellectual and artistic reflection (Leerssen 14). Moreover, it is not stable, as it is actively involved in the historical process and has its own dynamics and development. This aspect of nationalism is often reflected in art, since it can take drastically different forms depending on the country and its political situation; it is not a stable and homogenous force.

The cultural elements of nationalism, like language and symbols, are specifically what links an abstract ideology with attitudes of the population it relates to (Smith, *National Identity* 73). The notions crucial in the construction of the self-image of a nation – authenticity, autonomy, natural community – are expressed through cultural products, such as recreations of events, nature symbols, or historical memorials(Smith, *National Identity* 73). Notably, these characteristics of the nation are represented in its culture even when they are not fulfilled in re-

ality. For example, Czechia was not an independent country at the time of constructing the *Divadlo*, yet it nevertheless presents itself as autonomous in artistic representations like decorations. Through cultural products, these concepts shift from abstract and distant to symbols that members of the nation can easily identify with and get emotionally attached to (Smith, *National Identity* 77). When a citizen, for example, participates in national ceremonies, they experience the community's emotions and virtues, and through this affective process, strengthen their national identity (Smith, *National Identity* 78). Such processes can occur at every scale, as cultural symbols of a nation can be ingrained in small, everyday objects, such as iconography on coins and stamps (Leerssen 188) – however, in this paper, I examine much more monumental examples as my case studies.

They are, however, embedded in the context of a very specific moment in the development of nationalism – its 19th-century form. It emerged from eighteenth century philosophical roots, such as Herder's notion of individuality of nations, or Rousseau's concept of sovereignty (Leerssen 125). Additionally, it was influenced by the general discussion of national characteristics and peculiarities, evoked by Napoleon's imperial campaign, as well as contemporary cultural notions (Leerssen 125). According to Leerssen, 19th century nationalism can be described as taking three main forms, although sometimes they could function at the same time or mix (Leerssen 135). The first one was centralist nationalism and its goal was to culturally unite citizens into a uniform collective (Leerssen 135). The second type is unification nationalism, occurring when a community was scattered over various states, and it meant to join them together into a communal whole (Leerssen 135). Lastly, Leerssen described separatist nationalism, which can be observed in multi-ethnic states, like empires (136). My preliminary argument (that will be later verified in the analytical section) is that in regard to my case studies in the context of the 19th century, 'separatism nationalism' applies to Czechia, and a form of 'centralist nationalism' could apply to the Netherlands. This assessment of 19th century Czech nationalism corresponds with most of the scholarship on the subject. For example, Dalbior Dobiáš states that it began as 'the main expression of liberal anti-absolutism,' specifically countering the Habsburg rule. Similarly, Marta Fil-

ipová argues that its main goal was to establish a vision of 'the Czechs as a more or less independent nation within the Austro-Hungarian monarchy' (27), and Anthony Alofsin writes that the Czech national revival was largely fuelled by the conflicts with Germans stemming from the suppression of the Czech language (33). All of these arguments seem to support the reasoning that Czech nationalism was separatist. The latter claim regarding the Netherlands seems to at least partly align with Joep Leerssen's description of the 19th century Dutch nationalism – according to him, it was mainly defined by centralising efforts of both Louis Bonaparte and Willem I, which 'marked a transition from a loose ancient-regime federal republic into a 19th century centralized monarchy' (Leerssen, *Background: Nationalism in the Dutch state*).

However, there still existed overlapping elements in the different manifestations of nationalism, and one of those is the notion of national character. Redefined by Romantic idealism, it came to be perceived as a 'spiritual principle' – a nation's culture was understood as a 'manifestation of a nation's soul and essence' (Leerssen 126). Every nation perceived its identity as tied to its essence exemplified by national character (Leerssen 112). This shift has definitely been reflected in the nationalistic symbols of the time, which developed rapidly in 19th century art. Through numerous artistic genres – though painting was clearly of the most importance at the time (Potter 2) – nationalist artists could recreate the sights, sounds, and images of the nation, with historical authenticity (Smith, *National Identity* 92). They were often drawn to ancient beginnings of the nations, suggesting their antiquity and continuity (Smith, *National Identity* 92). Examples of this can be found in both case studies, as Rijksmuseum and *Divadlo* attempt to 'recreate' their nations' beginnings by portraying them in historical paintings: in the Dutch case, by the story of Claudius Civilis, and in the Czech case, by mythical origins embedded in Slavic folklore.

Therefore, the new model of understanding national character laid the foundation for its visual representations, and I argue that its two key characteristics defined by Romanticism – emphasis on symbolic, essentialized meaning, as well as the focus on nation's beginnings – are directly correlated with the decorative elements seen in both Rijksmuseum and *Divadlo*. Specifically, I believe they are reflected in the usage of allegory and the thematic emphasis on the ancient beginnings of each nation, which will be the elements of both case studies I will focus on in my analysis.

I will examine them by first providing their historical context, then describing both buildings briefly, and later zooming in on specific decorative elements that illustrate either the portrayal of ancient beginnings of Czechia and the Netherlands, or the use of allegory. I will use the term as meaning a visual form presenting one thing in form and another in meaning, created by a sequence of metaphors (Melion and Ramakers 4). More specifically, I will be analysing examples of personification allegory, which transform abstract concepts into a human-like form.

The subjects of my examination will be described as representative of historical art, which itself was a highly debatable term in Romanticism. As it does now, historical art depicted distant events, but at the time, the genre could also include contemporary happenings that were perceived as potentially having a historical importance (Potter 3). For the sake of clarity, I will only analyse art aligning with the more conventional understanding of the term – portraying moments significantly distant from the time of its creation.

The goal of this analysis will be, as indicated in the introduction, tracing the connections between the case studies and cultural memory, and I will do so by using the definition coined by Jan and Aleida Assmann as well as the concept of *lieux de memoires* described by Pierre Nora. Cultural memory, a concept introduced in the 1980s by the Assmanns, occurs when abstract and non-specific forms of 'history' are transformed into collective 'memory' (A. Assman 52), in the forms of shared knowledge and communal participation (A. Assman 65). Through this process, what may be perceived as distant historical events becomes something personal and emotionally significant, a part of a community's identity (A. Assman 65).

According to Jan Assmann, cultural memory can be seen as a grouping of various texts, rituals, and images that are both specific to the society and the epoch they represent, but can also be reused to further stabilise and strengthen the community's image in the future (126). Its core consists of mythical events, usually from the ancient past, but sometimes also from relatively recent history, which are seen as a foundation of the community (Erll 28, 34). They are meant to serve as guidance for the

present and give hope for the future (Erll 34). When the nation sees and accepts them as common history, these myths can function as legitimization of existing systems (Erll 34). These aspects of cultural memory are highly reminiscent of elements of nationalist iconography as described by Anthony Smith, and not coincidentally, as national identity is built on, among other factors, shared memories (*National Identity* 14). Cultural heritage plays a major role in constructing a nation's self-image, since it is 'through its heritage a society becomes visible to self and others' (J. Assmann 133).

Many forms of cultural heritage depict crucial, fateful moments in the history of a community it represents, and such moments are what Jan Assmann calls the 'fixed points' of cultural memory (J. Assmann 129). They mark cultural memory's 'distance from the everyday,' and exist in a different temporal sense than the community's lived reality, yet they still factor into the community's lives, since as its audience, the group maintains the memory of specific events portrayed in a given cultural product (J. Assmann 129). Such cultural production usually relies upon 'established, stable forms of expression,' and this rigidity in formation is one of the six clusters of cultural memory's central characteristics as defined by Jan Assmann (Erll 30). The remaining ones are 1) 'concretion of identity,' meaning that social groups derive their collective identity from cultural memory; 2) 'capacity to reconstruct,' relating the memory to present day; 3) 'organization,' as cultural memory is institutionalised and gatekept by chosen elites; 4) 'obligation,' since it creates a specific order of values differing in importance; and 5) 'reflexivity' – cultural memory 'reflects the group's lifeworld and its self-image' (Erll 29, 30).

One of the methods of tracing the relationship between cultural memory and cultural production in the field of memory studies is the concept of *lieux de memoires*, coined by Pierre Nora. It will be especially useful when analysing my case studies, as it specifically relates to 'memory, history, and nation' (Erll 23). *Lieux de memoires* are '*lieux* (places) in three senses of the word – material, symbolic, and functional' (Nora 18). Notably, they do not have to be physical objects, merely cultural artefacts in the broad sense (Erll 24). The second characteristic, the 'symbolic' aspect of *lieux de memoires*, is the most crucial, as it is the intentional ascribing of a symbolic meaning to a cul-

tural object that transforms it into a site of memory (Erll 25). In this sense, material, social, and mental cultural phenomena can all be seen as *lieux de memoires*, as long as the society they represent associates them with their past and national identity (Erll 24). At the same time, it is crucial to understand that they are classified as *lieux de memoires*, because they are no longer 'real environments of memory' (Erll 23). They are constructed because of the nation's will to remember (Nora 19), as loci evoking the nation's memory images (Erll 23). Created by a play of memory and history, their purpose is to stop time and establish the state of things, capturing 'a maximum of meaning in the fewest of signs' (Nora 19). A wide variety of artefacts can function as *lieux de memoires*, for example tangible objects such as monuments, artworks, geographical locations, but also much more abstract ones, including, but not limited to scientific texts, symbolic actions, historical figures, or calendar dates (Erll 23). In this paper, however, I will analyse one of the most conventional forms of *lieux de memoires* – national monuments, here expressed as a national museum and a national theatre.

Chapter III: Rijksmuseum, a Secular Church of a Nation

While the origins of Rijksmuseum are closely tied to the early 1800s, Louis Napoleon, and William I (Bergvelt 176, 177), the building known as Rijksmuseum today opened in 1885 (Reynaerts 245). It was designed by prominent Dutch architect Pierre Joseph Cuypers, but his original project was altered almost immediately after its realisation , parts of it restored only in the 2003–2013 renovation (Reynaerts 246).

Despite many controversies – the most important of which will be elaborated on in this chapter – upon its opening (Bergvelt 171), Rijksmuseum's impact on the Dutch nation and culture is undeniable. What proved to be especially influential were the decorations designed mostly by Cuypers, as well as the wall paintings by Georg Sturm. They were a significant part of the Dutch arts and crafts movement, and the idea of 'art of the nation,' as formulated by Cuypers and his collaborators, became quite prominent. The decorations in the museum are a clear example of cultural national-

ism, spreading throughout Europe since the mid-19th century and manifesting in various forms of public-use architecture (Reynaerts 246). According to Antoni Ziemba, the Rijksmuseum had three crucial symbolic functions, all stemming from the 'national revival movement' (Ziemba 10). It was supposed to signify a 'Gate to the City,' a 'National Palace of Art and History,' which was emphasised through the Dutch neo-Renaissance architectural forms, and lastly, the 'Sanctuary of Art and History,' a quasi-cathedral dedicated to the artistic heritage of the country (Ziemba 10). While all these elements comprise the symbolic meaning of the museum, what is most crucial for my analysis are the latter two, the combination of the focus on the nation and its art, as well as the church-inspired aesthetics.

However, starting in the 1870s, a phenomenon called 'verzuiling' became prevalent in the Netherlands (Reynaerts 256). Jenny Reynaerts translates it as 'compartmentalization,' but I will use the term 'pillarization,' as it is much more widely-used. Dutch society was divided into 'pillars,' clearly partitioned social groups based on religious and political differences (Reynaerts 256). Because of this, the concept of expressing common Dutch history, shared by everyone, was not as relevant in the year of Rijksmuseum's opening as at the beginning of its construction (Reynaerts 256). Consequently, 'much of the decoration' was removed in the 1920s (Reynaerts 256); however, they mostly returned in the 21st century renovation (Ziemba 28).

Before briefly discussing the changes made during the renovation, it is crucial to address the figure of the architect, Pierre Cuypers. He 'was the leading architect in the Netherlands at the end of the nineteenth century,' and participated in the medieval revivalist movement (Reynaerts 246). While he is mainly known for designing the Rijksmuseum and the Centraal Station, 'he also built many private homes and ... Catholic churches' (Reynaerts 246). His vision of Rijksmuseum, developed alongside the Minister for the Arts Victor de Steurs, focused specifically on the importance of the decorations, which were supposed to present Dutch art history to the Dutch public (Reynaerts 248).This was expressed mainly through Cuypers' neo-Gothic *Gesamtkunstwerk* (universal artwork), including stained-glass windows, terrazzo floors, and ornaments made from wood and metal (Pijbes 6). Cuypers aimed to portray art, science, and craftsmanship there, and he did so by the means of allegories, personifications, and historical scenes (Reynaerts 246).While other artists worked on designing these elements as well, they did not have much freedom, as Cuypers recorded and planned out even the smallest elements of the building (W. van Leeuwen 39).

What is worth noting, especially in the context of pillarization, is that the team behind Rijksmuseum's design was wholly Catholic. Pierre Cuypers himself, as well as his brother in-law Joseph Thijm, and Victor de Steurs, were Catholics, and their faith influenced the project (J. van Leeuwen 29). All of them strongly supported Catholic emancipation, occuring in the Netherlands in 1853, and this led them to focus not just on the Protestant Holland in their decorative programme (J. van Leeuwen 29), which turned out to be visibly influenced by their own image of Dutch art history (J. van Leeuwen 31). For them, the museum was meant to represent almost a secular cathedral placing art at the centre of life, a source of deep national significance (W. van Leeuwen 39).

However, Cuypers' ambitious vision was not completely preserved. As mentioned before, it did not take long for the decorations to be altered. The display space lost its clear layout, and the original decorations and frescoes were painted over (Ziemba 11). Even the exhibition's narration was changed, switching from showcasing national history to a less-national focused, chronological and evolutional history of art (Ziemba 11). These changes were nevertheless at least partly reversed by the 2003–2013 renovation, conducted under the motto 'return to the roots' (Ziemba 13) by two Spanish architects, Antonio Cruz and Antonio Ortiz, and French designer Jean-Michel Wilmotte (Ziemba 12). Many of the changes aimed to modernise the museum, particularly on the ground floor, but for the sake of this paper, the crucial alteration was the attempt to restore the Great Hall to its original state. During the renovations, the formerly misplaced terrazzo floor was reconstructed with the inclusion of the mosaic designs (Hoogevest 65). The stained-glass windows and the wall paintings were diligently restored, as well (Ziemba 13).

After the renovation, the new iteration of the Rijksmuseum was promoted as a museum of national history once again, and it was seen as a praise of the Dutch nation and the Netherlands (Ziemba 28). According to Antoni Ziemba, this approach and the

'return to history' motto shows a changed, apologetic attitude to the nineteenth-century patriotic and historic approach taken by Cuypers, which signals an explicit nationalistic motivation (11). Therefore, despite many changes in the design and the presumed intention of the Rijksmuseum, it is arguably not ahistorical to interpret it an expression of national art, and I will proceed to do so in my analysis.

A section of the Rijksmuseum I aim to specifically focus on, as I believe it is the most representative of Cuypers' goals, is the Great Hall (also referred to as Entrance Hall or Grand Hall; in Dutch, *Voorhaal*) placed next to the Gallery of Honour. It 'was intended as a point of departure for visitors' (J. van Leeuwen 31), as well as a space for parties and reception (W. van Leeuwen 45). According to De Steurs, the Hall was inspired by the cycle of 'human life and aspiration' (J. van Leeuwen 31), 'a microcosm of the world seen through the eyes of Cuypers and his brother-in-law' (Hoogevest 67). The wall paintings, encompassing the whole surface area and created under the leadership of George Sturm, an Austrian artist (Hoogevest 67). Their goal was to depict happenings and persons crucial to Dutch history (Hoogevest 67). At the same time, the stained-glass windows were meant to represent the history of art in its entirety (J. van Leeuwen 31). The windows are divided into three main sections, portraying three artistic disciplines: architecture, sculpture, and painting (J. van Leeuwen 31). Meanwhile, the intermediate windows picture Christian and pagan philosophy, as well as music and poetry (J. van Leeuwen 31). A feature worth noticing is that each window also depicts a medieval social class, referencing the guild system (J. van Leeuwen 31). While the entirety of the windows' iconography is arguably 'based on the notion of a cohesive cultural identity,' this element emphasises the Catholic Middle Ages, showing Cuypers' potential bias (J. van Leeuwen 31). Moreover, two of the artists portrayed, Willem van Heerle and Jan van Terwen, 'played almost no role in the Dutch art history at the time,' and their inclusion, arguably just for the sake of showcasing medieval and Renaissance artists, reinforces the focus on the Middle Ages (J. van Leeuwen. 41, 44, 55).

The wall paintings, another major part of the decorative programme of the Great Hall, combine historic scenes, images of representative artists and craftsmen, and allegories of the arts and sciences. They are divided into three tiers: the top one contains allegories for Love of the Arts, Self Sacrifice, Neighbourly Love, Science, Justice, and Faith; the second one comprises of 'paintings of youths playing with attributes of art, science, and crafts,' and the last one portrays crucial moments regarding Dutch art, science, and history (Reynaerts 250). The three walls of the hall are thematically divided: the east wall propagates the idea of love of art, the west focuses on science, and the south represents faith, hope, and love (W. van Leeuwen 45). The themes are portrayed either through historical paintings, or through allegory (W. van Leeuwen 45).

