FRANZISKA HARTUNG

GETTING UNDER YOUR SKIN

THE ROLE OF PERSPECTIVE AND SIMULATION OF EXPERIENCE IN NARRATIVE COMPREHENSION

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Getting under your skin:
The role of perspective and simulation of experience in narrative comprehension

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The role of perspective and simulation of experience in narrative comprehension

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Chapter 1:

General Introduction

“Reading gives us some place to go when we have to stay where we are.”

Mason Cooley

When we read literature, we often get completely absorbed by the story and forget the world around us, temporarily escaping our real lives by diving into a fictional world. The stories we read can provide us with quite different reading experiences. There are stories which make us think, there are stories which make us experience strong emotions and there are other stories which create colourful pictures in our minds and take us on wild adventures. Sometimes we are mere spectators of the scenes unfolding on the pages, sometimes we are companions of our heroes, and sometimes we even merge with fiction and experience the events through the eyes of a character. These experiences are thought to be a result of simulating what is written on the pages. Our brains create mental models of what is going on in the stories and by doing so provide us with the illusion of experience.

How do we become the hero of a story? Does the way we immerse ourselves in a story affect our enjoyment during reading? Are people who identify more easily with characters more likely to be avid readers? What is it about literature which pulls us into a story? In this dissertation, I set out to investigate simulation during comprehension of fictional narratives with neuroimaging and self-report measures of subjective experience. A special focus is perspective taking in simulation. My goal was to qualify the role of perspective in mental models in natural comprehension and to identify factors influencing perspective taking during simulation, such as narrative perspective in stories. In four experimental projects, I tested perspective in simulation by measuring behaviour and brain activity during narrative comprehension.

The remainder of this introduction is dedicated to critically introducing the concept of simulation and its role in cognition. In addition, I will discuss new directions for simulation in situated and contextual language use, argue that simulation plays a more fundamental role in natural situations, and discuss the role of perspective in simulation and language. Finally, I will give an overview of the work presented in this dissertation.

What is simulation?

Simulation (from Latin *simulationem*, *simulo*' imitate', 'pretence') is the imitation of the behaviour or characteristics of one system through the use of another system (from https://en.wiktionary.org/wiki/simulation). In psychology, the term is used to describe a theory which assumes that the human mind imitates behaviour of others without overt execution of that behaviour for the purpose of understanding and predicting the world, and in order to facilitate appropriate output (Binder & Desai, 2011; Goldman, 2006; Moulton & Kosslyn, 2009). This means that our brain functions as a sort of proxy by simulating situations and events in order to understand and represent meaning through creating internal models of the world. The most basic assumption of simulation is that mental models involve re-enacting brain states which were involved in its encoding, and are therefore based on prior subjective experience with the world (e.g. Barsalou, 2015). For example, when observing someone performing an action, we create a mental model of the event by partially re-enacting brain states from the moment of learning or executing this action. The term simulation theory is often used to contrast 'theory-theory'. While simulation theory proposes that we understand others by unconsciously reconstructing how it would be to be the other person based on prior experience of being in similar situations ourselves, theory-theory proposes that we understand states of minds from others by statistical inference based on prior experience with other agents.

It has been suggested that the dissociation between simulation and real experience is along the lines of bottom up and top down processing: in contrast to real experiences, simulations do not have bottom up input from sensory channels (Barsalou, 2015). In line with this, simulation is often understood as a subconscious or reduced form of mental imagery, which differs from the latter in terms of detail, specificity, consciousness, automaticity, and long term memory involvement (Barsalou, 2008; Hétu et al., 2013; Iachini, 2011). Indeed, there is evidence that brain activations in regions involved in executing, imagining, observing, and even hearing and talking about action are spatially overlapping, which is taken as evidence that these processes share neural resources (Taylor & Zwaan, 2009; but see e.g. Willems, Toni, Hagoort, & Casasanto, 2010a).

Simulation is also sometimes understood as a unifying mechanism for cognition which binds information from different levels of cognition like perception, imagery and social cognition based on (partial) re-activations of perceptual, motor and introspective states (Barsalou, 2008, 2009, Jeannerod, 2001, 2006). As such, simulation is framed as a much more basic computational mechanism which unifies information across various forms of cognition. In this sense, simulation functions as a form of working memory mechanism which integrates information from different modalities and levels of cognition into a coherent model of the current situation. For instance, when a person is throwing a ball to someone else, simulation helps unify input from perception with predictions about the current situation in order to generate an integrated representation of the event and appropriate output. The input in such a model originates from different modalities like visual (e.g. spatial relations), tactile (e.g. weight and size of the ball), and motor modalities (e.g. muscle feedback), as well as social knowledge (e.g. is the other person a child?). The function of simulation has further been linked to episodic memory (e. g. Rosenbaum, McKinnon, Levine, & Moscovitch, 2004; for review see Wagner, Shannon, Kahn, & Buckner, 2005), and situation models (Zwaan & Taylor, 2006; Zwaan & van Oostendorp, 1993). Because simulation shares network and functional properties with experiencing, some accounts argue that simulation can also function as a learning mechanism, especially for social learning (R. A. Mar & Oatley, 2008; Taylor & Zwaan, 2009).

In language sciences, simulation is typically linked to semantic processing. Indeed, there is experimental evidence from neuroimaging research that when we comprehend a word, we activate brain states which are associated with cortical regions of the corresponding modalities. For instance, sensory and motor regions in the brain can become active when people are presented with language which is semantically related to action and perception (e. g. Hauk, Johnsrude, & Pulvermuller, 2004). When we comprehend a word referring to an object (e.g. scissors) it is thought that visual cortices represent its shape and colour, whereas motor and premotor cortices represent actions associated with that object (affordances, e.g. grasping, cutting). Sensorimotor or action simulation is the most investigated form of simulation during language comprehension (Aziz-Zadeh, Wilson, Rizzolatti, & Iacoboni, 2006; Hauk et al., 2004; see Kiefer & Pulvermüller, 2012 for a review; Tettamanti et al., 2005; Willems, Toni, Hagoort, & Casasanto, 2010b) and has inspired theories of embodiment in language (Glenberg & Gallese, 2012). Similar evidence for different kinds of simulation has been found, for instance for emotion words (Etkin, Egner, & Kalisch, 2011; Olson, Plotzker, & Ezzyat, 2007; Ross & Olson, 2010; Zahn et al., 2007), and colour words (Simmons et al., 2007). Another type of simulation is mentalizing, which is understood as the social cognition equivalent of sensorimotor simulation. Mentalizing refers to the understanding, representing, and processing of mental states of other agents by using one’s own mind as a proxy for simulating the states of mind of other agents (Decety & Chaminade, 2003; Frith & Frith, 2006). Indeed, at a conceptual level, sensorimotor simulation and mentalizing can be considered two aspects of mental simulation, as was argued by Goldman (2006). Mentalizing has been associated with the activation of a set of regions referred to as the ‘mentalizing network’ (Decety & Chaminade, 2003; Frith & Frith, 2006; Tamir & Mitchell, 2010).