This set of elements establishes what Cuypers and Sturm, deem to be the Dutch 'national character' (as defined in the Chapter II). One can identify a few key tendencies present – the focus on the Middle Ages, the blend of both pagan and Christian representation (and within that, references to Antiquity), and representing specific virtues as part of the national history. The construction of Dutch national image and, therefore, Dutch national memory in the Great Hall, depends on these three key elements.

The preoccupation with Middle Ages is visible both on the stained-glass windows in the representations of the medieval guilds and aforementioned portraits of van Heerle and van Terwen, as well as on the wall paintings, many of which present events from Dutch medieval history (such as the ones portraying Jan van Schafeelar and William the Good). Moreover, this focus is reinforced by the very form of the neo-Gothic building, which has been commonly compared to a cathedral due to its layout and *Gestamkunstwerk* (W. van Leeuwen 39). Arguably, this is the aspect of the building most influenced by the fact that its designers were Catholic, as their view of Dutch history places the Middle Ages, not the Golden Age, in the centre, therefore highlighting a time before the Reformation (J. van Leeuwen 29). Crucially, Cuypers and Sturm do not present the Dutch national character as completely Catholic, as they do not include only medieval history (the Golden Age is represented as well, for example in the painting showing Jacob van Campen), but they do include it as an important part of the national memory they aim to express or construct. By emulating the aesthetics (or the imagined aesthetics) of Roman Catholic Middle Ages in Rijksmuseum's design and portraying mo-

Figure 1: Rijksmuseum, ca. 1900 (Atelier Herz).

Figure 2: Great Hall, ca. 1908-1909. Cuypers' and Sturm's decorations ("Voorhaal naar het").

Figure 3: Great Hall, 1904-1910 ("Voorhal gezien naar").

Figure 4: Great Hall, ca. 1955-57. State of the Hall after the removal of most of the decorations and wall paintings ("Overzicht centrale").

Figure 5: Great Hall, 1988. All of the wall decorations removed ("Voorhal met informatiebalie").

Figure 6: Great Hall, 2012. State after the 2003-2013 renovation (Linders, *Interieur Voorhal,* [Photo 1]).
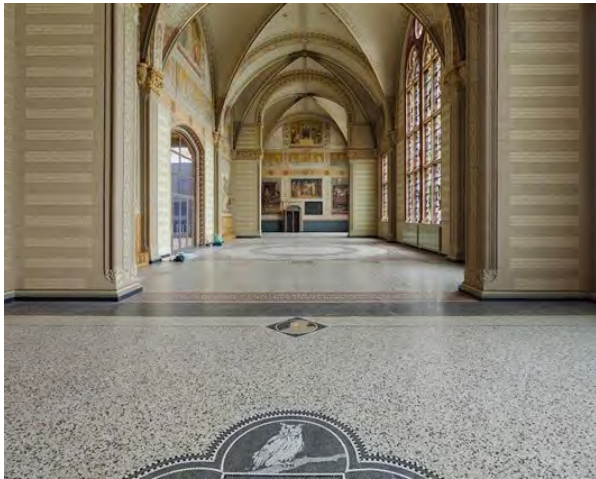

Figure 7: Great Hall, 2012. State after the 2003-2013 renovation (Linders, *Interieur Voorhal,* [Photo 2]).

Figure 8: Great Hall, 2012. State after the 2003-2013 renovation (Linders, *Interieur Voorhal,* [Photo 3]).

ments from it on the wall painting, they elevate this part of Dutch history to a 'fixed point,' as defined by Jan Assmann, a crucial, fateful event in a history of a community (129). At the time of pillarisation, this proved highly controversial, as it was seen as not representative of the 'predominantly Protestant nation' (Reynaerts 256).

However, Cuypers' and Sturm's presentation of 'Dutch-ness' and Dutch history does not just include its Catholic or medieval elements. Another key aspect of the Great Hall is how it positions the Netherlands in regards to larger European history. By including Plato and Apelles next to Rembrandt, the artists seem to imply a continuity between Classical Antiquity and Netherlands. The

connection is particularly emphasised in the wall painting representing the (imagined) beginnings of the Dutch nation; chiefly, the painting portraying Claudius Civilis.

The artwork is meant to represent the Batavian revolt, an event very crucial to the Dutch national myth (Smith, *The Nation Made Real* 40). The man portrayed, known as Claudius Civilis, was actually named Julius Civilis, and 'was a Batavian auxiliary commander' (Dyson 264). He led the revolt of the Batavians against the Romans, initiating it on a 'ceremonial feast held in a sacred grove' (Dyson 265), and this very moment is shown on the Sturm's painting. Civilis became a source and prototype of the Dutch national character (Smith,

Figure 9: Great Hall, 2012. State after the 2003-2013 renovation (Gotink).

The Nation Made Real 39) in the sixteenth and seventeenth century, and the Batavians themselves served as 'proof' that the Dutch nation existed since antiquity (Smith, *The Nation Made Real* 40).

In the painting, Civilis is presented in the very centre, in a position typical for representation of leaders – *en face*, during an impassioned speech. Batavians are gathered around him, but the composition guides the viewer's eye solely to Civilis, as they look at him from the sidelines. While he does not stand out from his environment, as he is painted in the same shades as his companions, he does differ from the Batavians, mainly through his distinctly Roman armour. He is standing in front of the tree, whose branches mimic his gestures, implying a connection with nature.

An interesting aspect of the painting when one considers it as solidifying or constructing a national memory, and therefore national character, is that while it portrays an act of rebellion, the enemy against whom Civilis and the Batavians are rebelling is not visualised. They are not defined in contrast to the Romans, similarly to how the rest of the paintings do not define the Dutch in contrast to the Spanish, a historically significant enemy; they are defined simply by the act of uprising

itself. This aspect will be of additional significance upon the comparison with how the Czechs portray their enemies in *Divadlo*. Moreover, while the Batavian myth is deemed mostly a literary construct by Anthony Smith, it is nevertheless grounded in Tacit's records (41). Here Sturm is attempting to recreate it accurately (unlike, for example, in Rembrandt's portrayal), as the Batavians are dressed according to the era, and the sacred grove is visible in the background. There is much scholarly debate over whether there is a clear goal or leitmotif in the iconography of the Entrance Hall, including Sturm's paintings. Ellinoor Bergvelt argues that in this case, the only aim of Cuypers and Sturm was to show Amsterdam as a 'centre of arts and culture,' while Jenny Reynaerts, the former Rijksmuseum's curator of nineteenth-century paintings, states that there is a clear agenda of promoting art, science, and culture (Delvigne and Heij. 40). I agree with Reynaerts' claims, but I do argue that Cuypers' and Sturm's goals are more extensive; the historical accuracy of the painting of Claudius Civilis, combined with the extensive historical research conducted by Cuypers (Delvigne and Heij 39) leads me to believe that they wanted to achieve more in the decorations than just to promote art, science and culture. As Delvigne and Heij write, Rijksmuseum was intended to be a museum of not just art, but also history (40). The careful, detailed representations of crucial moments of Dutch history shows that Sturm and, by extension, Cuypers, might have aimed to construct a memory, or rather, to invoke an environment of a memory long forgotten and slightly mythicized, a *lieu de memoire*.

The portrayal of Civilis seems to match Nora's definition – it is not a real environment of memory, but it calls up the memory image of a nation, here specifically the Dutch as the nation stemming from a revolt. It remains functional as a decoration, but its main purpose is ostensibly to capture a maximum of meaning in the fewest of signs' (Nora 19). Sturm accomplishes this by appealing to a well-known event in Dutch history, and presenting a crucial snapshot of it. Through this, he constructs a timeline of 'Dutch-ness' and Dutch national memory as beginning with Claudius Civilis, establishing not only a 'fixed point' in the cultural memory, but also signalling what an ideal 'Dutch character' could be (Smith, *The Nation Made Real* 39).

This concept of constructing a national identity through presenting characteristics of both the

nation as a collective and a citizen as an individual is further developed in the rest of the Great Hall. As mentioned before, each wall has an allegory of a specific virtue at the very top – specifically, there are allegories of the arts, of prudence, justice, and moderation, self sacrifice, hope, faith, and love, charity, patriotism, and of the sciences (Delvigne and Heij 55, 56, 58). These virtues establish the Dutch as a nation accomplished in arts and sciences (as the historical paintings below each allegory prove), connecting Dutch identity to both emotions and civil principles. One can also notice the similarities between them and the seven Catholic virtues, perhaps another sign of Cuypers' religion influencing the design. They construct a vision of what an ideal Dutchman should be – just, prudent, moderate, charitable, patriotic, among others – and ground this vision of national character in historical events, as each allegory corresponds to the historical scene below it. To examine this further, I will analyse the allegory above the aforementioned painting of Claudius Civilis, one that perhaps can reveal the most about how Sturm and Cuypers imagined the Dutch – an allegory of patriotism.

Placed above the entrance to the Great Hall, the allegory comprises five figures, the central one presumably being the personification of patriotism itself. Like all other personifications in the Great Hall, it is a woman, this time standing on a podium, dressed in armour and wielding a Dutch flag. Her garments resemble those worn by Claudius Civilis, a metal breastplate, metal belt, presumably a leather cloak. She also has a helmet, presumably meant to be Ancient Roman. She is surrounded by three men and one woman, the two men on her right are scantily dressed in clothes similar to those of Civilis' companions, yet still armed. The man on her left is much older, dressed in a toga and holding a lyre, while the woman is kneeling down, presumably handling an instrument that serves to keep the nearby fire going.

From this description, one can gather much information on how Sturm's defines patriotism. He portrays it as connected to war and armed struggle, as both the personification of patriotism herself and her companions are armed, looking ahead, as if awaiting an enemy. Once again, Sturm portrays an act of resistance against some other force (in this case, more so a defence), but the opponent remains invisible. This leads me to believe that the

nationalism represented here treads a fine line between the two different kinds of nationalisms as described by Leerssen – centralist nationalism, as it tries to define the Dutch as a whole and not in particular opposition to a specific oppressor, and separatist nationalism, as it still portrays the nation as resisting against something unspecified. However, arguably the depiction of 'defending' the Netherlands could just serve to highlight one of the key elements of national imagery, as listed by Anderson, namely sovereignty.

At the same time, patriotism portrayed by Sturm seems to be also rooted not just in identification with the military, but also in culture. This is represented by the man on the left, and its key characteristic is that culture is never-ending, as symbolised by the ongoing fire. Interestingly, all the people portrayed in the allegory are white, which is not the case in all allegories in the Great Hall (a counter-example: the allegory of self-sacrifice), perhaps implying that patriotism is a virtue for the ethnically Dutch people. Moreover, while the personification of patriotism is a woman, she does not seem explicitly sexualised, as her body is covered in armour. This creates an impression of respect and authority around the figure, underscoring the importance of the virtue portrayed.

While the allegory does not portray a specific historical event *per se*, its context is grounded in one – the Civilis painting below – and bears some similarities to products of cultural memory, as defined by Jan Assmann. It surely 'serves to stabilize and convey that society's self-image' (J. Assmann. 132); here, it defines what a patriotic member of Dutch society should be. Drawing on the visual analysis, it calls on a Dutch person to base their patriotism on supporting the military endeavours of the country, through that assuming a perception of the nation as autonomous and separate from others, take pride in the culture, and upkeep these patriotic feelings forever. Therefore, it portrays a form of 'national character,' as described by Leerssen, an essence of the Dutch nation, here constructed around the three characteristics. By the references to the ancient past of the country, expressed by the garments worn by the figures, it also presents the national community as natural, grounded in long, quasi-mythical history. The connection between the two paintings described presents the link between nationalism and its cultural roots clearly. They show how the nation has

originated, take the character of Claudius Civilis as an archetype, and by placing an allegory of patriotism above him, instructs the viewers to follow his example, reinforcing the nationalistic values embedded in this portrayal of Dutch history.

Figure 10: *Claudius Civilis predikt den opstand tegen de Romeinen* (Claudius Civilis preaches the revolt against the Romans) by Georg Sturm (Englesman and Rebers).

Figure 11: *Allegory of Patriotism* by Georg Sturm (Burdzińska).

Chapter IV: *Národni Divadlo* – the Czech Parthenon

The second case study, *Národni Divadlo*, is deeply embedded in the context of the Austro-Hungarian empire, a 'collage' of multilingual nationalities, which was never unified into a homogenous nation-state (Alofsin 2). Its Czech-speaking provinces – Bohemia and Moravia (Alofsin 2), as well as parts of Silesia – experienced a revival of the classical tradition in the visual arts in the last third of the nineteenth century, coinciding with political developments focused on the fight for Czech national self-determination (Bažant 133). One of the ways this process manifested was in the drive for a new and separate, genuinely Czech national theatre, which started to 'take shape at meetings of Czech patriots and intellectuals' (Bakal 31). However, the process of actually building *Divadlo* proved long and difficult, ultimately lasting 38 years. Firstly, while the Austrian emperor Franz Josef I approved the Czech petition regarding the theatre, he did not allocate any funds for it, therefore it was mainly sponsored through independent fundraisers (Bakal 31). Moreover, in 1881 a large portion of the building burned down in a fire, and the reconstruction delayed the opening further (Hüttel et al. 6). In the end, *Divadlo* opened on November 18, 1883 (notably, less than two years before the Rijksmuseum), and more than thirty representatives of various Slav peoples were invited to celebrate with the Czechs (Kimball 78).

Divadlo was the most successful monumental building in Prague in the 19th century, and for the Czechs, it was proof of their own national strength (Hüttel et al 12). The entire nation was deeply invested in the process, keeping up with the construction and decoration developments (Dvořák 27). It was seen as a collective, national dream (Šubert 2), a fulfilment of a long struggle and a promise of expansion of Czech culture (Kimball 85). Moreover, it was seen not only as 'evidence of the vitality of the Czech national life, but also a good example of Slavic 'communality and solidarity'(Kimball 77). *Divadlo* was even called 'the Cathedral of National Rebirth,' a Czech equivalent of the Athenian Parthenon, 'as classical tradition in art was, and still is, an important part of Czech self-definition' (Bažant 134). The national importance was even strengthened by the fact that it was funded by Czechs themselves, not by the Emperor. It was a

gift 'from the nation to itself' (Kimball 85), or *Národ sobě*, as proclaimed by the letters embossed over the curtain in the main auditorium.

The amount of artists that worked on the *Divadlo* led to coining of the term 'The Generation of the *Narodni Divadlo*,' which included, among others among others, Mikoláš Aleš, Vojtěch Hynais, and František Ženíšek (Dvořák 27). However, the central figure was naturally the architect, Josef Zítek. Even though he was born in Prague's suburbs, he received a cosmopolitan education in Vienna and spoke only German (Alofsin 32–33). At some point, his background became a subject of criticism in regard to him being in charge of designing a building of such national importance – what was specifically seen as controversial was the fact that his wife was German (Alofsin 40). One cannot help but notice certain similarities between him and Pierre Cuypers, both never quite representative of the nations they designed for. Another parallel is how quickly their original projects were altered. Zítek did not even manage to complete his design, as after the 1881 fire, a new architect, his student Josef Schulz, was brought in to alter the plans (Nolte 60). However, as his revisions touched mainly upon practical amenities (Nolte 60), Zitek's vision remains dominant in *Divadlo*'s decorations.

The building was seen as the peak of monumental neo-Renaissance, embedded in the context of the Prague architecture and linked to many Baroque churches by its characteristic dome (Bažant 137). Inside, Zitek combined classical elements such as arches, pilasters, and columns with iconography strongly signalling national revival (Alofsin 42). There is, however, a spatial divide in the themes. Most of the theatre is indeed dominated by the classical decorations and motifs, and the national, domestic themes are largely concentrated in the foyer (Vybíra 33). The painters Mikoláš Aleš and František Ženíšek introduced domestic themes to the walls and ceiling of the foyer, representing the history and the resources of the nation (Vybíral 33). Their paintings are the culmination of the nationalistic agenda of *Divadlo*, fulfilling the promise '*Nation to itself*' (Vybíral 33). They are, however, still placed against a neo-Renaissance, classical backdrop, as Ženíšek called the foyer '[a] Renaissance hall, transported to the north from Italy' (Vybíral 33).

This combination of classical references and Czech-centric, Slavic imagery defines the key ten-

dencies in the decoration of the *Divadlo*, alongside some Christian elements. The Christian iconography represents the religion of the nation, but, unlike in the Rijksmuseum, it was not a point of contention. In this case, religious themes did not play such a major part in the construction of national image. The other factors seem much more prevalent and impactful. The classical language of the decoration could be seen as just an aesthetic choice, popular at the time of historicist architecture. However, as already mentioned, the revival of classical tradition in visual arts was a crucial part of the Czech national movement (Bažant 113). The official Czech website of the theatre to this day states that 'the neo-Renaissance style became a means of expression for the Czech National Revival, and a symbol of the nation's patriotic ability to manage its own affairs in art and politics' (Bažant 134). While at first, the classical tradition in Prague conformed to European and German standards, it came to be associated with the national revival, as it seemed to legitimise Czechia as a European nation, able to construct such monumental buildings for national institutions (Bažant 139) That is why, even though at first glance it could seem a neutral choice, fitting with the architecture of the rest of the Austro-Hungarian empire (Alofsin 31), it still carries national and pro-Czech meanings.

However, it is not the classical vocabulary of *Divadlo* that elevated it to be perceived as the most prominent expression of the Czech national revival in the Czech imagination (Bažant 139). After all, a similar building more aligned with neo-Renaissance style, the National Museum, is seen as less important when it comes to national monuments in Prague (Bažant 139). An element that *Divadlo* has, but The National Museum lacks, are the many decorative references to Czech history and Slavic folklore (Bažant 139). Most of them were concentrated in the foyer – for example, the *Homeland* cycle, arguably the best-known element of the decorations, was placed in the lunettes of the foyer.

In the *Homeland* cycle, described by Hüttel as 'the most monumental Czech visual poem' (Hüttel et al 208), Mikoláš Aleš aimed to portray the Czech struggle by showing the journey of a mythical character through the countryside of Czech Kingdom, facing the enemies of the nation (Daňhelová 110). Crucially, Aleš' goal was not to portray specific historical events nor ancient gods; while he was fascinated by landscape, which is clearly visi-

Figure 12: *Narodni Divadlo* seen from the opposite side of Vltava ("Praha Narodni Divadlo").

Figure 13: The ceiling of the main stage, decorated with the figures of the seven allegories of art (Pavlíček and Karel, "Strop s monumentálním").

Figure 14: The foyer of the *Narodni Divadlo* (Pavlíček and Karel, "Malířskou výzdobou").

Figure 15: The foyer of the *Narodni Divadlo* (Pavlíček and Karel, "Na stropě vyniká").

ble in his work, his main mission was to create a Czech modern myth (Daňhelová 115). The myth was nevertheless based on historical past and diverse sources. To prepare for *Homeland*, Aleš studied books about the lives of old Slavs, their folk costumes and embroidery, as well as their customs (Daňhelová 123). He wanted to make his hero a Slavic everyman to the point that he decided on how he would look based on what he interpreted as the most typical Slavic characteristics (Daňhelová 123). His commitment to inspire patriotic feelings through his art was arguably successful, as *Homeland* has been described as the most indicative of the mission of *Divadlo* as a whole (Dvořák 39), elevating the space of the theatre to what has been called 'The Temple of Rebirth' (Daňhelová 123).

The third lunette from *Homeland*, titled *Domažlice*, truly illustrates Aleš' goals and is the one I will focus on in my analysis. It shows the hero at the start of his journey, encountering his first struggle, as near the city of Domažlice, he is confronted with the ghosts of his homeland's many enemies (Burian 22). At this point, he realises the gravity of his mission and 'readies himself for the fight to come' (Burian 22). As seen in the figures 18 and 19, the hero is facing away from the viewer, consumed with watching the ghosts behind him. His clothes are vaguely reminiscent of medieval Slavic garments, but they are not specific enough to anchor the scene in a particular time period, aligning with Aleš' concept of creating a mythical, timeless tale. The ghosts themselves also seem quite

Figure 16: The foyer of the *Narodni Divadlo* (Pavlíček and Karel, "Výzdobou foyeru").

ambiguous in their identity. One cannot see distinguishable symbols that would help to guess which countries or lands they represent. Some of them are just skeletons, while others are in human form, holding bows or a horn. One of them also seems to have wings, perhaps a reference to the winged demons from Slavic mythology, *strigas*. The scene is set against a backdrop of a night landscape, with a full moon on the left. Only the foreground, where the hero is positioned, is illuminated by its light, dividing the world of the living from the world of the dead.

In a way, *Domažlice* fulfils similar functions as Sturm's painting depicting Claudius Civilis. Both works portray a hero representing the national spirit at the beginning of his journey, presumably at the moment when they decide to take action. There are, however, obvious differences. While the story

of Civilis is likely fictionalised, he is nevertheless a historical figure, which cannot be said about Aleš' hero. Moreover, while both artworks portray a moment inciting a rebellion or act of defiance against the enemies, here the enemies are a much bigger part of the narrative. One may not know exactly who they are, but they are visible, confronting the hero. It is also vital to note that in a later part of the cycle, *Northern Passes* (Figure 20), the hero's enemies are identified specifically as the Germanic people, and they do bear visual similarities to the ghosts in *Domažlice*. Therefore, perhaps the enemies there remain ambiguous for political reasons, since the Czechs were still a part of the Austro-Hungarian empire during the construction of *Divadlo*. Because of this, arguably, Aleš could not portray the opponents of his hero explicitly as, for example, Austrians. Nevertheless, the very fact that he does show them defines the Czech hero in contrast to his enemies, not just by the act of uprising, which is a stark difference to Sturm's Civilis. His portrayal of his nation aligns with Leerssen's statement that a nation is an 'interplay between Otherness,' in this case, the Germanic enemies, 'and self-image' (Leerssen 17), represented here by the Aleš' hero.

Another crucial contrast is the presence of the supernatural in *Domažlice* and *Homeland* as a whole. Aleš portrays the magical elements of Slavic folklore and mythology explicitly, including dragons, pagan gods such as Veleš, or fairies. These aspects surely strengthen Aleš' goal of creating a myth and, more importantly, articulate the difference between the Czechs and the rest of the Austro-Hungarian empire. While he might not portray the empire as the enemy *per se*, the fact that he includes Slavic folklore sends a clear message stating that the *Divadlo* is for the Czechs, and they are a separate nation with their own culture and mythology. This also reinforces my previous assumption that *Divadlo* is an example of separatist nationalism – the emphasis on Czechs' differences from the rest of the empire proves it.

Naturally, one could see the inclusion of the supernatural as at odds with the concept of *Homeland* as a *lieu de memoire*, or attempting to construct a cultural memory. However, I argue that *Homeland* could still be perceived as such. Firstly, the careful research Aleš has done in preparation for the cycle shows that he aims to at least partly reconstruct a memory of Czech history. Moreover, cul-

tural memory is often based on events of a distant past 'within mythical time,' which serve as foundational to the community, offering 'orientation in the present and hope for the future' (Erll 28, 34). Arguably, *Domažlice* and *Homeland* fulfil this definition. By showing a parable of the Czech struggle against their enemies, even if articulated as supernatural beings, it guides them in their acts of separation from the Austro-Hungarian empire and creates a mythical past. Aleš' does not attempt to show a specific event in Czech history, rather, his work could be seen as a metonymy of all Czech oppression, encompassing larger parts of their past. This fantastical version of the past in a way seems appropriate as a representation for a nation – as Anderson writes, nation 'is an imagined political community' (6), and in this case, is bounded by both real and imagined history.

A case for *Domažlice* as a *lieu de memoire* is more complex. Surely, it is not a 'real environment of memory,' as it is a story constructed by Aleš, which matches Nora's definition. However, its very artificiality could be seen as disqualifying it from being a *lieu de memoire*, posing the question whether a myth imagined by an artist could function as a form of memory. I argue that to some extent it does, at least when one considers Nora's assertion that *lieux de memoires* are created 'by a play of memory and history', and they serve to 'stop time and establish the state of things' (Nora 19). While Aleš' mythical hero did not exist, his story is woven out of memories and history of the Czech people. The story is inspired by true events, it is just condensed and mythicized, which arguably complies with Nora's concept of *lieux de memoires* 'capturing a maximum of meaning in the fewest of signs' (Nora 19). A crucial characteristic that makes a cultural phenomenon qualify to be seen as a *lieu de memoire* is its association with past and national identity (Erll, 24) and Aleš' cycle was definitely perceived as such.

However, while *Homeland* might be the most recognizable series of decorations in *Divadlo*, it was hardly the only one capturing national themes. Another cycle, this one created by Václav Brožík – a lesser known artist involved in decorating the theatre – is placed on the staircase, and is much shorter. It depicts allegories of the Czech lands, among them Bohemia, Moravia, and Silesia (Štech 134), all presented as women or girls. The one that I will focus on is the allegory of Prague, as I argue

it is the one most thematically connected to the *Divadlo* as a whole and the most representative of the cycle. Moreover, I think of all the allegories in *Divadlo* (of which there are many), this is the one most comparable with the allegory of patriotism in the Rijksmuseum.

Much like other allegories in the cycle, Prague is personified as a woman of ambiguous age; she is definitely not a girl, but she still seems young. Her looks are aligned with what Aleš considered the typical Slavic characteristics in his research for *Homeland*: pale skin and dark brown hair. She is seated on a throne, dressed in vaguely ancient garments, a white chiton with a red cloak. Beside her, one can see a skyline of Prague, with *Hradčany* castle visible on the left. In the foreground, there are many attributes lying around Prague's throne: on the right, there is a capitol of a Corinthian column, a part of a sculpture, and a palette. On the left, there is a musical instrument, perhaps a lute, with papers underneath, and Prague's coat of arms, which the personification of the city is holding. She is adorned with regalia, wielding a decorative staff and wearing a crown seemingly composed of Romanesque buildings on her head.

There are two crucial tendencies visible in this allegory, the emphasis on royalty and the land. The very fact that the city of Prague, alongside other lands in Czechia, is represented in allegorical form shows how important the actual territory occupied by the nation was to the Czechs. Naturally, this most likely stems from their situation as a part of the Austro-Hungarian empire. While there are no decorations outwardly opposing the Austro-Hungarian rule in the *Divadlo*, and there is even a painting depicting the Habsburg dynasty (Žákavec 286), the emphasis on marking the land of Prague as inherently Czech is an act of defiance against their oppressor. It shows that while the emperor might have jurisdiction over the Czechs, the territory of Prague, Bohemia, Moravia, and Silesia culturally belongs to them. This point is even strengthened by the royal elements in the allegory, Prague's crown, staff, and throne. By showing their former capital as a queen, it creates the Czechs' own hierarchy of power, disregarding the emperor, and shows their nation as a sovereign, despite their lack of independence, fulfilling one of the key elements of national imagery as described by Anderson (7

However, the inclusion of elements in the fore-

Figure 17: A reproduction of *Domazlice* (Ales, "Do-mazlice").

Figure 19: A reproduction of Ales' *Northern Passes* (Ales, "Severní průsmyky").

Figure 18: Ales' *Domazlice* in colour, seen in the lunette of the foyer (Pavlíček and Karel, "Detail of Aleš's lunette Domažlice").

Figure 20: *Allegory of Prague* by Vaclav Brozik (Pavlíček and Karel, "Detail of Brozik's Allegory of Prague").

ground might be a way to not just highlight the Czech ambition for independence, but also construct a vision of national character. One could argue that it could be just a representation of 'city character,' archetypes and essence inherent only to Prague, but as a capital, it can plausibly serve as a symbol of the nation as a whole. Therefore, Brožík shows the Czech national character as deeply connected to the arts and culture. The lute, papers (perhaps music notes or just a representation of Czech literature), the palette, the column, and the sculpture all present the importance of different art forms to Czech identity. In a way, they echo the portrayals of artistic disciplines placed on the ceiling of the main stage (Figure 13). The emphasis on the national character of the arts is even stronger in the context of the painting; after all, it is placed in a theatre funded by the Czechs themselves, 'from

the nation to itself.'

While the allegory of Prague has less obvious connections to cultural memory than the example from the Rijksmuseum, as it is not presented in tandem with a historical scene, it nevertheless constructs the nation's self image. It shows a form of essence of 'Czech-hood,' a defiance against the Austro-Hungarian rule by asserting the land as their own, and themselves as a royal nation, as well as identity deeply grounded in the arts. According to Erll, a product of cultural memory, upon being perceived by the community as an expression of common history, can legitimise existing systems (34). While the allegory is surely elevated to that role by the public perception of *Divadlo*, it shows that it can also cause the public to doubt the existing systems (the Austro-Hungarian empire) and believe in their own ones.

Chapter V – Conclusions

After examining both case studies individually in the previous chapters, it is evident that they share certain elements in the way they represent each nation and construct or interpret their collective memory. The three key similarities one can identify are the usage of neo-historical styles (neo-Gothic in Rijksmuseum and neo-Classicism in the *Divadlo*), the depiction of historical (or partly historical scenes) in the decorations, and the inclusion of various allegories. While the first aspect – the historicism in the overall design of the building – was a common practice in the second half of the 19th century, I believe Cuypers and Zítek used it for quite different reasons. The classical style, as elaborated on previously, is crucial to the Czech self-identification, therefore it strengthens the *Divadlo*'s goal to assert Czech national identity; however, Cuypers' decision to replicate medieval style, associated with the time of the Netherlands' Roman Catholic past, instead of the more obvious Golden Age, shows the influence of his own identity.

However, the other commonalities align more with the function of these buildings, and I believe they connect directly to national memory through specific visual narratives of each nation's history and their depiction of national character by allegories. The first of those elements is perhaps a common tactic in constructing cultural memory, the second is more 19th-century specific. While both use these elements, they do so differently, and I argue that these differences say the most about the two separate constructions of national identity and memory in my case studies.

The only almost direct parallel is the inclusion of allegories of the arts. One can attribute that to them being cultural institutions and therefore referring to the arts in general, as well as establishing a connection with the Ancient Greek idea of the muses. Both case studies feature allusions to antiquity, for different reasons. The *Divadlo*, mainly in its neo-Classicism connected to Czech visual tradition, and the Rijksmuseum presumably to position Dutch history as a continuation of antiquity, by the story of Claudius Civilis.

However, aside from the artistic allegories, the tendencies in the historical scenes and the rest of the allegories are quite different. The personifications in the Rijksmuseum focus mainly on representing virtues. As described in Chapter III, the wall paintings represent key characteristics comprising what Dutch society or individuals should be like, ranging from ones relating to science and justice to self-sacrifice and charity. Moreover, they are connected to the historical scenes directly, functioning as a form of an instruction for the Dutch audience; an ideal Dutch-man should be patriotic, by following an example of Claudius Civilis. This aspirational quality, the attempt at historical realism (unlike the folklore-infused visual history in the *Divadlo*), and the aforementioned emphasis on Catholicism are the three foundational elements of Cuypers' and Sturm's representation of Dutch national identity and memory.

The key tendencies in *Divadlo* are quite different. Instead of virtues, the theatre's decorators pay much attention to the historically Czech lands, both by aforementioned allegories, but also through paintings of landscapes, present in the foyer as well. Moreover, while Aleš did care about historical accuracy of his cycle to some extent, he included supernatural elements of Slavic folklore, making *Homeland* more of a parable than a straightforward historical narrative. These discrepancies between the two case studies could be partly attributed to them belonging to different cultures – there is much to be said about the influence of Western European and Slavic traditions on them both – but I do believe they are also connected to the geopolitical situations of each nation. Therefore, I argue that the differences in constructing (or attempting to construct) cultural memory, one can see a representation of different forms of 19th century nationalism.

The situation of Czechia is more straightforward. A nation within the Austro-Hungarian empire, striving for its own independence, is a textbook example of a separatist nationalism, as defined by Leerssen (136). One can see clear signs of this in the *Divadlo*; while there is no iconography directly defying the Habsburg rule, the emphasis on both the elements of culture unique to the Czechs, as well as the lands, asserting them as their own and therefore legitimising their claim of autonomy, showing separatist ambitions. *Divadlo* and its decorators define the Czech identity in direct connection to the Czech territories, in the context of fighting back against their enemies, and basing it on the foundation of Slavic myths. Even if the 'memories' presented in the historical scenes are fictionalised, they nevertheless serve the function of legitimis-

ing the Czechs as a nation by representing them as people who would be able to achieve all the successes of Aleš' hero, as a defiant and determined nation separate from the Austro-Hungarians.

However, the question of the presentation of the Dutch in the Rijksmuseum is more complex. While it seems like a major institution of an independent, colonial empire such as the Netherlands could be an example of centralist nationalism, it does not seem to cover all the nuances in Cuypers' design and vision of his nation. There are surely attempts to define the Netherlands as a whole, by showing the origins of the nation and well-known scenes from their history, however, the emphasis on both Catholic-related aesthetics and the Catholic history of the Netherlands complicates the question of how Cuypers defines the nation. As Julia van Leeuwen writes, Cuypers and the rest of the team behind Rijksmuseum's design attempted to portray the cultural past of the Netherlands in a more inclusive way, but inclusive specifically for Catholics, who at the time campaigned to reclaim the Dutch Medieval Catholic past (J. van Leeuwen 46). Arguably, Cuypers presents Dutch history in a continuity with antiquity, legitimising it as a community highly accomplished in arts and sciences, and striving for virtuous life. However, by placing Catholic iconography in a national monument like Rijksmuseum, he also implicitly defines Catholicism as Dutch, which was not seen as representative of the nation at the time, and controversial to the point that the Dutch king at the time, Willem III, stated that he would never 'set foot in this monastery' (Reynaerts 247). According to van Leeuwen, Cuypers' inclusion of Catholic history and aesthetics was a part of a very intentional agenda of making Catholics be perceived as 'full-fledged Dutch citizens' and countering the dominant, Protestant-centric narrative (J. van Leeuwen, 46). It would perhaps be too extreme to call this inclusion an example of separatist nationalism, but some elements of it – articulating and focusing on the existence of a group not seen as dominant – are surely present. Therefore, I revisit my claim from Chapter II by stating that Rijksmuseum proves some forms of centralist and separatist nationalism can coexist in the same artefacts, showing how multi-faceted representations of a nation can be. Cultural memory can represent nuanced visions of a community, however, for it to be truly embraced, it needs the community to identify with it.