Effects of simulation are a robust and frequent finding in neuroimaging and behavioural research and there is evidence that simulation contributes to language comprehension (see Willems & Casasanto, 2011 for a review). However, the typical effects of modality specific activations are not always present (Bedny, Caramazza, Grossman, Pascual-Leone, & Saxe, 2008; de Zubicaray, Postle, McMahon, Meredith, & Ashton, 2010; Postle, McMahon, Ashton, Meredith, & de Zubicaray, 2008; Raposo, Moss, Stamatakis, & Tyler, 2009; Marc Sato, Mengarelli, Riggio, Gallese, & Buccino, 2008), and there is only limited evidence for a strong causal contribution of simulation in language processing (Binder & Desai, 2011; Willems & Casasanto, 2011). Typically, it is found that comprehension is possible without simulation (Bak, O'Donovan, Xuereb, Boniface, & Hodges, 2001), but processing times might be increased (Papeo, Corradi-dell'acqua, & Rumiati, 2011). This has sparked some controversy regarding the functional role of simulation in language (Caramazza, Anzellotti, Strnad, & Lingnau, 2014; Mahon & Caramazza, 2008). However, the controversy about the role of simulation is entirely based on findings from studies investigating processing of single words (action verbs) or decontextualized sentences (e. g. Maieron, Marin, Fabbro, & Skrap, 2013). While simulation seems not essential for comprehension of words or sentences as argued by many accounts based on non-contextual language (Caramazza et al., 2014; Mahon, 2014), we cannot exclude that the possibility that simulation plays a fundamental role in language comprehension beyond the level of single, isolated units. Moreover, some accounts (Taylor & Zwaan, 2009) argue that despite not being necessary for successful comprehension, simulation is a helpful supplementary mechanism supporting comprehension and construction of mental models with a high degree of specificity (see also Barsalou, in press, Barsalou 2015). Recently research has shifted to investigating more systematically how and when simulation takes place and to define its function for cognition (Chatterjee, 2011; Willems & Francken, 2012). Some theoretical approaches tried to implement a more integrated view of simulation as a multimodal, flexible, and context dependent process (Barsalou, in press; 2016). Yet, the function of simulation in cognition is a matter of dispute (e. g. Chatterjee, 2011; Kemmerer, 2015; Willems & Francken, 2012; Wilson & Golonka, 2013).

Simulation in situated language

It has been argued that simulations play a more fundamental role in comprehension in situated, more natural language use by facilitating the construction of situation models (Bower & Morrow 1990; Jacobs 2015; Schrott & Jacobs 2011; Zwaan 2004; Zwaan & Radvansky 1998; see Zwaan 2014 for a review). Experimental evidence shows that simulation in language processing is flexible and highly context dependent (Cuccio et al., 2014; for review see Kiefer & Pulvermüller, 2012; Papeo, Rumiati, Cecchetto, & Tomasino, 2012; van Dam, van Dijk, Bekkering, & Rueschemeyer, 2012; Willems & Casasanto, 2011).

For instance, Papeo and colleagues (2011) found that activation of primary motor areas as a consequence of action verb comprehension is stronger when the verb is presented in 1st person (*I throw* instead of *throw*). In contrast, presenting the same verb in 3rd person (*she throws*) activated areas typically found during action observation, but not execution (Papeo et al., 2011). This shows that simulations are tailored to situations and current task requirements, and the resulting mental models are constructed dynamically as needed (Barsalou, 2015).

Situation models are globally coherent representations of specific situations, which integrate simulations from multiple modalities. According to Zwaan et al. (1995) the events in a situation model are connected along five dimensions: space, time, agent identity, causality, and intentionality (Johnson-Laird, 1983; Zwaan & Radvansky, 1998). These models have a robust memory representation compared to the language input in which they were encoded, suggesting that they function as a memory mechanism for encoding information as coherent representations (Johnson-Laird, 1983; Kintsch, 2005; Kintsch & Dijk, 1978). Zwaan (2008) argues that situation models receive information from modality specific simulations in order to represent information about events and situations, and facilitate integration of knowledge into a coherent, existing framework. According to Zwaan's view (Zwaan, 2008), simulation only takes place in modality specific cortical areas for concept retrieval, whereas it is only indirectly involved in the event representation on the level of the situation model. Other accounts (e. g. Barsalou, 2015; Casasanto & Lupyan, 2015) argue that simulation is a multimodal, context dependent, ad hoc construction of representation, therefore a unified representation with information from multiple modalities.

Simulation on the level of situation models can only be investigated in context. For language research, narratives provide a great opportunity to investigate simulation in situation models while being confined enough to maintain experimental control, which is difficult in many natural contexts. Similarly to situation models, information in narratives is organized coherently along the 5 dimension of space, time, agent identity (here: protagonist), causality, and intentionality. (Fiction) stories especially are highly appropriate to test simulation in language comprehension (Willems & Jacobs, 2016), because becoming immersed in a story is thought to facilitate mental simulation (Jacobs, 2015a; Schrott & Jacobs, 2011; Sestir & Green, 2010; Zwaan, 2004). Indeed, Kurby and Zacks (2013) demonstrated in two studies that modality specific sensorimotor simulation is more robust in connected discourse as compared to single sentences (see also Madden-Lombardi, Jouen, Dominey, & Ventre-Dominey, 2015). There is a growing body of research on sensorimotor simulation and mentalizing on the level of narrative comprehension (e.g. Nijhof & Willems 2015; Wallentin et al. 2011; Speer et al. 2009; Kurby and Zacks, 2013).

In addition to facilitating simulation, stories could have a substantial advantage for experimental research by reducing inter-individual variability in semantics. For example, when looking into action semantics, a verb like *throwing* without context can activate very different action representations, while *throwing a dart* or *throwing a tennis ball* reduces the probability that subjects activate different types of events. The contextual embedding in a narrative helps to further reduce ambiguity by keeping the time, agent and causality components of the event constant for different events in a design. Besides, using more natural and meaningful stimulus materials increases motivation and relevance for participants in experiments. Especially in neuroimaging research, continuous stimulus presentation times have been avoided due to technical limitations. However, in recent years, methodological advancements in data analysis have allowed for a growing body of new research with narratives (e. g. Chow et al., 2013; Kurby & Zacks, 2013; Lerner, Honey, Silbert, & Hasson, 2011; Wallentin et al., 2011b; Yarkoni, Speer, & Zacks, 2008), movies (e. g. Hasson, Nir, Levy, Fuhrmann, & Malach, 2004; Kauttonen, Hlushchuk, & Tikka, 2015), theatre plays (e. g. Metz-Lutz, 2010), and dance performances (e. g. Bachrach, Jola, & Pallier, 2016).

Narratives open an exciting new perspective to investigating language comprehension in more natural contexts. Humans spend a substantial part of their awake time being engaged with stories. Whether we read the newspaper, watch TV, listen to others, or read a book, much of our information input has the form of a narrative. A very interesting question for research on language comprehension is why humans engage in stories for entertainment. Following simulation theory, engaging with stories helps us simulate real world encounters, and therefore experience situations 'vicariously' (Zwaan, 2004). This offers an explanation for human engagement with stories and why we have developed such a rich tradition of storytelling: we transmit knowledge and experience. Immersion into story worlds could therefore serve as a type of learning to gain experience and knowledge, which in turn can lead to benefits in real life (Bruner, 1990; R. A. Mar & Oatley, 2008). By simulating information during reading or listening about the experiences of others, we can learn new things about the world in a manner analogous to real life experience (R. A. Mar & Oatley, 2008; Taylor & Zwaan, 2009).

Perspective

The eager search for evidence supporting the hypothesis of sensorimotor re-enactment in semantic processing has led to an understanding of simulation which is reduced to a mental 1st person imitation of action, perception, or emotion. Given the limited understanding of the function of simulation, such a limitation obscures the potential of simulation as an important cognitive mechanism (Barsalou, n.d.). By restricting the focus to motor simulation and mirror neurons, simulation has been reduced to 1st person (re-) enactment, which drastically underestimates the role of perspective in the construction of mental models, particularly in situated contexts.

From research on spatial and motor cognition we know that mental representations of events or mental states can be from the 1st or 3rd person perspective (Vogeley & Fink, 2003). Neuroimaging research on action and motor imagery shows that perspective taking affects the involvement of different neural networks for 1st and 3rd person perspective, which overlap only partially (e. g. Ruby & Decety, 2001). Similar findings have been shown for imagining the mental states of self or others, showing that mentalizing in 1st person shares resources with 3rd person, but the networks are largely independent (Vogeley et al., 2001). However perspective is not only crucial for representing information in a mental model, but also for the format in which it is fed into this model. Pointing out the relation between perceptual input and its mental representation seems trivial when we think about action and perception, where perspective is a clear inherent feature. For language and communication however, the relation between how an event is communicated and its mental model is much less clear.

In most languages it is impossible to talk about an event without specifying the agent, and language is a successful tool for communicating information like spatial descriptions or action execution. But we still understand very little about how referring to an agent relates to our cognitive representation of it. Do we always represent events in an enactive manner or do different linguistic expressions of how we refer to agents (e.g. *Sarah*, *I*, *they*, *we*, *Mr. Smith*, *you*, *he*, *the guy over there*) result in different mental models? Unfortunately, perspective in language processing has not received much attention from embodied accounts of language. Instead, it seems to be commonly assumed that mental representations are constructed in an enactive manner, meaning from a 1st person perspective by default (Barsalou, 1999b; Barsalou, Kyle Simmons, Barbey, & Wilson, 2003; Bergen & Wheeler, 2010; Beveridge & Pickering, 2013; Borghi & Scorolli, 2009; Glenberg & Kaschak, 2002; Wu & Barsalou, 2009; Zwaan & Taylor, 2006). This assumption is consistent with results from studies in which it has been shown that presenting isolated action verbs or action sentences can activate motor cortices for specific body parts in a similar way to when the related action is performed (Hauk et al., 2004; Tettamanti et al., 2005; Willems, Hagoort, & Casasanto, 2010; Willems, Toni, et al., 2010b). How this generalizes over contextually embedded language is unclear.

Perspective taking is considered important in the construction and comprehension of fiction (e.g. M. Bal, 1997; Genette, 1980; Rimmon-Kennan, 2002; Sanford & Emmott, 2012) as well as in the generation of situation models (Bower & Morrow, 1990; Johnson-Laird, 1983). Readers often take the mental perspective of the protagonist and simulate his or her mental states as the source of construal when constructing a situation model (Albrecht, O'Brien, Mason, & Myers, 1995; Horton & Rapp, 2003). Taking the viewpoint of a character is linked to identification: it is believed that the reader is more engaged when taking a character's viewpoint and adopting the character's goals and intentions. During the course of the story this results in experiencing emotions of empathy (Oatley, 1999a). Indeed, adopting a protagonist's perspective causes changes in the mental and emotional states of the reader (Gerrig, 1993; Green & Brock, 2000; Komeda, Tsunemi, Inohara, Kusumi, & Rapp, 2013) which also has been linked to story immersion (Sestir & Green, 2010).

Narrative perspective (Who is telling the story?) and narrative viewpoint (Whose viewpoint is the narrative constructed from?) are typically aligned with a character (or a narrator), whose mental or visual response to the events in the story is the source of construal of the narrative events for the reader (Dancygier, 2014). In 1st person narratives the narrator coincides with the character from whose viewpoint the ongoing situations are constructed. In contrast, 3rd person narratives present the story from the viewpoint of a (partially) uninvolved character which often coincides with 'a detached, omniscient, all-knowing agent that oversees the story world and reports it to the reader' (Graesser, Millis, & Zwaan, 1997). Using narrative perspective, story writers can make readers 'see' through the eyes of one of the characters or take a mere spectator's view. It has been assumed that the mental viewpoint substantially shapes the reading experience (Herman, 2002; Rimmon-Kennan, 2002). The effectiveness of the modulation of 'mental viewpoint' by focalization has been taken as common place; 1st person perspective narration facilitates taking an internal perspective, while 3rd person perspective facilitates taking an external perspective (Borghi, 2004; Brunyé, Ditman, Mahoney, Augustyn, & Taylor, 2009). However, the cognitive basis of perspective taking in reading remains unclear and this assumption is in contrast to simulation accounts of language, which assume a cognitive default 1st person perspective (see discussion above).

An established way to guide cognitive perspective taking is the choice of personal pronouns, which refer to protagonists (Bergen & Chang, 2005; Brunyé et al., 2009; Brunyé, Ditman, Mahoney, & Taylor, 2011; Ditman, Brunyé, Mahoney, & Taylor, 2010; Sanford & Emmott, 2012). Experimental research with single sentences shows that personal pronouns in thematic agent's positions affect the spatial representation in the reader, e.g. people react faster to a picture showing a tomato being sliced from 1st person perspective after hearing the sentence 'I am slicing a tomato' than after hearing the sentence 'he is slicing a tomato' and vice versa (Brunyé et al., 2009). In a series of experiments, it has been shown that 3rd person pronouns (*he*, *she*, *it*) robustly promote a 3rd person perspective mental representation, whereas 1st person pronouns can promote either 1st person or 3rd person mental perspective, depending on the contextual embedding. This is in line with the above discussed finding that 1st person action sentences show a motor simulation effect, whereas 3rd person sentences do not (Papeo et al., 2011).

Taken together, perspective is a largely overlooked feature which is crucial for mental models of events. The relation between how an event is communicated and its mental model is especially unclear. Whereas some language accounts propose that comprehension follows an enactment principle, literature theory assumes that narrative techniques, like narrative viewpoint and narrative perspective, shape its cognitive representation as well as the reading experience. Yet, little empirical work has been done to explore the validity of both accounts and their limitations.