In the case of *Divadlo*, the Czech identification with it and the version of history it presents is clear. While the process of building was hectic and controversial, in the end, it was perceived as (and remains) a monumental accomplishment of the nation, 'The Temple of Rebirth,' the Czech Parthenon. This shows that cultural memory, expressed in a form of an object like *Divadlo*, can truly empower a community and solidify their vision of themselves. However, that is not always the case. Cuypers attempted to represent the Dutch national memory and identity, but due to the inclusion of Catholic imagery and references, his vision was at least partly rejected, as evidenced by the renovations in the 20th century. That is not to say that the Rijksmuseum is a failed endeavour when it comes to cultural memory. It was still an object of major significance to the Dutch, just not in the version Cuypers intended. However, the 21st century saw the belated acceptance and appreciation of Cuypers' vision in the 2003-2013 renovation. In the post-pillarization time, when diversity and integration stands more at the forefront of Western European values, his narrative about Dutch society returned. Arguably, this shows that artists can only attempt to reflect or construct cultural memory in their work, and whether it actually is one depends on the community's reception, which is not often final and can change over time. Once rejected, an approach can resurface and become a part of a nation's identity in a different form. Cultural memory can change and fluctuate depending on the era and the community it aims to represent, and while there are visual tactics often used to represent or create it, such as historical scenes, neo-historical styles, or allegories, they can be performed completely differently in specific communities, as represented by the case studies. Cultural memory is neither stable nor homogenous, just like the nations it represents.

This analysis of the Rijksmuseum and *Divadlo* proves much more than just the differences between the two case studies and how they interact with cultural memory. It also shows the usefulness of perceiving an art-historical artefact through the lens of memory studies. If one rejects the concept of cultural memory, therefore denying that an object such as the Rijksmuseum could have a real effect on a nation's identity and memory, they would see the case studies as nothing more than aesthetically impressive institutions. By acknowledging the

power cultural artefacts have over collective memory, one sees the potential influence buildings like these have on a nation, which is proven by the lively, intense reactions both Czechs and the Dutch had to the respective case studies. The Rijksmuseum and *Divadlo* are more than just famous buildings in Amsterdam and Prague, they are a part of what it means to be Dutch and Czech.

However, the application of the memory studies lens also teaches one about the nature of cultural memory itself. It would be easy to see every cultural artefact relating to national memory as just constructing cultural memory, but the relationship between the two does not seem that straightforward. An object like the Rijksmuseum and the *Divadlo* bases its narrative upon preexisting history and memories, reinterpreting them and therefore partly rewriting them, but their version can be both accepted or rejected by the community they aim to represent. Sometimes the same artefact can receive both reactions, as seen in the Rijksmuseum. This proves that while cultural products have great influence over cultural memory, one is not equivalent to another; the success of these attempts relies greatly on its audience, the people actually identifying or disconnecting from it. Moreover, it is not stable or a given, as cultural memory forms in the shadow of ever-changing political and cultural discourse, making it fluctuate over time. It cannot be fully confined in a building like the Rijksmuseum or *Divadlo*. While cultural memory informs its existence and design, it reaches beyond them, influencing the identities and relying upon the people that visit them.

Acknowledgments

Works Cited

Alofsin, Anthony. *When Buildings Speak. Architecture as Language in the Habsburg Empire and Its Aftermath, 1867-1933.* University of Chicago Press, 2006.

Ales, Mikolas. *Domazlice. Modern and Contemporary Czech Art* by Antonín Matějček and Zdeněk Wirth, George Routledge and Sons, 1924.

—. *Severní průsmyky. Modern and Contemporary Czech Art* by Antonín Matějček and Zdeněk Wirth, George Routledge and Sons, 1924.

Anderson, Benedict. *Imagined Communities: Reflections on the Origin and Spread of Nationalism.* 1983. Verso, 2006.

An image of the Národní Divadlo. Received by Helena Burdzińska from The National Theatre Archive, 24 April 2024.

Assmann, Aleida. "Transformations between History and Memory." *Social Research,* vol. 75, no. 1, 2008, pp. 49-–72. https://doi.org/10.1353/sor.2008.0038.

Assmann, Jan. "Collective Memory and Cultural Identity." *New German Critique,* vol. 65, no. 65, 1995, pp. 125-–33. https://doi.org/10.2307/488538.

Atelier Herz. *Het Rijksmuseum, Stadhouderskade 42, gezien vanaf de Weteringschans over de Museumbrug (Brug 82) [The Rijksmuseum, Stadhouderskade 42, seen from the Weteringschans over Museumbrug (Bridge 82)].* c. 1900, Stadsarchief Amsterdam, https://archief.amsterdam/beeldbank/detail/5fc803bc-881e-b6f9-0d84-09d47f2f6473.

Bakal, Shirley. "From the Nation to Itself: Prague's Opera Centennial." *The Opera Quarterly,* vol. 3, no. 1, 1985, pp. 30-–40. https://doi.org/10.1093/oq/3.1.30.

Bažant, Jan. "The Classical Tradition and Nationalism." *A Handbook to Classical Reception in Eastern and Central Europe,* edited by Zara Martirosova Torlone et al., Wiley-Blackwell, 2017, pp.133–145. https://doi.org/10.1002/9781118832813.ch12.

Berger, Tomáš, et al. *The Foyer of the National Theatre,* edited by Berger et al., Museum Montanelli, 2016.

Burdzińska, Helena. *Photograph of Allegory of Patriotism.* 25 April 2024.

Burian, Jan. "Acknowledgements by the Director of the National Theatre." *The Foyer of the National Theatre,* edited by Berger et al., Museum Montanelli, 2016.

Chapman, H. Perry, et al. *"The Politics of Display."* Nederlands Kunsthistorisch Jaarboek, vol. 65, no. 1, 2015, pp. 6—21. https://doi.org/10.1163/22145966-06501002.

Cruz y Ortis Arquitectos. "Continue with Cuypers." *The New Rijks Museum: Pierre Cuypers and Georg Sturm Exonerate,* edited by Cees W. de Jong and Patrick Spijkerman, WOD, 2013.

Daňhelová, Petra. "The Birth of the Modern Myth – the Phenomenon of Aleš." *The Foyer of the National Theatre,* edited by Berger et al., Museum Montanelli, 2016.

Englesman, René den, and Staeske Rebers. *Schildering door Georg Sturm met de voorstelling Claudius Civilis predikt den opstand tegen de Romeinen, aan de zuidelijke wand in de Voorhal [Painting by Georg Sturm with Claudius Civilis preaching the revolt against the Romans, on the southern wall in the Entrance Hall].* 2012, Rijksmuseum, http://hdl.handle.net/10934/RM0001.HARCHIEF.28480.

Delvigne, Rob, and Jan Jaap Heij. "Rehabilitation for Georg Sturm." *The Rijksmuseum Bulletin,* vol. 61, no. 1, Rijksmuseum, Mar. 2013, pp. 24—63.

Denslagen, Wim. "Bad-Mannered Buildings." *Romantic Modernism: Nostalgia in the World of Conservation,* Amsterdam University Press, 2009, pp. 121-–54.

Dobiáš, Dalibor. "Politics and Nationalism in the Bohemian Lands and Upper Hungary." *Encyclopedia of Romantic Nationalism in Europe,* edited by Joep Leerssen, 2022. http://show.ernie.uva.nl/czc-1.

Dvořák, František. *O Národním Divadle* [About the National Theatre]. Lidové Noviny, 2010.

Dyson, Stephen L. "Native Revolts in the Roman Empire." *Historia: Zeitschrift Für Alte Geschichte,* vol. 20, no. 2/3, 1971, pp. 239—74.

Erll, Astrid. *Memory in Culture.* Palgrave Macmillan, 2011.

Filipova, Marta. *The Construction of National Identity in the Historiography of Czech Art.* University of Glasgow, 2009.

Gombrich, E. H. *The Story of Art.* Phaidon Press, 1995.

Gotink, Rik Klein. *Schilderingen van Georg Sturm in de Voorhal aan de oostwand, 2013 [Paintings by Georg Sturm in the Entrance Hall on the east wall, 2013].* 2013, Rijksmuseum, https://www.rijksmuseum.nl/nl/collectie/HA-0028184.

Haskell, Francis. "The Manufacture of the Past in Nineteenth-Century Painting." *Past & Present,* no. 53, 1971, pp. 109-–20.

Herscher, Andrew. "The Media(tion) of Building: Manifesto Architecture in the Czech Avant-Garde." *Oxford Art Journal,* vol. 27, no. 2, 2004, pp. 193—217.

Hoogevest, Carien de Boer-Van. "Reconstruction of the Cuypers Floor in the Entrance Hall." *The Rijksmuseum Bulletin,* vol. 61, no. 1, Rijksmuseum, Mar. 2013, pp. 64-–83.

Howlett-Martin, *Patrick. Art, Nationalism and Cultural Heritage: Artworks Belong Where They Are Found.* Createspace Independent Publishing Platform, 2017.

Hüttel, Josef, et al. *Průvodce Po Národním Divadle v Praze.* Školní Nakladatelství v Praze, 1933.

Imre, Zoltàn. "Staging the Nation: Changing Concepts of a National Theatre in Europe." New Theatre Quarterly, vol. 24, no. 1, Jan. 2008, pp. 75-–94. https://doi.org/10.1017/S0266464X08000079.

Jensen, Lotte, et al. *Free Access to the Past: Romanticism, Cultural Heritage and the Nation.* Brill, 2010.

Kimball, Stanley Buchholz. "The Slavs and the Opening of the Czech National Theatre, 1883." *The Polish Review,* vol. 6, no. 4, 1961, pp. 77—92.

Kimball, Stanley Buchholz, and Zakrzewski, Jakub. "The Poles at the Prague All-Slavic Congress of 1868." *The Polish Review,* vol. 4, no. 1/2, 1959, pp. 91-–106.

Knippenberg, Hans. "Dutch Nation-Building: A Struggle against the Water?" *GeoJournal,* vol. 43, no. 1, 1997, pp. 27-–40.

Kossmann, E. H. "The Dutch Case: A National or a Regional Culture? The Prothero Lecture." Transactions of the Royal Historical Society, vol. 29, 1979, pp. 155-–68. https://doi.org/10.2307/3679117.

Lass, Andrew. "Romantic Documents and Political Monuments: The Meaning-Fulfillment of History in 19th-Century Czech Nationalism." *American Ethnologist,* vol. 15, no. 3, 1988, pp. 456—71. https://doi.org/10.1525/ae.1988.15.3.02a00030.

Leerssen Joep. "Background: Nationalism in the Dutch State." *Encyclopedia of Romantic Nationalism in Europe,* edited by Joep Leerssen, 2022, Apr. 2015. https://doi.org/10.5117/9789462981188/ngTA5j96fUAPeEgkMTMP3Asd.

—. *National Thought in Europe: A Cultural History.* Amsterdam University Press, 2006.

Linders, Jannes. *Interieur Voorhal, juli 2012* [Photo 1]. 2012. Rijksmuseum, https://www.rijksmuseum.nl/nl/collectie/HA-0025701.

—. *Interieur Voorhal, juli 2012* [Photo 2]. 2012. Rijksmuseum, https://www.rijksmuseum.nl/nl/collectie/HA-0025699.

—. *Interieur Voorhal, juli 2012* [Photo 3]. 2012. Rijksmuseum, https://www.rijksmuseum.nl/nl/collectie/HA-0025698.

Long, Christopher. "East Central Europe: National Identity and International Perspective." *Journal of the Society of Architectural Historians,* vol. 61, no. 4, Dec. 2002, pp. 519-–29. https://doi.org/10.2307/991872.

Melion, Walter, and Bart M. Ramakers. "Personification: An Introduction." *Personification: Embodying Meaning and Emotion,* edited by Walter Melion and Bart M. Ramakers, Brill, 2016, pp. 1–40. https://doi-org.proxy.uba.uva.nl/10.1163/9789004310438_002,

Nolte, Claire. "Art in the Service of the Nation: Miroslav Tyrš." *Bohemia: Zeitschrift Für Geschichte Und Kultur Der Böhmischen Länder,* vol. 34, no. 1, 1993, pp. 47-–62.

Nora, Pierre. "Between Memory and History: Les Lieux de Mémoire." Representations, vol. 26, no. *Special issue,* University of California Press, 1989, pp. 7—24. https://doi.org/10.2307/2928520.

Overzicht centrale en westelijk deel Voorhal [Overview of the central and western part of the Entrance Hall]. 1955–57, Rijksmuseum, http://hdl.handle.net/10934/RM0001.HARCHIEF.12438.

Pijbes, Wim. "The Rijksmuseum Restored to Future Glory." *The New Rijksmuseum: Pierre Cuypers and Georg Sturm Exonerated,* edited by Cees W. de Jong and Patrick Spijkerman, WOD, 2013.

Potter, Matthew C. "From the Abstract World of Ideas to the Truest Possible Representation of the Historical Event: An Introduction to Historical Art in the Long Nineteenth Century." *Representing the Past in the Art of the Long Nineteenth Century,* 1st ed., Routledge, 2022, pp. 1—31, https://doi.org/10.4324/9781351004183-1.

"Praha Narodni Divadlo." 2005, *Wikipedia Commons,* https://commons.wikimedia.org/wiki/File:Praha_Narodni_divadlo.jpg.

Prahl, Roman, and Jindřich Vybíral. *Národni Divadlo: Historie a Současnost Budovy* [The National Theatre: The History and the Present of the Building]. Národni Divadlo, 1999.

Pavlíček, Roman, and Lupoměský Karel. *Detail of Aleš's lunette Domažlice.* 2010, The National Theatre Archive.

—. *Detail of Brozik's Allegory of Prague.* 2010, The National Theatre Archive.

—. *Malířskou výzdobou nejbohatší prostor Národního divadla – hlavní foyer na 1. balkoně.* 2010, The National Theatre Archive.

—. *Na stropě vyniká Ženíškův triptych na téma Zlatý věk umění, Úpadek umění a Vzkříšení umění; pod stropem je foyer obkroužen dvanácti Alšovými lunetami na téma Vlast, zobrazující putování hrdiny.* 2010, The National Theatre Archive.

—. *Strop s monumentálním lustrem a v kruhu uspořádanými obrazy alegorií umění od Františka Ženíška.* 2010, The National Theatre Archive.

—. *Výzdobou foyeru byli pověřeni malíři František Ženíšek a Mikoláš Aleš; ve foyeru opět pokračuje galerie bust slavných osobností.* 2010, The National Theatre Archive.

Reynaerts, Jenny. "The Wall Paintings in the Rijksmuseum Amsterdam." Museum History Journal, vol. 5, no. 2, 2012, pp. 245-—60, https://doi.org/10.1179/mhj.2012.5.2.245.

Šámal, Petr. *Living in Art: Painted and Sculpted Ornamentation of Prague Residential Buildings in the Nineteenth and Early Twentieth Century.* Národní Galerie Praha, 2019.

Smith, Anthony Douglas. *National Identity.* Penguin Books, 1991.

—. *The Nation Made Real: Art and National Identity in Western Europe, 1600–1850.* Oxford University Press, 2013.

Sobiesiak, Joanna. "Mediewalizm w Malarstwie Czeskim XIX Wieku. Zwycięstwo pod Mediolanem 1158 Roku i Inne Kluczowe Wydarzenia Epoki Średniowiecza Budujące Tożsamość Wspólnoty Czechów" [Medievalism in XIX Century Czech painting. The Victory at Milan in 1158 and Other Key Events of the Medieval Era Constructing the Czech Community Identity]. *Studia z Dziejów Średniowiecza,* no. 24, Dec. 2020, pp. 213-—28. https://doi.org/10.26881/sds.2020.24.09.

Sosnowska, Danuta. "Czeski Przełom Modernistyczny a Kondensacja Czasu Kulturowego" [The Czech Modernist Breakthrough and the Condensation of Cultural Time]. *Przegląd Filozoficzno-Literacki,* vol. 36, no. 1–2, 2013.

Spijkerman, Patrick. "Cuypers' Ornaments Restored to Former Glory." The New Rijksmuseum: Pierre Cuypers and Georg Sturm Exonerated, edited by Cees W. de Jong and Patrick Spijkerman, WOD, 2013.

Štech, Václav Vilém. Národ Sobě: Národní Divadlo a Jeho Umělecké Poklady [The Nation for Itself. The National Theatre and Its Artistic Treasures]. Melantrich, 1940.

Šubert, *František. Národni Divadlo v Praze. Dějiny Jeho I Stavba Dokončená* [The National Theatre in Prague. Its History and State of Completion]. J. Otto, 1881.