This dissertation

In this dissertation, I will focus on simulation during narrative comprehension in more natural situations. I set out to further qualify the function of mental simulation by investigating perspective as a core feature of simulation in a systematic investigation of simulation with literary narratives. The novelty of the projects in my dissertation is that I used a combination of behavioural, psychophysical, and neuroimaging methods to test the interaction of text and cognitive perspective. The goal was to scrutinize oversimplified assumptions about simulation and to push the field of research to a more comprehensive model of what simulation is, what it is not, and to reframe its functional role in cognition. The thesis concludes with sketching a model of simulation in natural language comprehension.

In Chapter 2 to 5 I report 4 experiments in which I investigated the role of perspective in simulation during comprehension of narratives. In Chapter 2, I present an experiment in which I tested the effects of 1st and 3rd person narration on experiential aspects of fiction reading. Participants read short literary stories in 1st and 3rd person perspectives while I measured their arousal during reading with electrodermal activity recordings (see Info box 1). In addition, I measured immersion and appreciation of the story with questionnaires. The aims of the study were to test whether readers become more immersed into stories in 1st person perspective and in how far narrative perspective affects appreciation of stories.

Info box 1: Electrodermal activity (EDA)

Measuring electric potential of the skin has a long tradition in psychological research. EDA is a robust and objective online measure of arousal caused by emotional and physical stimulation, increased mental workload, and the startle reflex (Boucsein, 2012, Figner & Murphy 2011). Arousal is the physical and psychological state of being alert and ready to react, which can be related to emotional stimulation, increased mental workload, and the startle reflex. High levels of arousal lead to increased heart rate and blood pressure, sensory alertness, and sweat gland activity. EDA measures electrical conductivity in the skin, which is sensitive to changes in blood pressure and sweat production. Spontaneous increases in electrical conductivity reflect sudden increases in arousal level as a consequence of stimulation like (negative) emotion, surprise or processing difficulty.
There are two main components to the overall complex referred to as EDA. One component is the skin conductance level, the general tonic-level EDA which relates to the slower acting components and background characteristics of the signal (the overall level, slow climbing, slow declinations over time), reflecting general changes in autonomic arousal. The other component is the rapid phasic component and this refers to the faster changing elements of the signal - the skin conductance response that results from sympathetic neuronal activity. The latter component is the one used in chapter 2. Both components are measured by applying an electrical potential between two points of skin contact and measuring the resulting current flow between them. EDA measurement units are micro Siemens (μS). EDA is the only autonomic psychophysiological variable that is not contaminated by parasympathetic activity.

Further reading:
Boucsein W. Electrodermal Activity. New York: Springer; 2012.
Figner B, Murphy RO. Using skin conductance in judgment and decision making research. In: Schulte-Mecklenbeck M, Kuehberger A, Ranyard R, editors. A Handbook of Process Tracing Methods for Decision Research. New York: Psychology Press; 2011.
http://www.birmingham.ac.uk/documents/college-les/psych/saal/guide-electrodermal-activity.pdf

Chapter 3 presents a follow up neuroimaging study on the findings of Chapter 2 in which I measured brain activity of participants while they listened to literary narratives. Participants were presented with 2 stories, one in 1st and one in 3rd person perspective, and answered questions regarding their engagement with the protagonist after each story. With functional magnetic resonance imaging (fMRI, see Info box 2), I tested for differences in brain activations between 1st and 3rd person stories associated with action events during comprehension. The aim of this study was to test the hypothesis that text perspective affects cognitive perspective taking, meaning that 1st person stories promote enactive simulation whereas 3rd person stories promote visual simulation.

Info box 2: Functional magnetic resonance imaging (fMRI)

Magnetic resonance imaging is a way to see inside the body in order to get a clear picture of anatomy and is used routinely for detection of diseases or abnormal conditions. The MRI scan uses a powerful, magnetic field along with rapidly changing local magnetic fields to generate very clear pictures of internal body structures by measuring structural differences in tissue and liquids.

Functional MRI is a neuroimaging procedure using MRI technology by comparing blood flow in the brain in two or more scans taken at different times. When a part of the brain is active, the cells in that region need more oxygen to function, which results in an increase in blood flow to that area. The primary form of fMRI uses the blood-oxygen-level dependent (BOLD) contrast by imaging the change in blood flow (hemodynamic response) related to energy (oxygen) use by brain cells. When neurons become active, local blood flow to some brain regions increases, and oxygen-rich (oxygenated) blood displaces oxygen-depleted (deoxygenated) blood around 2 seconds later. This rises to a peak over 4–6 seconds, before falling back to the original level (and typically undershooting slightly).

Oxygen is carried by the hemoglobin molecule in red blood cells. Deoxygenated hemoglobin is more magnetic than oxygenated hemoglobin, which is virtually resistant to magnetism. This difference in BOLD response can be tested statistically and the results of this show which groups of neurons are active at a time as colored blobs on brain maps.

Due to the relative slowness of the metabolic blood response the temporal resolution is not as good as in other types of neuroimaging, like electroencephalography. We typically average over 4-6 seconds of brain activity. Yet, fMRI neuroimaging provides us with relatively good spatial resolution when looking into brains non-invasively.

Further reading:

Huettel, S. A.; Song, A. W.; McCarthy, G., Functional Magnetic Resonance Imaging Second Edition , 2009, Massachusetts: Sinauer.

Seiji Ogawa and Yul-Wan Sung ‘Functional magnetic resonance imaging’ (2007), Scholarpedia, 2(10):3105.

Neuroskeptic (2010). ‘fMRI In 1000 Words’, http://neuroskeptic.blogspot.nl/2010/05/fmri-in-1000-words.html

In Chapter 4, I present a study which aimed to qualify the relation between simulation and mental imagery. In this experiment I tested empirically how (dis)similar simulation is from imagery by comparing brain activity during narrative comprehension of action and mentalizing events with imagining the same events either as the protagonist (1^{st} person) or an observer (3^{rd} person). Participants listened to 2 literary narratives, first for comprehension, and then two times again while imagining being in the shoes of the protagonist or imaging the situations from the perspective of an eyewitness, while I measured brain activity with fMRI (see Info box 2). I looked into differences and overlap of brain activity when participants engaged in 1^{st} and 3^{rd} person imagery as well as during normal comprehension.

In Chapter 5, I tested if perspective plays a similar role in factual and fictional stories. Following up on the findings of Chapter 2, I tested whether the effects of perspective on experiential aspects of reading like immersion and appreciation are specific to fiction. In an online study, I had participants read texts in 1^{st} or 3^{rd} person perspective which were labelled as either based on true events or as entirely fictional. I measured reading immersion, appreciation of the stories, and memory of events in the stories.

Finally, in the last Chapter of this thesis, I will discuss the findings of the 4 experiments and their implications for simulation theory. I will outline new directions for a more comprehensive model of simulation as a cognitive support mechanism computing situation specific representations during online cognition.

Chapter 2:

Taking perspective: Personal pronouns affect experiential aspects of literary reading

Based on:

Hartung, F., Burke, M., Hagoort, P., Willems, R. M. (2016). ‘Taking Perspective: Personal Pronouns Affect Experiential Aspects of Literary Reading’. *PLoS ONE* 11(5): e0154732. doi:10.1371/journal.pone.0154732

Abstract

Personal pronouns have been shown to influence perspective taking during comprehension. Studies using single sentences found that 3rd person pronouns facilitate the construction of a mental model from an observer's perspective, whereas 2nd person pronouns support an actor's perspective. Whether 1st person pronouns facilitate an actor's or an observer's perspective seems to depend on the situational context. In the present study, we investigated how personal pronouns influence fiction comprehension and if pronoun choice has consequences for affective components of reading, such as immersion into or appreciation of a story. In addition, we wanted to find out if pronouns have an influence on arousal during reading. In a natural reading paradigm, we measured electrodermal activity and story immersion, while participants read literary stories with 1st and 3rd person pronouns referring to the protagonist. In addition, participants rated and ranked the stories for appreciation. Our results show that stories with 1st person pronouns lead to higher immersion. Two factors in particular - *transportation into the story world* and *mental imagery* during reading - showed higher scores for 1st person as compared to 3rd person pronoun stories. In contrast, arousal as measured by electrodermal activity seemed tentatively higher for 3rd person pronoun stories. The two measures of appreciation were not affected by the pronoun manipulation. Our findings underscore the importance of perspective for language processing, and additionally show which aspects of the narrative experience are influenced by a change in perspective.

Introduction

Reading is a complex human behaviour in which several cognitive processes are involved. An elementary part of comprehension is building a mental model of the semantic contents of the text (Gernsbacher, 1997). Stories, as compared to non-narrative texts, often cause the reader to become immersed into the story and construct multimodal situation models (Zwaan & van Oostendorp, 1993). Immersion is similar to flow (Csikszentmihalyi, 1990) and transportation (Sestir & Green, 2010). These terms describe a state of absorption marked by 'deep concentration, losing awareness of one's self, one's surroundings and track of time' (Csikszentmihalyi, 1990; Kuijpers, 2014). Being immersed in a story is linked to mental simulation (Jacobs, 2015a, 2015c; Schrott & Jacobs, 2011; Zwaan, 2004), and defined as 'the state of feeling cognitively, emotionally, and imaginally immersed in a narrative world' (Gerrig, 1993; Green & Brock, 2000; Sestir & Green, 2010)(see also Burke, 2011 on disportation). Immersion is also associated with enjoyment (Busselle & Bilandzic, 2009; Green, 2004), meaning that the more we engage with a story, the more we enjoy it.

Immersion is a multidimensional experience based on different factors, whose contribution to the experience of being immersed varies with the situation. Factors which often reoccur in notions of immersion in narratives include the experience of mental imagery, emotional engagement with protagonists, transportation into the story world, and attention during reading (Kuijpers, 2014; Kuijpers, Hakemulder, Tan, & Doicaru, 2014). Experiencing imagery during narrative engagement, such as mental visualizations of surroundings, characters, and situations, has been hypothesized to influence immersion (Green & Brock, 2000; Kuijpers, 2014). Emotional engagement with fictional characters of stories such as feelings of sympathy, empathy, and identification can facilitate immersion (Kuijpers, 2014). Another important factor for immersion is attention. A high level of attention towards the story is often marked by a subjective experience of losing self-awareness, awareness of the surroundings, and track of time (Kuijpers, 2014). The factor transportation 'signifies a feeling of entering a story world, without completely losing contact with the actual world', thus the feeling of actually being part of a fictional world during reading (Kuijpers, 2014). Transportation into a fictional world is linked to increased affective responses and identification with fictional characters (Sestir & Green, 2010). In research with narratives, 'transportation' is also sometimes used to describe the general state of immersion into the narrative. In the present article, we treat transportation as one factor contributing to the general state of immersion or absorption during reading.

Perspective taking during reading

Readers can become immersed in a story by either taking the role of an observer (3rd person perspective) or by taking the viewpoint of one of the characters (1st person perspective) (Boyd, 2005; Oatley, 1999a; Sanford & Emmott, 2012). Readers often take the perspective of the protagonist and simulate his or her mental states as their point of view when constructing a situation model (Albrecht et al., 1995; Horton & Rapp, 2003). It has further been shown that which character the reader's viewpoint is aligned with affects whether readers take a 1st person perspective (de Graaf, Hoeken, Sanders, & Beentjes, 2011). Perspective taking is considered important in the construction and comprehension of fiction (e.g. M. Bal, 1997; Genette, 1980; Rimmon-Kennan, 2002; Sanford & Emmott, 2012), and the generation of situation models (Bower & Morrow, 1990; Johnson-Laird, 1983). But perspective taking is also an important topic of research in the cognitive sciences in general. Typically, perspective taking is investigated in the framework of spatial cognition (Kessler & Thomson, 2010; see e.g. Zacks & Michelon, 2005) or social cognition (Frith & Frith, 2007). We assume that narrative comprehension involves both types of perspective taking, because stories include information about actions, location changes and characters.

Taking the viewpoint of a character is linked to identification: it is believed that the reader is more engaged when taking a character's viewpoint and adopting the character's goals and intentions. During the course of the story this results in experiencing emotions of empathy (Oatley, 1999a). Adopting a protagonist's perspective can cause changes in the mental and emotional states of the reader (Gerrig, 1993; Green & Brock, 2000; Komeda et al., 2013) and has been shown to be linked to story immersion (Sestir & Green, 2010). Experimental evidence further shows that changing narrative viewpoints leads to changes in mental viewpoints. For example, in a discourse comprehension study, Black and colleagues (Black, Turner, & Bower, 1979) showed that participants are sensitive to consistency violations in narrative viewpoints. They show that verbal deixis in sentences like '[…] two men *came* in' versus '[…] two men *went* in' leads to slower reading times and decreased comprehensibility if it does not match the narrative viewpoint established by the previous context. People also tend to correct these inconsistencies in memory tasks (Black et al., 1979).

The most direct means of guiding the reader to take the role of a spectator or character are narrative perspective (Who is telling the story?) and narrative viewpoint (Whose viewpoint is the narrative constructed from?) (Herman, 2002) which are typically aligned with a character (or a narrator), whose mental or visual response to the events in the story is the source of construal of the narrative events for the reader (Dancygier, 2014). Using narrative perspective, story writers can make readers 'see' through the eyes of one of the characters or take a mere spectator's view. A well-established way to guide cognitive perspective taking in text is the choice of personal pronouns, which refer to protagonists (Bergen & Chang, 2005; Brunyé et al., 2009, 2011; Ditman et al., 2010; Sanford & Emmott, 2012). Experimental research with single sentences shows that personal pronouns in thematic agent positions affect the spatial representation in the reader (Brunyé et al., 2009). In a series of experiments, it has been shown that 3rd person pronouns (*he*, *she*, *it*) robustly promote a 3rd person perspective mental representation, whereas 1st person pronouns can promote either 1st person or 3rd person mental perspective, depending on the contextual embedding. Prevalence for 1st person perspective taking is strongest when participants are addressed directly with 2nd person pronouns (e.g. *You are slicing tomatoes.*) where embodying emotional states of fictional characters is also stronger compared to other pronoun types (Brunyé et al., 2011). In accordance with this, Papeo and colleagues (2011) showed that only 1st person action sentences show a motor simulation effect, whereas 3rd person sentences do not.