"The Great Hall." *Rijksmuseum,* https://www.rijksmuseum.nl/en/visit/inside-the-museum/great-hall.

van Dongen, Frits. "A Consummate Experience." The New Rijksmuseum: Pierre Cuypers and Georg Sturm Exonerated, edited by Cees W. de Jong and Patrick Spijkerman, WOD, 2013.

van Leeuwen, Julia. "The Stained-Glass Windows in the Entrance Hall of the Rijksmuseum: A Coloured National Art History." *The Rijksmuseum Bulletin,* vol. 70, no. 1, Mar. 2022, pp. 26-—57. https://doi.org/10.52476/trb.11721.

van Leeuwen, Wies. "The Rijksmuseum, a Secular Cathedral." *The New Rijksmuseum: Pierre Cuypers and Georg Sturm Exonerate,* edited by Cees W. de Jong and Patrick Spijkerman, WOD Projects, 2013.

Voorhal gezien naar het oosten omstreeks

1908.   1904–1910,   Rijksmuseum,
        https://www.rijksmuseum.nl/nl/collecti
        e/RMA-SSA-F-00603-1.

*Voorhal met informatiebalie in het midden, naar
        het oosten gezien Voorhal na verbouwing.*
        1988, Rijksmuseum, http://hdl.handle.net
        /10934/RM0001.HARCHIEF.14572.

Voorhaal naar het oosten omstreeks 1909.
        1908–1909.   Rijksmuseum,   https:
        //www.rijksmuseum.nl/en/my/collectio
        ns/182497--hanno-lans/gipsafgietsels/obj
        ecten#/RMA-SSA-F-00031-1,1.

Vybíral, Jindřich. "Tribute to Raphael in the 'Tem-
        ple of Rebirth.'" *The Foyer of the National
        Theatre*, Museum Montanelli, 2016.

Žákavec, František. *Chrám Znovuzrození: O Bu-
        dovetalích a Budově Národního Divadla v
        Praze.* Jan Štenc Praha, 1938.

Ziemba, Antoni. "Rijksmuseum in Amsterdam. His-
        toricism and (Anti)Multimediality." *Muzeal-
        nictwo,* vol. 2016, no. 57, *Index Copernicus
        International S.A.,* Oct. 2016, pp. 249—
        76.   http://dx.doi.org/10.5604/04641086.
        1221164.

Interdisciplinary

The Value of News Sources for Conflict Forecasting:

Predicting Changes in Violence Intensity
in Afghanistan Using Themes in the Media

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Abstract

Contemporary efforts to predict conflict are still limited by interpretability issues and low accuracy in hard prediction cases. In the face of these limitations, the conflict predicting field has turned towards the use of big data such as large news databases, which has generally yielded promising results. Nevertheless, the blind application of news-based features for conflict prediction exposes forecasts to significant risks, and this work argues that more attention should be paid to careful data selection. To highlight this point, this study investigates the relative predictive performance of over 6 million local, regional, and global news articles scraped from the Global Database of Events, Language, and Tone (GDELT), by training 7 different models that aim to predict changes in conflict intensity in Afghanistan. The results show that local models significantly outperform regional and global models, especially on shorter-term predictions and in cases of more drastic change. This indicates that local media are better at capturing early signs of tensions than non-local media, and calls for a more diversified forecasting approach. Finally, this study argues that although big data approaches to conflict prediction might achieve higher accuracy, smaller-scale, interpretable, and conceptually justified approaches should be prioritized in order for the field to become a useful asset for preventing conflict.

Keywords and phrases: *armed conflict, prediction, machine learning, bias, media, big data*

Contents

List of Abbreviations

ACLED Armed Conflict Location & Event Data Project

API Application Programming Interface

CAMEO Conflict and Mediation Event Observations

EWS Early Warning System

ICEWS Integrated Crisis Early Warning System

GDELT Global Database of Events, Language, and Tone

KEDS Kansas Event Data System

VIEWS Violence & Impacts Early-Warning System

Introduction

Being able to forecast the outbreak of violent conflict is one of the most crucial and fundamental tasks within peace research. Conflict prevention has become a central part of peacebuilding efforts by the United Nations (Muggah & Whitlock, 2022), and to this end, it has called for the development of early warning systems that could anticipate looming conflict. The potential of reliable forecasts to evaluate theory, compare policy responses, enable timely interventions and ultimately save lives, has motivated an ambitious field of research that aims to develop reliable forecasting methods (Bressan et al., 2019).

In recent years, researchers have turned towards the application of advanced machine learning methods and the use of big data approaches, and this has driven significant progress in the field. However, the field is still significantly limited in many ways, in particular due to the low interpretability of complex models (Ettensperger, 2021) as well as the low reliability of forecasting algorithms in hard prediction cases (Hegre, Metternich, et al., 2017; Hegre, Nygård, et al., 2017). Due to these challenges, the applicability of conflict prediction for peacebuilding on the ground is still limited. Several authors have tried to address these problems with creative methodological innovations, and one of the most promising avenues is the incorporation of features from the media, like the news or social media, which is posed to be able to help capture early warning signs and tensions in real-time (Chadefaux, 2014; Mueller & Rauh, 2022b). This has resulted in the use of large media-based event and sentiment databases for conflict prediction, and this has shown to improve prediction accuracy, especially in forecasting conflict onsets, which are particularly hard to predict (Mueller & Rauh, 2022b).

However, the use of the media as a feature for conflict prediction is also accompanied by a significant risk. Forecasts could be based on misrepresentative data, biases, and fake news, especially since most media-based conflict prediction endeavors use mainly Western sources or mass-scraped news databases. Biased data can lead to biased forecasts, which is a seriously dangerous consequence due to the sensitive nature of violence forecasting applications. Therefore, several scholars have argued that the blind use of big databases under a "the more data the better" philosophy should be avoided, and the field should pay close attention to the limitations of big data (Cederman & Weidmann, 2017; Chadefaux, 2017; Mancini, 2013).

With the aim to contribute to this mission, this work asks the following question: is local media better at predicting changes in violence than regional and global media? To investigate this, the differences in the forecasting accuracy of different kinds of news are evaluated by comparing the relative predictive power of models built with features from local, regional, and global news. The hypotheses are that (1) incorporating local media sources will lead to an increase in predictive performance compared to models without media information and (2) local media will be better at predicting conflict than regional and global media. This could furthermore underline the importance of a diverse forecasting framework, uncover biases in global conflict coverage, and highlight the value of local sources for conflict prediction.

Research Context

History of the field

Although the use of data methods for peace research has increased in the last decade, it is far from a new development. Since the early 1960s peace researchers have set out to systematically collect data on conflict, to enable the quantitative validation and development of theory, and to be able to predict conflict ahead of time (Small et al., 1997; Suzuki et al., 2002). Prominent early peace researchers, like David Singer et al. (1973), have argued that ultimately the ability to forecast peace and conflict is the "number one task of peace research," and since then the ambitious mission of prediction has become fundamental to the field (Hegre Metternich, et al., 2017).

Significant progress has been made since. Data on conflict has become increasingly more granular due to important early contributions to systemic data collection (i.e. Azar, 1980), most prominently the KEDS[1] project of Schrodt et al. (1994) and the CAMEO[2] framework by Gerner et al. (2002). Fine-grained event data enabled the use of more advanced computational methods and this led to in-

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[1]Kansas Event Data System
[2]Conflict and Mediation Event Observations

creasingly promising results (Schrodt, 1991, 2006; Schrodt et al., 2001; Subramanian & Stoll, 2006). These codifying methods have since been further developed and resulted in large-scale event databases such as the Integrated Crisis Early Warning System (ICEWS) (O'Brien, 2010) and the Global Database of Events, Language, and Tone (GDELT)[3] (Leetaru & Schrodt, 2013).

Still, the real boost for the conflict forecasting field came with the realization that conflict prediction methods play a crucial role in theory development. Conventional p-value-based quantitative studies have been argued to be highly misleading (Ward et al., 2010), and usually focus on explaining historical events at the cost of a tendency to overfit theoretical models to past events (Chadefaux, 2017). Through the lens of theories with little predictive relevance, "the future tends to surprise us" (Bressan et al., 2019, p. 6), and therefore many scholars argue that to evaluate theories, explanatory and predictive power are both necessary (Gleditsch & Ward, 2013; Hegre, Metternich, et al., 2017; Schrodt, 2013; Ward et al., 2010). Schrodt (2013) even lists the development of theory in the absence of prediction as one of the "Deadly Sins" of quantitative political analysis. This marked a major turn in the field and research increasingly focused on the use of out-of-sample methods, which spurred many methodological innovations. Researchers also started drawing methods and practices from the machine learning field (Colaresi & Mahmood, 2017), which resulted in significant accuracy improvements and has pushed the field into the mainstream of conflict research (Bressan et al., 2019).

Limitations

However, despite these recent successes and improvements in accuracy, the applicability of conflict prediction for early warning systems (EWS), effective interventions, and humanitarian response is still limited. Although it is well-established that early peacebuilding interventions can have a significant conflict-reducing effect (Hegre, Hultman, et al., 2019), there is a lack of a clear link between forecasted violence and potential interventions on the ground, known as the "warning-response" gap (Caldwell, 2022). Research into EWS in Western Africa, for example, has shown that data-driven

early warnings are often too detached from local reality to inform meaningful early action responses (Eze & Osei Baffour Frimpong, 2020). As a result, a report by OCHA[4] concluded that the "current state of the art is not sufficient for application in humanitarian response" (Caldwell, 2022, p. 11). This disconnect between research and practice significantly limits the usefulness of violence forecasting for early intervention or policy advice (Hegre, Metternich, et al., 2017).

This applicability gap has two main causes. Firstly, the introduction of complex ML methods into the field was accompanied by a trade-off between explainability and prediction accuracy (Hegre, Metternich, et al., 2017). More complicated models are more accurate, but often impossible to interpret (Hegre et al., 2022), leading to what Ettensperger (2019) labels as the "black box problem." This is further complicated by the fact that the best-performing models are often a combination of different methods, known as ensemble methods, which are even harder to disentangle (Ettensperger, 2021; Vesco et al., 2022). However, understanding the rationale behind a prediction is of pivotal importance for applicable results, and therefore the increase in accuracy achieved by complex but ambiguous methods might not be worth the loss of interpretability (Ettensperger, 2019; Hegre, Metternich, et al., 2017).

Secondly, predicting sudden changes in conflict, especially its onset, remains difficult. Predicting the escalation of conflict after a long period of peace or the de-escalation after a long period of violence is something even the best-performing models struggle with (Bazzi et al., 2021; Hegre et al., 2022; Vestby et al., 2022) and this has been labeled in the field as the "hard problem of conflict prediction" (Mueller & Rauh, 2022a). This is partly due to the dominance of past conflict as a predictor for future conflict (Caldwell, 2022), which means it is significantly easier to predict future conflict in a country already experiencing conflict (Hegre, Nygård, et al., 2017). In response, some authors have considered the possibility that there might be theoretical limitations to predicting conflict (Malone, 2022) or even that the presence of uncertainty itself is a requirement for war (Chadefaux, 2017), as has been posed before by political scientists (i.e. Gartzke, 1999).

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[3]See www.gdeltproject.org

[4]*United Nations Office for the Coordination of Humanitarian Affairs*

Big data solutions

In attempts to address these limitations, in particular the hard problem, researchers have looked for data that could contain more information on early warning signs for conflict. Researchers have used remotely sensed data (Levin et al., 2018; Racek et al., 2023), Twitter (Dowd et al., 2020), and large-scale event databases (Attinà et al., 2022), but of particular interest has been the systemic extraction of information from the news. The news, and media in general, is often posed to function as a mirror of society (Cook, 2000), and thus it has the potential to provide signs of political tension even before actual conflict has occurred (Chadefaux, 2014). Furthermore, the news could capture indicators of looming conflict at a much higher temporal resolution and in near real-time, which means it could provide more useful indicators of conflict compared to traditional structural variables, like GDP measures or democracy scores (Cederman & Weidmann, 2017).

Research has shown that the news indeed shows early warning signs of conflict (Chadefaux, 2014), displays signals of early tensions (Hegre et al., 2022), and enables the successful classification of countries into peace and conflict (Liebovitch et al., 2023). Of particular importance is the work of Mueller & Rauh (2017, 2022a, 2022b), who showed that the incorporation of newspaper articles in forecasting algorithms achieves a modest increase in prediction accuracy on hard cases. Moreover, many suggest that indicators derived from the media could become more important in the future, coinciding with a general shift of public discourse to the virtual realm (Bazzi et al., 2021; Dowd et al., 2020; Sweijs et al., 2022).

A database of particular significance for this purpose is the aforementioned GDELT project (Leetaru & Schrodt, 2013), which systematically archives worldwide online news in over 60 languages, and codifies themes, sentiments, tone, locations, events, and networks of actors (Saz-Carranza et al., 2020). It is recognized as the most comprehensive event and sentiment database that exists (Raleigh et al., 2023), and since its launch in 2011, the big data of GDELT has been applied to many areas in the social sciences. In the context of conflict prediction, it has been used to forecast social upheaval (Galla & Burke, 2018; Halkia et al., 2020; Keertipati et al., 2014), political risk

(Sun et al., 2021), conflict intensity (Levin et al., 2018), global peace index (Voukelatou et al., 2022) and even broader trends in international relations (Chen et al., 2020). The response to GDELT has been enthusiastic, and some even explicitly argue that forecasting methods using its data could be useful for early interventions by peacekeepers (Voukelatou et al., 2022) and humanitarian organizations like the UN or the Red Cross (Keertipati et al., 2014).

On the other hand, critics argue that peace researchers should be wary of the blind application of big data methods without carefully considering their nature and limitations. Research into large autocoded event databases, such as GDELT, has uncovered several limitations, such as noise (Halkia et al., 2020), fake news (Raleigh et al., 2023; Raleigh & Kishi, 2019), missing or duplicate data (Saz-Carranza et al., 2020), and a bias for urban events (Weidmann, 2016). Furthermore, despite efforts to diversify the sourcing of GDELT, most data consists of English and Western-based media (Saz-Carranza et al., 2020). Finally, there is a lack of transparency behind important classifying decisions such as "What counts as conflict?" (Day et al., 2015). Due to these limitations, Raleigh et al. (2023) argue that claims such as the one by Keertipati et al. (2014) that GDELT can be used for humanitarian organizations to make "important decisions" are short-sighted.

In general, various scholars warn that although the incorporation of media features into conflict prediction opens up many opportunities, it also opens the door to biases and misrepresentation issues in the data (Raleigh et al., 2023). It is well established in the field of media studies that the media is subject to various biases, especially in its coverage of conflict (Weidmann, 2016; Wolfsfeld, 2011). Conflict coverage often contains geographical biases (Barron & Sharpe, 2008) cultural biases (Barranco & Wisler, 1999), fake news (Day et al., 2015; Sweijs et al., 2022), censorship (Baum & Zhukov, 2015) and a bias towards violent events (Day et al., 2015). During conflict in particular, the societal mirror of the media is heavily distorted (Cook, 2000; Wolfsfeld, 2011), and selecting a representative collection of stories is difficult, even manually (Davenport & Ball, 2002). Especially when the bulk of news that is used comes from mostly Western and English sources, the coverage of events might be influenced by prej-

udices (Demarest & Langer, 2018), not covered correctly (Demarest & Langer, 2022), or be missed entirely (Raleigh et al., 2023). The use of biased data in conflict prediction models can lead to misleading forecasts with serious consequences, such as self-fulfilling prophecies that lead to more conflict (Raleigh et al., 2023). Therefore, using mass scraped media databases is a potentially dangerous endeavor (Sweijs et al., 2022), but the limitations of these large databases are often overlooked (Raleigh & Kishi, 2019).

Research focus

The current article aims to address one of these limitations by investigating the relative predictive value of local, regional, and global news as present in the GDELT dataset. Due to data availability constraints and the scope of the project, this study focuses on a case study of Afghanistan between the years 2017 and 2024. Afghanistan was selected specifically due to its extensive conflict history and because in these years it experienced both a period of war and a period of relative peace, rendering it an illustrative case for a prediction algorithm. In order to evaluate the relative predictive performance of local, regional, and global news, this study used the so-called "themes" in the GDELT database as features for prediction. Despite the issues with the GDELT database, the themes identified may still be a relatively reliable source for media focus and tone (Raleigh et al., 2023), which is what this research is interested in.

The theme information was split into three distinct datasets that contain features from local, regional, or global media sources. To evaluate their predictive performance relative to other methods, the baseline is a simple model based on a set of features related to conflict history. Furthermore, three models were evaluated that combined both historical features and features from the themes, resulting in a total of seven models: a baseline model, three themes models (for local, regional, and global themes), and three history + themes models (for local, regional and global themes). This comparative approach could underscore the importance of careful data selection, and counter the idea that more data always leads to better predictions.

Figure 1: *Monthly violence-related fatalities in Afghanistan between 2017 and 2024*

Note: Data derived from the Armed Conflict Location & Event Data (ACLED) Project, 2024. Retrieved from https://acleddata.com.