Aims of the present study

Despite the substantial body of narrative theory research and experimental evidence from psychological studies with personal pronouns, it remains unclear how the choice of personal pronouns influences experiential aspects of literary reading, such as immersion and appreciation of a story. In the present study we investigated how story immersion is affected by the choice of pronoun referring to the main character. We manipulated whether literary stories were written in 1st or 3rd person viewpoint, that is, by using 1st or 3rd person pronouns referring to the protagonist.

We refrained from testing second person perspective, because 2nd person perspective narration is uncommon in literary fiction, and the type of fiction in which it finds application is very different from typical 1st or 3rd person narration texts. This would not only limit our choice of appropriate stimulus materials substantially, but would also result in asymmetry regarding the amount of prior exposure our sample population has with the types of texts. Moreover, it has been shown that 2nd person pronouns tend to be interpreted in a generic meaning, particularly in descriptive language (de Hoop & Tarenskeen, 2014).

In the experiment, we combined measuring Electrodermal Activity (EDA) with appreciation ratings and established questionnaires for narrative engagement, to investigate if and how arousal, immersion, and affective responses to reading fiction are affected by personal pronouns referring to protagonists. The main reason to include the EDA measure was to have an objective and online measure of arousal during actual stimulus exposure, to relate to the self-report measures taken after exposure. EDA measures arousal, that is, the physical and psychological state of being alert and ready to react, which can be related to emotional stimulation, increased mental workload, and the startle reflex (Boucsein, 2012; Figner & Murphy, 2011; Kreibig & Gendolla, 2014) (see Info box 1, p. 16).

Hypotheses

Following the assumption that 1st person perspective facilitates a more immediate experience and therefore identification (Oatley, 1999a; Papeo et al., 2011), we expect that readers are more emotionally affected by 1st person perspective narratives and experience higher levels of immersion. This should result in higher scores on the immersion questionnaires, especially on the subscales for emotional engagement, transportation, and attention. Physical arousal could also be affected by the immediateness of 1st person narration, because of higher suspense or emotional responses during reading. Therefore, we expect that both immersion as measured by questionnaire responses and arousal as measured by EDA are higher when participants read 1st person perspective narratives. We further expect that higher immersion results in higher appreciation (Busselle & Bilandzic, 2009; Green, 2004), but without clear expectations as to which components of immersion might cause this effect. Moreover, we expect high individual variability regarding experiential aspects of literary reading and sensitivity to stylistic features. To be able to take this into account, we measured participants' self-reported reading behaviour, previous print exposure, and empathy. The latter is expected to correlate with immersion, print exposure and reading behaviour, following previous research which argues for a positive link between empathy and fiction reading (P. M. Bal & Veltkamp, 2013; Keen, 2007; Kidd & Castano, 2013; Koopman, 2015; R. a. Mar, Oatley, Hirsh, dela Paz, & Peterson, 2006; R. a. Mar, Oatley, & Peterson, 2009). We had no clear expectations about how reading behaviour and print exposure relate to immersion, arousal during reading, or appreciation.

Materials and methods

Participants

64 participants were recruited from the Max Planck Institute (MPI) participant database (35 female, 29 male; mean age 21.7 years, s.d.=3.5 range 18-34). Participants were native speakers of Dutch with normal or corrected to normal vision, and no reading impairments. We asked participants for their academic history to ensure that they had no high level of experience in literature analysis. Participants were naïve as to the purpose of the experiment. Participation was voluntary and participants received money for participation. All participants gave written informed consent in accordance with the Declaration of Helsinki. The study was approved by the local Ethics Committee of the Social Sciences faculty of the Radboud University (Ethics Approval Number ECG2013-1308-120). After data exclusion (see below), the data of 52 participants went into the final analysis (30 female, 22 male; mean age 21.4, s.d.=3.2, range 18-32).

Data exclusion

One participant stated that they had realized the manipulation of the stories during debriefing and therefore was excluded from processing. Another participant was excluded because they reported themselves to be an expert in fiction writing as well as being a published author during debriefing. Data from two other participants were not processed because the signal quality of the electrodermal activity (EDA) differed substantially between the two experimental blocks. Six additional participants were not analysed because they did not meet the predefined minimum correctness criterion for content questions (> 25% incorrect), which we took as an indication that participants did not pay sufficient attention to the content of the stories. One final participant was excluded as an outlier, because the difference in number of peaks in the EDA between the two conditions was more than four standard deviations from the mean difference of all participants. Removing this data set left us with N=53, so the last-tested participant in the opposite order of conditions was removed to have an equal number of participants in both orders of conditions. In total, 12 participants were excluded from the analysis. All reported results are for N=52.

Stimuli

Stories

We selected 8 short stories from Dutch fiction, which were published between 1974 and 2010 (see Table 1; mean number of words per story=1043.25, s.d.=723.05, range 338-2090).

Table 1: Story Information

Title	Author	Original perspective	Number of words	Publication year
Rivier (River)	Tommy Wieringa	3rd person	339	2010
De Mexicaanse hond	Marga Minco	1st person	1239	1990
Dubbele tong	Bernlef	3rd person	2005	1974
Broeder P.	Tommy Wieringa	3rd person	350	2010
De tekening	Thomas Rosenboom	1st person	1283	2006
De vissers	Thomas Rosenboom	3rd person	2092	2006
Liberty Mountain	Sylvia Witteman	1st person	652	2009
Officina Asmara	Tommy Wieringa	1st person	402	2010

Eight short stories from Dutch fiction, published between 1974 and 2010, were selected as stimulus material (mean number of words per story = 1043.25, s.d. = 723.05, min = 338, max = 2090). The stories were all typical short stories with a single plot, a single setting and focused on a single incident covering only a short period of time. There was only a very brief introduction (if at all) and an abrupt and open ending. All stories were internally focalized by the main character and the narrative voice was identical with the narrative point of view. Besides the main character, the number of active characters was very limited. In the original version half of the stories used 1st person pronouns to refer to the main character and half 3rd person pronouns. Word count is based on the original versions of the stories.

The selected stories were all typical short stories with a single plot, a single setting, focused on a single incident, and covered only a short period of time. Also, there was - if at all - only a brief introduction, an open ending, and the number of characters in the story was limited. The stories were written in a laconic style avoiding direct statements of judgments and attitudes, e.g. the following excerpt from the ending of *Officina Asmara* (see supplementary material for the full transcript of the story in English and 2 other example stories):

> "[Son, from who's viewpoint the story is told, asks his father] 'So now you're a criminal?'
> [Father replies] 'Who gives a damn about the law?'
> Later that evening we sit at the kitchen table in the grey light. My father's face is full of shadows. I examine this dubious man, who refurbishes old ship models in his barn between piles of paper, and resolve to take a closer look as long as time still allows. "

For all stories the narrative voice was identical with the narrative point of view. All stories were internally focalized, which means that the style of narration reflects the subjective perception of the main character (see example above, where we have access to the thoughts of the main character; Rimmon-Kennan, 2002).