Methods

Historical features

The data for Afghanistan's conflict history was obtained from the Armed Conflict Location & Event Data Project (ACLED) database. ACLED collects all types of information about violent events around the world, and is recognized as a reliable and complete source of conflict statistics with high validity (Raleigh et al., 2010; Raleigh & Kishi, 2019). The monthly fatalities in Afghanistan are displayed in Figure 1 below. The baseline model consists of a simple set of features based on historical violence and was adapted from the baseline model used by Mueller & Rauh (2022b). The historical feature set was chosen above other commonly used feature sets, such as economic factors, development measurements, or political indicators because it has consistently proven to be the most consistent predictor of violence (Hegre, Nygård, et al., 2017). The baseline model was given a total of ten features related to the current and recent levels of violence (month $t = 0$ till month $t-3$), the number of months since a certain level of violence (months since a month with 50, 500, and 2000 fatalities), and the aggregated number of fatalities over the last 3, 6 and 12 months.

Theme features

For information on themes present in the news, this study used the Global Knowledge Graph (GKG) from the GDELT project. The themes extracted[5] are based on a multitude of labels created by GDELT itself, and complemented with other taxonomies and labeling systems like those of the World Bank,[6] CrisisLex,[7] and the UN Global Pulse Project[8] (GDELT, 2015a, 2015b, 2016).

Using the GDELT DOC Application Programming Interface (API),[9] the total number of articles per day that mentioned Afghanistan were scraped, as well as the percentage of articles that were labeled with each theme out of the top 1000 most frequently used themes. The prediction was limited to a shorter period (January 2017 to March 2024) due to the limitations of GDELT's API (GDELT, 2017). Consistent with the article selection criteria of Mueller & Rauh (2022b), news was considered to concern Afghanistan when it either mentions its name or the name of its capital, Kabul. Conveniently, GDELT automatically translated the search terms to all languages it supports, which means that global articles in over 65 languages were included in the search. In total, information was scraped for 6.4 million articles published between January 2017 and March 2024, from a total of 162 countries. The degree of coverage of Afghanistan by all countries as present in the GDELT database is visualized in Figure 2 below.

The articles' theme information was then grouped into global (5.2 million articles), regional (941 thousand articles), and local news (201 thousand articles). An article was considered local when the source country was Afghanistan, and the news was classified as regional when the source country was Iran, Turkmenistan, Pakistan, Uzbekistan, Tajikistan, Azerbaijan, Kyrgyzstan, China, India, or Kazakhstan, due to their geographical proximity and

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[5]The exact methods for GDELT's theme extraction is ambiguous and not-well documented, but seems to be based on the CAMEO framework by Gerner et al. (2002) and topic modelling techniques such as Latent Dirichlet Allocation (Saz-Carranza et al., 2020, p. 9). For a full list of themes present in the GDELT database, see https://blog.gdeltproject.org/new-august-2019-gkg-2-0-themes-lookup/

[6]See https://vocabulary.worldbank.org/taxonomy/1737.html

[7]See https://crisislex.org/

[8]See https://post2015.unglobalpulse.net/

[9]See https://blog.gdeltproject.org/gdelt-doc-2-0-api-debuts/

Figure 2: *Coverage of Afghanistan as present in the GDELT database*

substantial media coverage of Afghanistan. The theme information was aggregated into local, regional, and global news, weighed by article count, and smoothed on a monthly basis. Figure 3 shows the total number of articles that were scraped for each of the news categories over time. Strikingly, there is a significant spike in articles that concern Afghanistan from August 2021 to September 2021, which is when the US evacuation from Kabul took place (Stewart et al., 2021). It should be noted that this spike was only observable for global and regional news, as the article count of local news sources remained highly consistent throughout the whole period that articles were scraped.
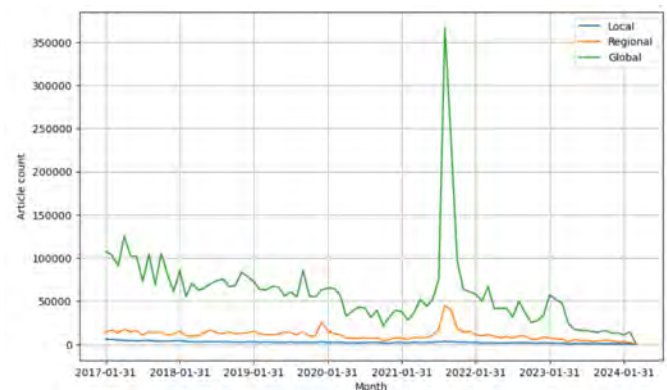
Figure 3: *Total articles scraped per month for local, regional, and global news*

Finally, the 20 most relevant themes were selected for each model separately, by calculating the relative absolute correlation of each theme with the fatalities in month T+1. Due to the low sample size, it was found that this number of features led to the best performance, which is also generally the case (Mueller & Rauh, 2022a). The feature themes for each model are displayed in Table 1.

As can be seen in Table 1, most of the themes

Table 1: Themes used as features for local, regional and global models

Local News	Regional News	Global News
Conventional War	Insurgency	Insurgency
Political Violence and War	Rebels, Guerrillas, and Insurgents	Conventional War
Armed conflict	Women	Rebels, Guerrillas, and Insurgents
Insurgency	Inflation	Macroeconomic Vulnerability Debt
Security Services	Economy Inflation	Non-State Security Actors
Rebels, Guerrillas, and Insurgents	Conventional War	Economy Inflation
Conflict and Violence	Take Office	Inflation
Non-State Security Actors	Self-Identified Humanitarian Crisis	Food Security
Economy Historic	Reconciliation	Points of Interest Airport
Rebellion	Responses to Human Rights Abuses	Airports
Policy	Food Security	Self-Identified Humanitarian Crisis
Economy	Budget Deficit	Drainage
Religion Islamic	Tax Troops	Terror
Terror	Policy	Affordable Nutritious Food
Jobs	Affordable Nutritious Food	Political Violence and War
Deputy	Macroeconomic Vulnerability Debt	Security Services
Military	Unrest Checkpoint	Transport Infrastructure
Job Opportunities Employment	Non-State Security Actors	Drainage change
Unemployment	Gender Equality	World Languages Ukrainian
National Security	Checkpoint	Ethnicity Ukrainian

that had a high correlation with changes in conflict are clearly related to conflict, such as "Conventional War," "Insurgency," or "Conflict and Violence." Other themes, such as "Economy," "Unemployment," or "Inflation," seem more related to socioeconomic conditions. For most of the local themes, it is intuitively clear why the presence of this theme in the news would have something to do with conflict, but for the regional and global themes, it is not always obvious. Most prominently, the themes "World Languages Ukrainian" and "Ethnicity Ukrainian" in the global model, could have been picked up because the Russian invasion of Ukraine coincided with a period of lower conflict intensity in Afghanistan. This already indicates that the features picked up by the regional and global model may be of less conceptual relevance than the features picked up by the local model.

Prediciton models

For the purpose of adhering to the standardized prediction frameworks established in the field set by Hegre et al. (2022), the goal was to predict changes in conflict intensity on the country-month (CM) level. Predicting the change in fatalities is preferred to predicting the exact number of fatalities, because it often corresponds with the change in humanitarian impact and is therefore more relevant for on-the-ground applications (Hegre et al., 2022). Change in conflict intensity is defined as the change in the log number of fatalities as a result of violence,[10] and hence the prediction target O becomes:

$$O_{s,i,t} = \Delta_s \ln(Y_{i,t+1}) = \ln(Y_{i,t+1}) - \ln(Y_{i,t-s+1})^{[11]}$$

where $Y_{i,t}$ is the aggregated number of fatalities in S months from now, and $Y_{i,t-s}$ is the aggregated number of fatalities in the current month. To predict one month into the future, the prediction target then becomes $\Delta_s \ln(Y_{i,t+1})$, which is the change in the log amount of fatalities plus one from month $t-1$ to month t (Hegre et al., 2022, p. 526). Due to the log transformation, the changes are predicted proportionally, and thus a shift from 10 to

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[10]The definition of "fatalities" here follows ACLED's definition of "Reported Fatalities". See ACLED's codebook for more information: https://acleddata.com/acleddatanew/wp-content/uploads/dlm_uploads/2023/06/ACLED_Codebook_2023.pdf

[11]See Hegre et al. (2022) for detailed elaboration on the purpose of this prediction metric.

Table 2: Overall MSE scores of prediction models

Model	Months ahead					
	1	2	3	4	5	6
Baseline (History)	0.540	1.134	1.683	2.303	2.839	2.914
History + Local	0.492	1.029	1.610	2.358	3.418	4.031
History + Regional	1.030	2.142	2.849	3.147	2.784	2.277
History + Global	1.032	1.627	1.911	2.871	3.338	4.150
Local	0.468	0.824	1.173	1.464	1.920	2.199
Regional	1.199	1.737	2.190	2.009	1.690	1.747
Global	1.398	1.608	1.731	2.216	2.765	3.326

20 fatalities is given the same severity level as a shift from 1000 to 2000 fatalities. Nevertheless, as argued by Mueller & Rauh (2022b), in practice, this is the same as first predicting the number of fatalities in the month $t + s$ and then calculating $O_{s,i,t}$ afterward, which is significantly easier than predicting the log change directly. Due to the one-month lag with which many conflict-prediction features become available, most models are only able to predict conflict at least 2 months ahead ($S = 2$), but given the real-time nature of the theme-related features (GDELT updates its database every 15 minutes), this research also made predictions for $S = 1$. Overall, violence was predicted up to six months into the future, corresponding to the forecasting windows $S \in [1, 6]$.

For all the history models, the theme models, and the baseline model, random forest was used. Random forest is a popular machine-learning method, used for both classification and regression tasks. It ensembles a large number of randomly generated decision trees, and designs its cutoff points in such a way that the mean squared error (MSE) of the prediction is minimized. The average of all decision trees is computed for the regression result. Even though more advanced ML methods have been applied in the field, random forest remains among the most successful, and it is often preferred above more complex models due to its high interpretability. Random forest has proven especially useful in the context of predicting violence with the news (Mueller & Rauh, 2017, 2022a, 2022b). Nevertheless, many other promising approaches have recently been successful in the field, such as neural networks (Ettensperger, 2019), AutoML algorithms (D'Orazio & Yu, 2022), and ensemble methods (Ettensperger, 2021), but these were omitted in this study due to time and resource limitations.

The models were trained to minimize the MSE of the predicted log change in fatalities. Furthermore, parameters were optimized for each individual model using a grid search, which ran over the following parameters on a training split: number of trees (50, 100, 200), maximum depth of trees (none, 10, 20), minimum sample split (2, 5, 10), and minimum sample at end leaf (1, 2, 4). For each prediction month $t + s$, the model was trained with all data up until the month t, with a base number of 12 months. In other words, the model with the least amount of data was trained on 12 months of data to predict changes in conflict intensity for month 13 to month 18, and the model with the most amount of data was trained to predict up to six months into the future beyond the dataset.

Results

Key findings

Table 2 displays the mean squared error of all seven models. The optimal parameter set of each model can be found in Appendix A.

The first, and most obvious observation is that the MSE of all models increases substantially when the model has to predict for more months into the future. Nevertheless, some models suffer from this more than others, in particular the baseline model and the models history + local, history + global, and global. Interestingly, for some other models, the MSE seems to peak around the 3-4 month mark and then drop again slightly. The regional model, for example, achieves its second-lowest MSE around the 5-month mark.

Second, the results show that the history + local model slightly outperforms the baseline model.

This is the case particularly for $S \leq 3$, as the baseline model performs better when forecasting further into the future. Furthermore, both the baseline and the history + local model are outdone by the local model, which only uses theme information. The local model performs the best for all $S < 5$ and has the lowest average MSE over all forecasting windows. Interestingly, for $S \geq 5$, the regional model achieves the lowest MSE.

Third, the results show that the local model achieves better scores compared to regional and global models, regardless of whether history was incorporated. This is the case particularly for the shorter forecasting windows, while for longer periods this distinction is less well-defined. Moreover, it seems that on average, the regional models outperform the global models, although this depends on the forecasting windows and is mostly the case for $S \geq 4$. In general, the models that use historical features appear to be worse at predicting over longer time periods than the models that solely use theme information.

Comparing local models with the baseline

In the figures below, the relative performance of local models is explored in more detail. In Figure 4, the fatalities are plotted against the predicted fatalities of the baseline model, the history + local model, and the local model. Of particular interest is the ability of the models to anticipate the huge spike in fatalities that occurred in June and July of 2021. The baseline model seems to struggle with this drastic change and is mostly catching up with the increase in fatalities after the fact. Here, the local models do significantly better and are able to match the spike in fatalities more accurately, although still with a one-month lag. Furthermore, as seen in Figure 4, the local models are better at adjusting to the change from a period of intense conflict to a period of relative peacefulness. The baseline model predicts an increase in fatalities in the years after 2021, while the local models correctly predict the amount of fatalities to remain relatively stable.

The same phenomenon is observed when comparing local models to both the regional and global models. The MSE of the three different theme-based models are compared over time in Figure 5, which shows that although the three models are quite close in terms of MSE for the period up to Au-
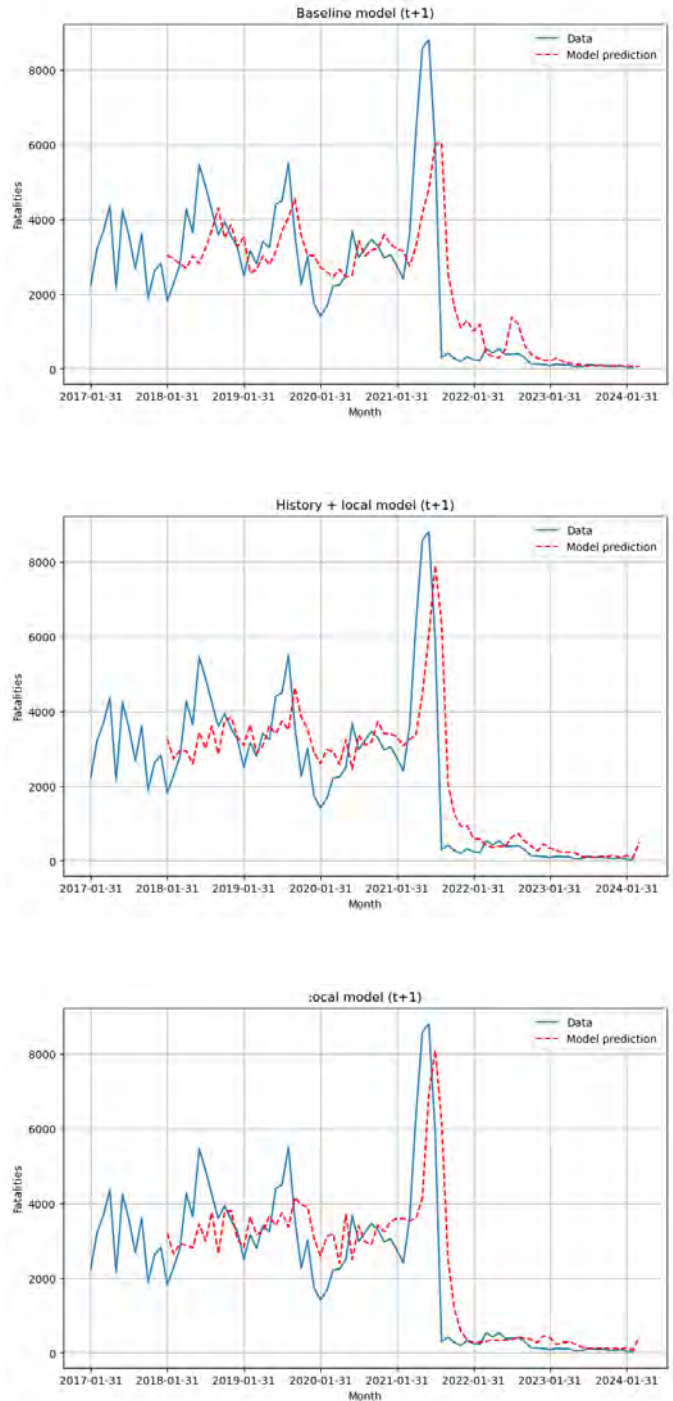

Figure 4: *Comparison of predictions and data for local models and baseline model*

gust 2021, both the regional and the global model struggle to adapt to the period of relative peace that comes after.
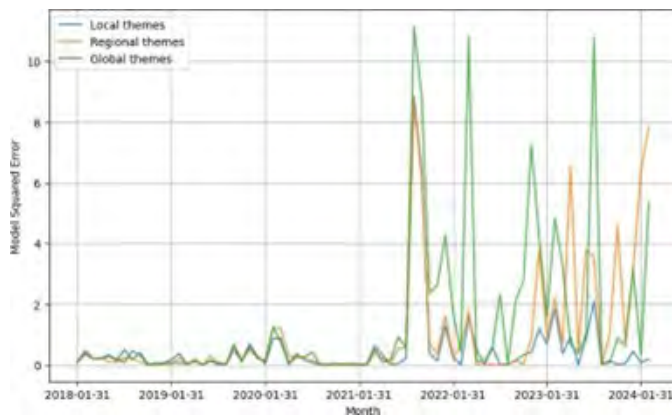
Figure 5: *MSE for local, regional and global model over time*

Discussion

Interpretation of results

Firstly, it is observed that the incorporation of local media features leads to a slight increase in prediction accuracy, which was the first hypothesis. Local media is mostly better at shorter-term prediction, which is not unsurprising given that media features are posed to help catch signals on short-term tensions, not necessarily long-term developments (Chadefaux, 2014). The media features thus help improve the predictive accuracy of the baseline model, which is in line with earlier findings of Mueller & Rauh (2022a, 2022b). What is especially interesting about the results of the current article is that the model that only uses theme features from local media performs better than the local model that also uses history features. This could suggest that in hard prediction cases, historical features actually add noise to the model instead of contributing to it. Furthermore, in the period of relatively lower conflict intensity after August 2021, the local models provide more stable predictions, while the baseline struggles. This is likely because the training data mostly consisted of periods with much conflict, and thus the dominance of past conflict as a predictor for future conflict (Caldwell, 2022) could have influenced the model towards predicting more violence.