Half of the stories referred to the protagonist with 1st and half with 3rd person pronouns in the original version. To make exact comparisons we created a second version of each story in the corresponding condition. This was done by changing personal pronouns and their respective verb forms (see Table 2). In addition, direct speech was changed to indirect speech for the 1st to 3rd person condition to support a natural reading flow in cases where direct speech seemed very unnatural as judged by a native speaker of Dutch (total number of changes made=8 out of 98 direct speech segments).

Table 2: Illustration of story modification.

1st person perspective (original)	3rd person perspective
Ik kende Marianne nog maar kort. We waren met de veerpont overgestoken naar de haven pier, waar wij de nieuwbouw bekeken en toen een café vonden. Achterin, op een verhoog, was nog een tafeltje vrij; het liep tegen vijven, schemeruur; de kleine kaart, waarboven 'Tapas' stond, vermeldde Italiaanse paté, en vervuld van daadvaardig geluk wrong ik mij naar de toog om te bestellen. *'Twee broodjes alstublieft met...'* I only had known Marianne for a short time. Together we took the ferry to the harbour pier, where we looked at the new constructions and entered a coffee bar. Inside at the back, on a little platform, we found a free table; it was almost 5 already, gloaming time; the little menu, with ‘Tapas’ written on the top, listed Italian pastries, and vigorously I wrestled my way to the bar: ‘Two sandwiches please...’	*Hij kende Marianne nog maar kort. Ze waren met de veerpont overgestoken naar de haven pier, waar zij de nieuwbouw bekeken en toen een café vonden. Achterin, op een verhoog, was nog een tafeltje vrij; het liep tegen vijven, schemeruur; de kleine kaart, waarboven 'Tapas' stond, vermeldde Italiaanse paté, en vervuld van daadvaardig geluk wrong hij zich naar de toog om te bestellen.* *'Twee broodjes alstublieft met...'* He only had known Marianne for a short time. Together they took the ferry to the harbour pier, where they looked at the new constructions and entered a coffee bar. Inside at the back, on a little platform, they found a free table; it was almost 5 already, gloaming time; the little menu, with ‘Tapas’ written on the top, listed Italian pastries, and vigorously he wrestled his way to the bar: ‘Two sandwiches please...’

For each story a second version was created by replacing the personal pronouns referring to the main character and its related verb in each text with the personal pronoun in the corresponding condition. Example taken from *De tekening* by Thomas Rosenboom. No authorized translation is available; the current translation is for illustration purposes only.

Questionnaires for measuring individual differences

For an estimate of print exposure we used a Dutch version of the **Author Recognition Test** (ART, Acheson, Wellu, & MacDonald, 2008) containing 42 names of which 30 are existing fiction authors and 12 are made up names (see supplementary material). In the ART, participants are instructed to read a list of names and indicate which of the writers they know. The score of each participant is computed by subtracting the sum of all incorrect answers from the sum of all correct answers. Total score can vary between -12 (only non-existent author names selected) to 30 (all correct names selected).

In addition, a **general reading habits questionnaire** was used consisting of 4 items (2 questions addressing amount and frequency of reading for pleasure, and 2 questions about genre preferences). The items of the reading habit questionnaire consisted of 'How often do you read fiction?' with five possible answers ranging from 'daily' to 'never', 'How many books do you read per year?' also with five possible answers ranging from zero to 'more than 1 per month', 'Which type of fiction do you prefer?' with 5 options including 'prose', 'comic', 'poetry', 'drama' and 'I don't like fiction at all', and finally a list of 22 popular genres (e.g. 'horror', 'romance') on which subjects were asked to indicate which they like without number limitations. There was also an option to add genres which were not suggested. In addition, we used the 6 items from the **fantasy scale** of the **Interpersonal Reactivity Index** (IRI, Davis, 1980, 1983). IRI is a self-report measure of individual differences in empathy, consisting of 4 subscales. The Fantasy scale of the IRI tests individual readiness to get transported imaginatively into the feelings and actions of fictive characters in books, movies, and plays. For the 6 items from the IRI Fantasy scale we used a 7-point scale ranging from 'I totally agree' (7) to 'I totally disagree' (1).

As recent evidence suggests a positive relation of fiction reading with social factors such as empathy, interpersonal relationships, and social competence (P. M. Bal & Veltkamp, 2013; Green, 2004; Keen, 2007; Kidd & Castano, 2013; Koopman, 2015; R. a. Mar et al., 2006, 2009), we included the **Empathy Quotient questionnaire** (**EQ**) to measure individual differences in empathy (Baron-Cohen & Wheelwright, 2004; Dutch version http://www.autismresearchcentre.com/arc_tests).

Questionnaires for main measures

The **immersion questionnaire** we used was based on the story world absorption scale (SWAS) (Kuijpers et al., 2014) and selected items from the 30-item version of the narrative engagement questionnaire (NEQ) developed by Buselle and Bilandzic (2009).We used the **attention**, **transportation**, **emotional engagement**, and **mental imagery** subscales from SWAS and in addition the **narrative understanding** subscale from NEQ, as this is not covered by SWAS. Our questionnaire comprised of 34 items (see supplementary material). Participants responded to the items on a 7-point Likert scale ranging from 'I totally disagree' (1) to 'I totally agree' (7).

Appreciation was measured in two ways. First appreciation directly after reading each story (**Rating**) was measured by asking the participants to indicate how much they liked the story on a 10-point scale (1=bad, 10=brilliant). For the second appreciation measure

(**Ranking**) participants were provided with a list of titles of the stories and were asked to rank them in order of appreciation with the one they liked the most on top and the one they like the least at the bottom.

To test whether participants paid attention to each story, we prepared 1 content question per story, which participants answered in a multiple choice task with 3-4 alternatives of which only one was correct. Each question indicated clearly to which story it belonged. Participants who answered more than 25% of questions incorrectly were excluded from the analysis.

Procedure

Participants were seated in a soundproof testing cabin with a bright ceiling light, a desk lamp with two brightness levels, and a window with blinds. They were encouraged to adjust the light to personal preference and make themselves as comfortable as possible sitting at a desk with a stable chair. The aim was to create a relaxed atmosphere with a natural reading situation. After explaining the cycle of tasks, participants gave written informed consent and the EDA sensor was attached (for details see below).

The experiment was pen and paper based. To make relevant comments and set markers in the recording file of the EDA, participants were asked to indicate every time they started and finished reading a story. A practice trial was performed with one story to familiarize participants with the setting and order of events within a trial. The story from the practice trial was not used in the main part of the experiment. The practice task took about 10 minutes, leaving the EDA sensor time to adjust to body temperature.

The experiment was conducted as a block design consisting of 2 blocks, with 4 stories per block. The block design was chosen to avoid potential switching costs between the two perspectives. There was no repetition of story per participant: each participant read every story only once, meaning that they read eight different stories in total. Within each block participants were presented with stories with either 1^{st} or 3^{rd} person pronouns referring to the main character. Both blocks took place consecutively with a 10 minute break in between. Block order was counterbalanced across participants. Directly after reading each story, participants rated the story for appreciation and completed the immersion questionnaire. The stories were presented in black font (Calibri, 14pt.) on white paper (A4, landscape orientation, 2 pages per sheet, printed single-sided). After reading all stories, participants ranked the stories for appreciation and answered the content questions. This was followed by the general reading habits, ART, and EQ questionnaires.