Secondly, local media is significantly better at conflict forecasting than both regional and global media, confirming the second hypothesis. This indicates that locally sourced news is more valuable for deriving early signs of tensions than news from other countries. The local models are also notice-

ably better at anticipating the massive spike in fatalities in June 2021, constituting a slight improvement in accuracy for what is a hard prediction case and echoing earlier findings on the contribution of news data by Mueller & Rauh (2022). Furthermore, local models particularly adjust better to drastic changes in conflict climate, something the baseline, regional models, and global models struggle with. As a result, the non-local models seem to suffer from a bias toward predicting violence in the period after 2021, which could be because international reporting of conflict often contains a violence bias in its coverage (Day et al., 2015). This is also illustrated by the fact that both regional and global media attention on Afghanistan spiked immensely in August 2021, coinciding with the spike in fatalities that occurred around the same time. The local media features provided more consistent coverage of the conflict, and this seems to have led to more accurate forecasts.

The third striking observation is that the model built on regional news features outperforms the model built on global news features in many cases. This suggests that the proximity of news sources matters and that the better performance could be explained by the higher geographical (Barron & Sharpe, 2008) and cultural (Barranco & Wisler, 1999) proximity of news sources in the region. A higher proximity may lead regional news sources to pay more attention to the situation in Afghanistan and therefore produce coverage that is more representative than global news sources. Previous literature has attempted to combine and quantify these measures, most prominently by using the notion of "relative proximity" coined by Sheafer et al. (2014). The regional models still perform worse than the local models overall, but they seem to provide better predictions for longer forecasting windows, and therefore future models might benefit from a combination of both local and regional features.

Limitations of results

In general, the models in this research still suffer from the limitations most pertinent to all conflict prediction efforts. First of all, the accuracy of all the models drops immensely when predicting further into the future, and this remains a persevering symptom of forecasting efforts, as also communicated in recent state-of-the-art reviews (Hegre et al., 2022; Vesco et al., 2022). To a degree, this lim-

itation is inherent to the problem by definition, but it nevertheless limits the degree to which predictions can be useful for real-life applications (Caldwell, 2022). Second, the hard problem remains hard, and even though the local models show slight improvements, all models failed to timely predict both the massive increase in fatalities following the US evacuation in 2021 and the massive decrease afterward. This aligns with prior studies on the hard problem (Bazzi et al., 2021; Hegre et al., 2022; Vestby et al., 2022), and confirms the early observation in the field that predicting conflict in a country that is already experiencing conflict is significantly easier (Hegre, Nygård, et al., 2017).

Furthermore, the comparison of the models with other studies in the field demonstrates that the performance of all seven models is relatively poor; state-of-the-art models in the field achieve significantly lower MSE scores, even those that employ a similar methodology. To contextualize the performance of the best model, Figure 6 compares the MSE scores of the local model of this study with the MSE scores of three high-performing models in the literature. All three of the comparison models were published as part of a forecasting competition organized by the Violence & Impacts Early-Warning System (VIEWS) project (Hegre, Allansson, et al., 2019), where participants were asked to predict changes in violence in Africa on a country-month level.

The first model is the news model by Mueller & Rauh (2022b), who employed a similar methodology as this study, using both measures of past violence and topics in the news to predict changes in violence. The second and third models are both ensemble models created by Vesco et al. (2022), which consist of a weighted combination of 13 different models. The results are compared to both the predictions of their model on a test-set, and for the true future.[12, 13]

Figure 6 clearly shows that the present model scores significantly worse than both the VIEWS models and the news model. For the first two fore-
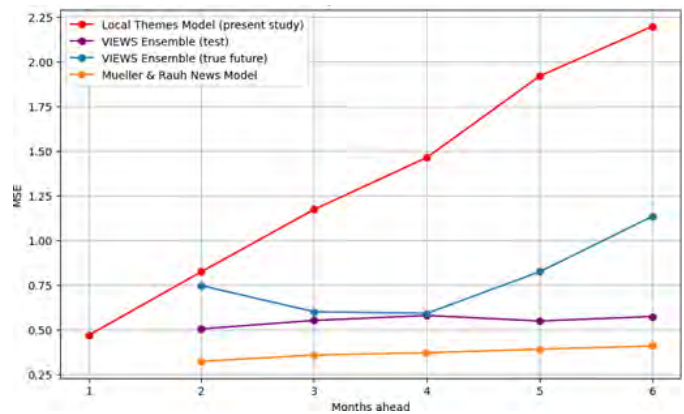
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[12]In the VIEWS competition, participants were asked to submit predictions for a test period, and for the true future at the time of submission (Vesco et al., 2022)

[13]Note that although the prediction task for the three compared models is similar enough to give some context to the results presented here, the task did differ substantially, and because it predicted changes in violence only for the African continent, no direct comparison with the predictions for Afghanistan of our model was possible.

Figure 6: *Comparison of the best model of the present study with state-of-the-art models*

casting windows $S \leq 2$, the local model still performs relatively well, but for the predictions further into the future the MSE increases linearly, while the MSE of the compared models remains relatively constant. This difference in prediction accuracy can partly be explained by the smaller data scope of this research. First, due to limitations of the GDELT API, the data was limited to a shorter time period compared to the models in the literature: the datasets for both VIEWS models and the news model range back to 1990, while the dataset for this research only ranges from January 2017 to March 2024. Second, most models in the literature use worldwide conflict features, but this research focused on a case study of Afghanistan, further limiting the number of cases the model could draw on. This choice for a case study was motivated in large part by the desire to use local news, and the baseline was accordingly also constructed using only historical data from Afghanistan. Therefore, for a full comparison of the models presented here, either the dataset for the current methodology would have to be expanded, or the state-of-the-art would have to be recreated with similar, smaller datasets.

Finally, the model in this study was significantly limited by the quality of the data in GDELT's GKG. Other than the limited time window for which data was retrievable, many studies have identified problems with the nature of the data. Some of these, such as noise (Halkia et al., 2020), unclear conflict criteria (Day et al., 2015), and missing and duplicate data (Saz-Carranza et al., 2020), are mostly crucial for the GDELT event database and less so for the theme information derived from the GKG data used by the present models. However, other prob-

lems are more concerning, such as the presence of fake news (Raleigh et al., 2023), the disproportionate amount of Western and English media sources (Saz-Carranza et al., 2020), and the lack of robust documentation of the dataset.

Implications

The fact that news features add value to prediction efforts has been established before (Chadefaux, 2014; Liebovitch et al., 2023; Mueller & Rauh, 2017). However, the observation that local media contributes to a significantly greater extent to prediction accuracy introduces a new and important distinction. Crucially, filtering the large amounts of data scraped to only local data led to a better-performing model, which highlights that more data is not always better data. Media-related features will likely play a more pivotal role in the future (Bazzi et al., 2021; Dowd et al., 2020; Sweijs et al., 2022), but it is important that the field takes the value of carefully selected data seriously. Criteria for data selection should become a robust part of conflict prediction research, for a number of important reasons.

First of all, all data, especially that which is derived from the news, is inherently sensitive to bias and subject to interference, by means of propaganda, misinformation, and censorship (Baum & Zhukov, 2015). This is illustrated by the many limitations of the GDELT dataset as discussed above, and although other sources of data may suffer from them less, to a degree all datasets of this nature face similar problems by definition (Chadefaux, 2017). Features from the news can indeed function as a mirror of society (Cook, 2000) and provide important early warning signs, but we have to carefully distinguish which reflections are to be trusted and which are not. The combatting of bias, Western dominance, and misinformation in data sources is thus paramount to use data for the forecast of future conflict and to avoid basing predictions on a distorted version of reality.

Second, the findings challenge the persistent notion in the field that more data is always better data or leads to more informed predictions. This resonates with existing calls by experts, who argue that the belief that "brute force" approaches using big data will lead to better forecasts is highly flawed in the domain of conflict studies (Cederman & Weidmann, 2017; Mancini, 2013). The overconfidence

in machine learning methods and the sidelining of theoretical approaches might even be dangerous, due to the complex nature of conflict environments (Mancini, 2013). Furthermore, Cederman & Weidmann (2017) argue that even if features from large-scale data-scraping operations have shown to contain signs of political tension, this does not necessarily mean that the resulting algorithms will be able to predict conflict with high accuracy.

These concerns are particularly relevant in light of the possibility that certain aspects of conflict, or even conflict as a whole, could be inherently unpredictable. The field has largely been under the assumption that since big data has been able to predict many other things that were once considered unpredictable, like the weather, the current low accuracy in conflict prediction is attributable to methodological limitations (see i.e. Ward & Beger, 2017). However, the current limits for conflict predicting could not be due to flawed data or flawed models but point to a fundamental theoretical limitation. As Chadefaux (2017) argues, perhaps conflict events are like clouds, highly unpredictable and irregular, or even like "Black Swans," and thus cannot be predicted at all (Taleb, 2010). The sudden surge in fatalities in Afghanistan in July 2021, for example, could simply have been so irregular that it was inherently impossible to predict. Another persevering hypothesis is that conflict might be in the "error term" of prediction (Gartzke, 1999), or that a high uncertainty about the future is itself a contributor to the onset of war (Malone, 2022). The conflict-predicting discipline has mostly overlooked the potential that conflict prediction might simply not be possible (Cederman & Weidmann, 2017), and seems motivated by trust in data-driven progress. However, the possibility of these limitations matters, because if the field is really trying to predict the unpredictable, then seemingly accurate predictions could lead to costly mistakes when they start to inform policy decisions (Chadefaux, 2017).

Therefore, it is important that data-driven approaches to the forecasting of conflict are theoretically informed, and that the field does not blindly fixate on naive accuracy measures such as MSE (Blair & Sambanis, 2020; Colaresi & Mahmood, 2017; Hegre et al., 2022). The field has to be careful not to mistake statistical straws in massive conflict databases for needles that represent some sort of conflict-predicting crystal ball. Big data can convey big errors (Taleb, 2013), and therefore Mancini

(2013) argues that data-based approaches to conflict prediction should start on a small scale with local data before drawing big conclusions on a larger scale. Researchers often opt to draw conflict features of many different countries and large timespans, and although this has been shown to increase the prediction accuracy (Hegre, Metternich, et al., 2017), it could also lead to self-fulfilling prophecies, or the repetition of one country's conflict dynamics in another (Chadefaux, 2021). Poorly designed conflict prediction algorithms are vulnerable to a bias toward predicting further conflict, as was shown in this research, and this could reinforce uninformed top-down decision-making structures, rather than enabling people-centered and bottom-up early warning systems (Muggah & Whitlock, 2022).

For a prediction to result in an effective intervention, it is not only important that a prediction is accurate, but also that it is understandable. To this end, simple models built on local data from the news might be more valuable, as they are easier to understand, and even though they might be less precise than more complex machine models, an increase in interpretability could outweigh slightly lower accuracy (Ettensperger, 2019, 2021). Current forecasting systems are often too remote and disconnected to be applied productively (Caldwell, 2022; Eze & Osei Baffour Frimpong, 2020; Hegre, Metternich, et al., 2017), but local news data could provide better information about the situation on the ground, and therefore help make forecasts more applicable.

The rationality of a conflict prediction is also important with respect to the warning-response gap that often prevents a forecast from resulting in effective policy intervention (Hegre, Hultman, et al., 2019; Musumba et al., 2021). If conflict prediction efforts are to make an impact on conflict prevention, it is crucial that early warnings are connected with suggested policy responses, and therefore forecasts have to be explainable and theoretically sound. The idea that conflict is inevitable because it is written about by Western media is unlikely to persuade policy makers or be actionable. In this regard, using local news for conflict prediction is inherently more appropriate for informing policy, and might be more conceptually desirable, regardless of the resulting accuracy. Of course, a prediction algorithm should not be deemed reliable just because it is based on local sources, but on the opposite end, an algorithm based on non-local sources warrants a significant dose of skepticism, no matter how accurate its prediction record.

Future works

This present work could be extended in the future by investigating the relative predictive value of news features in more detail. Firstly, future work should expand on the data collection, and deploy a more rigorous data-scraping methodology. For example by scraping news articles from different sources that might contain more local coverage, scraping over a larger time period, or predicting for multiple countries at the same time. Research could also focus on systemizing the distinction between regional and local news, for example by using relative proximity measures such as the one suggested by Sheafer et al. (2014). Furthermore, the performance of more complex ML methods that have proven successful in the field should be evaluated, in particular neural networks, AutoML algorithms, and ensemble methods. This could address some of the limitations of this study, increase the prediction accuracy, and enable a more direct comparison with the state-of-the-art in the field.

Finally, research should focus on explicitly interpreting the models' predictions, and evaluating to what extent they can be useful for informing policy decisions. There is some initial work with suggestions to improve the interpretability of more complex models, for example by Ward & Beger (2017) who provide some guidelines for the analysis of ensemble methods, and by Colaresi & Mahmood (2017) who designed a general framework for the critical analysis of machine learning research. This is also relevant with respect to the general mission in the field to incorporate quantitative forecasting methods into a larger framework with theory, qualitative methods, and human input (Chadefaux, 2017; Eze & Osei Baffour Frimpong, 2020; Hegre et al., 2022; Sweijs et al., 2022).

Conclusion

In closing, this research has highlighted the value of local news sources for predicting changes in conflict intensity. The comparison of the local, regional, and global models confirmed both hypotheses; (1) the incorporation of local media

features leads to an increase in prediction accuracy compared to the baseline model, and (2) local media is significantly better at predicting conflict than both regional and global media. The models that use local media features are especially better at short-term prediction and at harder prediction cases. These findings suggest that local media sources could be more valuable for conflict prediction than regional and global media sources, and illustrate the value of careful data selection methods in the field. This presents a promising new avenue that could aid progress, especially because prediction frameworks using local news features could be better at capturing local political tensions, might suffer less from a bias towards conflict coverage, and are likely to be more conceptually sound and understandable.

Nevertheless, this present work has also shed light on a few significant limitations, and although the immense potential of conflict prediction is clear, whether we will ever be able to predict conflict with high accuracy is still unknown. The current limitations could be on the methodological or the theoretical side, but either way, the prevailing assumption that big data methods can by themselves address a problem of such a complex nature is highly misinformed, and could have potentially disastrous consequences. This research suggests that it might be more fruitful to slow down and start on a smaller scale, to enable more careful consideration of diverse and local data collection methods. For the conflict prediction field to become more than just an interesting academic discussion, efforts should not aim merely for prediction accuracy, but also for high interpretability, conceptually justified methodology, and practical relevance for policy interventions. Only when predictions are coupled with meaningful tools for early intervention could these efforts hope to actually contribute to conflict prevention, and ultimately, save lives.

Replicability statement

The data and code used for this study are publicly available on GitHub through the following link: https://github.com/lboekestein/capstone

References

Attinà, F., Carammia, M., & Iacus, S. M. (2022). Forecasting change in conflict fatalities with dynamic elastic net. *International Interactions, 48*(4), 649–677. https://doi.org/10.1080/03050629.2022.2090934

Azar, E. E. (1980). The Conflict and Peace Data Bank (COPDAB) Project. *Journal of Conflict Resolution, 24*(1), 143–152. https://doi.org/10.1177/002200278002400106

Barranco, J., & Wisler, D. (1999). Validity and Systematicity of Newspaper Data in Event Analysis. *European Sociological Review, 15*(3), 301–322. https://doi.org/10.1093/oxfordjournals.esr.a018265

Barron, P., & Sharpe, J. (2008). Local Conflict in Post-Suharto Indonesia: Understanding Variations in Violence Levels and Forms Through Local Newspapers. *Journal of East Asian Studies, 8*(3), 395–423. https://doi.org/10.1017/S1598240800006482

Baum, M. A., & Zhukov, Y. M. (2015). Filtering revolution: Reporting bias in international newspaper coverage of the Libyan civil war. *Journal of Peace Research, 52*(3), 384–400. https://doi.org/10.1177/0022343314554791

Bazzi, S., Blair, R. A., Blattman, C., Dube, O., Gudgeon, M., & Peck, R. (2021). The Promise and Pitfalls of Conflict Prediction: Evidence from Colombia and Indonesia. The Review of Economics and Statistics, 104(4), 1–45. https://doi.org/10.1162/rest_a_01016

Blair, R. A., & Sambanis, N. (2020). Forecasting Civil Wars: Theory and Structure in an Age of "Big Data" and Machine Learning. *Journal of Conflict Resolution, 64*(10), 1885–1915. https://doi.org/10.1177/0022002720918923

Bressan, S., Håvard Mokleiv Nygård, & Seefeldt, D. (2019). Forecasting and Foresight: Methods for Anticipating Governance Breakdown and Violent Conflict. *EU-LISTCO, 1*(2). https://doi.org/10.17169/refubium-26117

Caldwell, S. (2022). *Assessing the Technical Feasibility of Conflict Prediction for Anticipatory Action.* OCHA Centra for Humanitarian data. https://centre.humdata.org/assessing-the-technical-feasibility-of-conflict-prediction-for-anticipatory-action/

Cederman, L.-E., & Weidmann, N. B. (2017). Predicting armed conflict: Time to adjust our expectations?. *Science, 355*(6324), 474–476. https://doi.org/10.1126/science.aal4483

Chadefaux, T. (2014). Early warning signals for war in the news. *Journal of Peace Research, 51*(1), 5–18. https://doi.org/10.1177/0022343313507302

Chadefaux, T. (2017). Conflict forecasting and its limits. *Data Science, 1*(1–2), 7–17. https://doi.org/10.3233/DS-170002

Chadefaux, T. (2021). A shape-based approach to conflict forecasting. *International Interactions, 48*(4), 633–648. https://doi.org/10.1080/03050629.2022.2009821

Chen, P., Jatowt, A., & Yoshikawa, M. (2020). Conflict or cooperation? Predicting future tendency of international relations. *Proceedings of the 35th Annual ACM Symposium on Applied Computing*, 923–930. https://doi.org/10.1145/3341105.3373929

Colaresi, M., & Mahmood, Z. (2017). Do the robot: Lessons from machine learning to improve conflict forecasting. *Journal of Peace Research, 54*(2), 193–214. https://doi.org/10.1177/0022343316682065

Cook, T. E. (2000). Governing with the News: The News Media as a Political Institution. *American Political Science Review, 94*(3), 718–719. https://doi.org/10.2307/2585858

Davenport, C., & Ball, P. (2002). Views to a Kill: Exploring the Implications of Source Selection in the Case of Guatemalan State Terror, 1977-1995. *Journal of Conflict Resolution, 46*(3), 427–450. https://doi.org/10.1177/0022002702046003005

Day, J., Pinckney, J., & Chenoweth, E. (2015). Collecting data on nonviolent action: Lessons learned and ways forward. *Journal of Peace Research, 52*(1), 129–133. https://doi.org/10.1177/0022343314533985

Demarest, L., & Langer, A. (2018). The study of violence and social unrest in Africa: A comparative analysis of three conflict event datasets. *African Affairs, 117*(467), 310–325. https://doi.org/10.1093/afraf/ady003

Demarest, L., & Langer, A. (2022). How Events Enter (or Not) Data Sets: The Pitfalls and Guidelines of Using Newspapers in the Study of Conflict. *Sociological Methods & Research, 51*(2), 632–666. https://doi.org/10.1177/0049124119882453

D'Orazio, V., & Yu, L. (2022). Forecasting conflict in Africa with automated machine learning systems. *International Interactions, 48*(4), 714–738. https://doi.org/10.1080/03050629.2022.2017290

Dowd, C., Justino, P., Kishi, R., & Marchais, G. (2020). Comparing 'New' and 'Old' Media for Violence Monitoring and Crisis Response: Evidence from Kenya. *Research & Politics, 7*(3), 2053168020937592. https://doi.org/10.1177/2053168020937592

Ettensperger, F. (2019). Comparing supervised learning algorithms and artificial neural networks for conflict prediction: Performance and applicability of deep learning in the field. *Quality & Quantity, 54*(2), 567–601. https://doi.org/10.1007/s11135-019-00882-w

Ettensperger, F. (2021). Forecasting conflict using a diverse machine-learning ensemble: Ensemble averaging with multiple tree-based algorithms and variance promoting data configurations. *International Interactions, 48*(4), 1–23. https://doi.org/10.1080/03050629.2022.1993209

Eze, C. B. & Osei Baffour Frimpong. (2020). Contributions of Early Warning to the African Peace and Security Architecture: The Experience of the West Africa Network for Peacebuilding (WANEP). *Springer eBooks*, 181–194. https://doi.org/10.1007/978-3-030-46636-7_11

Galla, D., & Burke, J. (2018). Predicting Social Unrest Using GDELT. In P. Perner (Ed.), *Machine Learning and Data Mining in Pattern Recognition* (pp. 103–116). *Springer International Publishing.* https://doi.org/10.1007/978-3-319-96133-0_8

Gartzke, E. (1999). War Is in the Error Term. *International Organization, 53*(3), 567–587. https://doi.org/10.1162/002081899550995

GDELT. (2015a, March 2). *World Bank Group Topical Taxonomy Now in GKG – The GDELT Project.* https://blog.gdeltproject.org/world-bank-group-topical-taxonomy-now-in-gkg/

GDELT. (2015b, July 7). *CrisisLex Taxonomies Now Available in GKG – The GDELT Project.* https://blog.gdeltproject.org/crisis

lex-taxonomies-now-available-in-gkg/

GDELT. (2016, January 18). *UN My World Survey Topics Added to GKG 2.0 – The GDELT Project.* https://blog.gdeltproject.org/un-my-world-survey-topics-added-to-gkg-2-0/

GDELT. (2017, June 20). *GDELT DOC 2.0 API Debuts! – The GDELT Project.* https://blog.gdeltproject.org/gdelt-doc-2-0-api-debuts/

Gerner, D. J., Rajaa Abu-Jabr, Schrodt, P. A., & Yilmaz, Ö. (2002). Conflict and Mediation Event Observations (CAMEO): A New Event Data Framework for the Analysis of Foreign Policy Interactions.

Gleditsch, K. S., & Ward, M. D. (2013). Forecasting is difficult, especially about the future. *Journal of Peace Research, 50*(1), 17–31. https://doi.org/10.1177/0022343312449033

Halkia, M., Ferri, S., Papazoglou, M., Van Damme, M.-S., & Thomakos, D. (2020). Conflict Event Modelling: Research Experiment and Event Data Limitations. In A. Hürriyetoğlu, E. Yörük, V. Zavarella, & H. Tanev (Eds.), *Proceedings of the Workshop on Automated Extraction of Socio-political Events from News 2020* (pp. 42–48). European Language Resources Association (ELRA). https://aclanthology.org/2020.aespen-1.8

Hegre, H., Allansson, M., Basedau, M., Colaresi, M., Croicu, M., Fjelde, H., Hoyles, F., Hultman, L., Högbladh, S., Jansen, R., Mouhleb, N., Muhammad, S. A., Nilsson, D., Nygård, H. M., Olafsdottir, G., Petrova, K., Randahl, D., Rød, E. G., Schneider, G., . . . Vestby, J. (2019). ViEWS: A political violence early-warning system. *Journal of Peace Research, 56*(2), 155–174. https://doi.org/10.1177/0022343319823860

Hegre, H., Hultman, L., & Nygård, H. M. (2019). Evaluating the Conflict-Reducing Effect of UN Peacekeeping Operations. *The Journal of Politics, 81*(1), 215–232. https://doi.org/10.1086/700203

Hegre, H., Metternich, N. W., Nygård, H. M., & Wucherpfennig, J. (2017). Introduction: Forecasting in peace research. *Journal of Peace Research, 54*(2), 113–124. https://doi.org/10.1177/0022343317691330

Hegre, H., Nygård, H. M., Ræder, R. F., Metternich, N. W., & Wucherpfennig, J. (2017). Evaluating the scope and intensity of the conflict trap. *Journal of Peace Research, 54*(2), 243–261. https://doi.org/10.1177/0022343316684917

Hegre, H., Vesco, P., & Colaresi, M. (2022). Lessons From an Escalation Prediction Competition. *International Interactions, 48*(4), 1–34. https://doi.org/10.1080/03050629.2022.2070745

J. David Singer, Lear, J. B., Macaulay, D., & Meredith Reid Sarkees. (1973). The peace researcher and foreign policy prediction (1973). *Papers of the Peace Science Society (International), 21*(1). https://doi.org/10.4324/9780203128398-18

Keertipati, S., Savarimuthu, B. T. R., Purvis, M., & Purvis, M. (2014). Multi-level Analysis of Peace and Conflict Data in GDELT. *Proceedings of the MLSDA 2014 2nd Workshop on Machine Learning for Sensory Data Analysis,* 33–40. https://doi.org/10.1145/2689746.2689750

Leetaru, K., & Schrodt, P. (2013). *GDELT: Global Data on Events, Location and Tone, 1979-2012.* http://data.gdeltproject.org/documentation/ISA.2013.GDELT.pdf

Levin, N., Ali, S., & Crandall, D. (2018). Utilizing remote sensing and big data to quantify conflict intensity: The Arab Spring as a case study. *Applied Geography, 94,* 1–17. https://doi.org/10.1016/j.apgeog.2018.03.001

Liebovitch, L. S., Powers, W. J., Shi, L., Chen-Carrel, A., Loustaunau, P., & Coleman, P. T. (2023). Word differences in news media of lower and higher peace countries revealed by natural language processing and machine learning. *PLOS ONE, 18*(11), e0292604–e0292604. https://doi.org/10.1371/journal.pone.0292604

Malone, I. (2022). Recurrent neural networks for conflict forecasting. *International Interactions, 48*(4), 614–632. https://doi.org/10.1080/03050629.2022.2016736

Mancini, F. (Ed.). (2013). New Technology and the Prevention of Violence and Conflict. *Stability: International Journal of Security & Development, 2*(3), 55. https://doi.org/10.5334/sta.cp

Mueller, H., & Rauh, C. (2017). Reading Between the Lines: Prediction of Political Violence Using Newspaper Text. *American Political Science Review, 112*(2), 358–375. https://doi.org/10.1017/s0003055417000570

Mueller, H., & Rauh, C. (2022a). The Hard Problem of Prediction for Conflict Prevention. *Journal of the European Economic Association, 20*(6), 2440–2467. https://doi.org/10.1093/jeea/jvac025

Mueller, H., & Rauh, C. (2022b). Using past violence and current news to predict changes in violence. *International Interactions, 48*(4), 579–596. https://doi.org/10.1080/03050629.2022.2063853

Muggah, R., & Whitlock, M. (2022). Reflections on the Evolution of Conflict Early Warning. *Stability: International Journal of Security and Development, 10*(1), 2. https://doi.org/10.5334/sta.857

Musumba, M., Fatema, N., & Kibriya, S. (2021). Prevention Is Better Than Cure: Machine Learning Approach to Conflict Prediction in Sub-Saharan Africa. *Sustainability, 13*(13), 7366. https://doi.org/10.3390/su13137366

O'Brien, S. P. (2010). Crisis Early Warning and Decision Support: Contemporary Approaches and Thoughts on Future Research. *International Studies Review, 12*(1), 87–104. https://doi.org/10.1111/j.1468-2486.2009.00914.x

Racek, D., Thurner, P. W., Davidson, B. I., Zhu, X. X., & Kauermann, G. (2024). Conflict forecasting using remote sensing data: An application to the Syrian civil war. *International Journal of Forecasting, 40*(1), 373–391. https://doi.org/10.1016/j.ijforecast.2023.04.001

Raleigh, C., & Kishi, D. R. (2019). Similarities and Differences Across Conflict Datasets. ACLED. https://www.acleddata.com/wp-content/uploads/2019/09/ACLED-Comparison_8.2019.pdf

Raleigh, C., Kishi, R., & Linke, A. (2023). Political instability patterns are obscured by conflict dataset scope conditions, sources, and coding choices. *Humanities and Social Sciences Communications, 10*(1), 1–17. https://doi.org/10.1057/s41599-023-01559-4

Raleigh, C., Linke, R., Hegre, H., & Karlsen, J. (2010). Introducing ACLED: An Armed Conflict Location and Event Dataset. *Journal of Peace Research, 47*(5), 651–660. https://doi.org/10.1177/0022343310378914

Saz-Carranza, A., Maturana, P., & Quer, X. (2020). The Empirical Use of GDELT Big Data in Academic Research (822654; p. 41). GLOBE. https://www.globe-project.eu/the-empirical-use-of-gdelt-big-data-in-academic-research_13809.pdf

Schrodt, P. A. (1991). Prediction of Interstate Conflict Outcomes Using a Neural Network. *Social Science Computer Review, 9*(3), 359–380. https://doi.org/10.1177/089443939100900302

Schrodt, P. A. (2006). Forecasting Conflict in the Balkans using Hidden Markov Models. *Programming for Peace, 1*(1), 161–184. https://doi.org/10.1007/1-4020-4390-2_8

Schrodt, P. A. (2013). Seven deadly sins of contemporary quantitative political analysis. *Journal of Peace Research, 51*(2), 287–300. https://doi.org/10.1177/0022343313499597

Schrodt, P. A., Davis, S. N., & Weddle, J. L. (1994). Political Science: KEDS—A Program for the Machine Coding of Event Data. *Social Science Computer Review, 12*(4), 561–587. https://doi.org/10.1177/089443939401200408

Schrodt, P. A., Gerner, D. J., Abu-Jabr, R., & Yilmaz, Ö. (2001). Analyzing the dynamics of international mediation processes in the Middle East and Balkans. Semantic Scholar. https://www.semanticscholar.org/paper/Analyzing-the-dynamics-of-international-mediation-Schrodt-Gerner/03f8efbbef0c7015a09a42d728fcf2621c4f9013

Sheafer, T., Shenhav, S. R., Takens, J., & van Atteveldt, W. (2014). Relative Political and Value Proximity in Mediated Public Diplomacy: The Effect of State-Level Homophily on International Frame Building. *Political Communication, 31*(1), 149–167. https://doi.org/10.1080/10584609.2013.799107

Small, M., J David Singer, & Bennett, R. (1997). Resort to arms: International and civil wars, 1816-1980. Umi, Stampa.

Stewart, P., Ali, I., Stewart, P., & Ali, I. (2021, August 30). Last U.S. troops depart Afghanistan after massive airlift ending America's longest war. Reuters. https://www.reuters.com/world/last-us-forces-leave-afghanistan-after-nearly-20-years-2021-08-30/

Subramanian, D., & Stoll, R. J. (2006). Events, Patterns, and Analysis Forecasting International Conflict in the Twenty-First Century. Kluwer Academic Publishers

eBooks, 145–160. https://doi.org/10.1007/1-4020-4390-2_7

Sun, X., Gao, J., Liu, B., & Wang, Z. (2021). Big Data-Based Assessment of Political Risk along the Belt and Road. *Sustainability, 13*(7), Article 7. https://doi.org/10.3390/su13073935

Suzuki, S., Krause, V., & Singer, J. D. (2002). The Correlates of War Project: A Bibliographic History of the Scientific Study of War and Peace, 1964-2000. *Conflict Management and Peace Science, 19*(2), 69–107. https://doi.org/10.1177/073889420201900204

Sweijs, T., Teer, J., van Hoeve, S., Berti, G., van Schie, J., van der Weerd, J., & Michaelis, J. (2022). Practices, Principles and Promises of Conflict Early Warning Systems. JSTOR. https://www.jstor.org/stable/resrep39641

Taleb, N. N. (2010). The Black Swan: The Impact of the Highly Improbable (2nd ed., Random trade pbk. ed). Random House Trade Paperbacks.

Taleb, N. N. (2013, January). *Beware the Big Errors of "Big Data."* Wired. https://www.wired.com/2013/02/big-data-means-big-errors-people/

Vesco, P., Hegre, H., Colaresi, M., Jansen, R. B., Lo, A., Reisch, G., & Weidmann, N. B. (2022). United They Stand: Findings from an Escalation Prediction Competition. *International Interactions, 48*(4), 1–37. https://doi.org/10.1080/03050629.2022.2029856

Vestby, J., Brandsch, J., Larsen, V. B., Landsverk, P., & Tollefsen, A. F. (2022). Predicting (de-)escalation of sub-national violence using gradient boosting: Does it work?. *International Interactions, 48*(4), 841–859. https://doi.org/10.1080/03050629.2022.2021198

Voukelatou, V., Miliou, I., Giannotti, F., & Pappalardo, L. (2022). Understanding peace through the world news. *EPJ Data Science, 11*(1), Article 1. https://doi.org/10.1140/epjds/s13688-022-00315-z

Ward, M. D., & Beger, A. (2017). Lessons from near real-time forecasting of irregular leadership changes. *Journal of Peace Research, 54*(2), 141–156. https://doi.org/10.1177/0022343316680858

Ward, M. D., Greenhill, B. D., & Bakke, K. M. (2010). The perils of policy by p-value: Predicting civil conflicts. *Journal of Peace Research, 47*(4), 363–375. https://doi.org/10.1177/0022343309356491

Weidmann, N. B. (2016). A Closer Look at Reporting Bias in Conflict Event Data. *American Journal of Political Science, 60*(1), 206–218. https://doi.org/10.1111/ajps.12196

Wolfsfeld, G. (2011). Making sense of media and politics: Five principles in political communication. Routledge.

A   The best parameters for each model as found in the grid search

Model	n_estimators	max_depth	min_samples_split	min_samples_leaf
Baseline (History)	50	None	2	2
History + Local	50	None	2	1
History + Regional	100	None	2	1
History + Global	50	10	2	1
Local	200	10	2	1
Regional	200	10	2	1
Global	50	None	2	1