Once participants finished the experiment, they were asked what they thought the experiment was about and whether they recognized anything specific about the selected stories or a significant change between the two blocks. This was followed by a verbal debriefing, which informed them about the research question, the experiment, and our expectations. The entire experiment took approximately 90 minutes.

Data acquisition

We measured EDA with BrainAMP ExG MR, Acceleration Sensor (Brain Products, www.brainproducts.com), and Ag/AgCI sensor electrodes (Model F-EGSR, Grass Technologies). The signal was recorded with Brain Vision Recorder (Brain Products) at a sampling rate of 5000Hz for the first 8 participants and 1000Hz for all others, with low cut-off DC and high cut-off 1000Hz. The reason for decreasing the sampling rate was to reduce unnecessary memory requirements and processing time in the data analysis as we were not interested in high-frequency components of the EDA signal. No other filters were applied to the signal. Sensor electrodes for EDA were placed at the middle phalanx of the index and middle finger of the non-dominant hand (right hand for 4 people). Questionnaire data were acquired with pen and paper, and later digitized manually.

Data analysis

EDA

EDA signal processing was done with Matlab R2013a (MathWorks, Natick, MA, USA). The data were segmented into individual trials. Each trial was defined from the onset to the offset of reading a story. Trials with recording errors (e.g. data not saved to disk) were replaced with NaNs (out of 416 trials 13 were missing, meaning 3.1% of missing values). Linear trend was removed from time courses (‘de-trending’) and data were resampled to 100Hz. To correct for the time at the beginning or end of each trial when participant’s movement tended to create artefacts in the EDA signal, we removed three seconds from the beginning and end of each trial.

The number of spontaneous fluctuations were computed using a peak detection algorithm in which peaks are defined as local maxima surrounded by valleys (Eli Billauer, 3.4.05, see http://www.billauer.co.il/peakdet.html; d=0.15). This algorithm picks out peaks very well across a range of settings. We used the number of peaks for statistical comparisons, because they reflect spontaneous fluctuations, due to increased arousal (Figner & Murphy, 2011). We ignored valleys in the analysis because only little is known about local minima in arousal. Analysing the number of peaks in EDA is not a standard measure such as area under the curve or absolute amplitude changes relative to a baseline. Because of our experimental design, which focused on the naturalness of the reading situation, the trials are relatively long and differ substantially in length. This means that we cannot time lock the EDA response to certain events which would be crucial for types of analysis based on amplitude or amplitude-dependent measures.

Questionnaire Data

There were 87 missing values in total (0.67% of all responses), which occurred when a participant did not tick the scale for one item or when the marking was ambiguous. Missing values were replaced with the variable mean. Data points were averaged for each subscale to compute mean scores for attention, transportation, emotional engagement and mental imagery (SWAS), and narrative understanding (NEQ).

The content questions were checked for correctness. Two items were answered incorrectly by more than 25% of participants indicating unexpected difficulty and were therefore not included in the evaluation. For the remaining 6 questions we defined that more than 1 incorrect answer (=33.33% or more) led to exclusion of the participant.

The items of the general reading habits questionnaires, and the mean scores of the Fantasy scale, EQ and ART were treated as measures of individual differences.

Statistical Model

All data were analysed using the statistical software package RStudio v00.96.331 (R Core Team, 2009), using the nlme library for testing linear mixed models (Pinheiro, Bates, DebRoy, Sarkar, & (R CoreTeam), 2014). The use of a linear mixed model allows for the inclusion of both participants and stories as random effects (Baayen, Davidson, & Bates, 2008). Each of the main measures (Immersion, Rating, Ranking, Peaks) was analysed in a separate model. First, a simple model was constructed to predict each main measure, in which the dependent variable was on the intercept, and order of conditions, pronoun type, and whether the stories were the original or the modified version were used as fixed effects. Story and participant were included as random effects in all models. In addition, a variation of this model including random slopes for participants and stories was constructed. A model comparison between the model only including random intercepts and the model including random intercepts and slopes was used to select the model with the better fit to the data. For each main measure, we constructed a second model to which we added individual differences measures, namely gender, ART score, EQ score, the score from the IRI Fantasy scale and the four question responses regarding reading habits. All numerical predictors for individual differences (EQ, ART) were centred. To test for correlations between the dependent measures, we constructed an additional model for the EDA and the appreciation measures and added the other dependent variables as factors. In order to rule out that differences in the number of peaks between conditions were a result of different reading times in both conditions, we constructed a control model for the analysis of EDA data. The model was identical to the statistical model used for the analysis of number of peaks, with 'duration' as dependent variable instead of peaks.

P-values for specific effects were obtained by a model comparison procedure with an asymptotic chi square distribution. We only used the full model including individual differences for exploring the subscales of the immersion questionnaire.

Results

Here we report the results of the following main measures: Immersion, Rating, Ranking, and EDA. In addition, as immersion is a multidimensional concept, we analysed the standardized subscales of the immersion questionnaire separately in order to get a better understanding of which factors of immersion are affected by personal pronouns, e.g. it is more likely that subscales directly related to the protagonist are more sensitive with regards to the main manipulation. Finally, we relate individual difference measures including EQ, ART, reading habits, and the score on the fantasy scale of the IRI to the main measure to explore their contribution to explaining the variance.

Individual Difference measures

Participants scored on the **EQ** questionnaire within the normal range and distribution on the standardized EQ (mean=40.50, sd.=11.69, min=17, max=63).

In the **ART** questionnaire, participants scored on average 6.50 writers (out of maximal 30; sd.=4.30, min=0, max=22).

On the **general reading habits** items, participants indicated that they read on average once per week, ranging from daily to never (48.1% don't read regularly, 5.8% never read, 17.3 % read once per week, 21.2% read more than twice per week, and 7.7% read daily). Most participants read 3-10 books per year (34.6%), 26.9% read less than 3, 1.9% do not read at all, and 13.5% read at least 1 book per month (23.1% more than that). Regarding literature type preferences, 78.8% of participants indicated that they prefer prose. On average, participants checked 5.7 genres (s.d.=2.02, minimum=3, maximum=11). On the **Fantasy scale**, participants scored on average 4.7 (s.d.=0.81, minimum=3.00, maximum=6.83).

Immersion

We first report the results of averaging over all questions in the immersion questionnaire. The findings for separate subscales follow below.

The best model fit was produced when only including random intercepts for *Immersion*. Stories with 3rd person pronouns showed lower scores on the immersion questionnaire than stories with 1st person pronouns (β=-0.16, s.e.=0.08, t=-1.98, $p<0.05$, see Figure 1). From all individual difference measures, only EQ contributed significantly to the model (β=0.022, s.e.=0.01, t=2.57, $p<0.05$), meaning a higher EQ score predicts a higher immersion score.

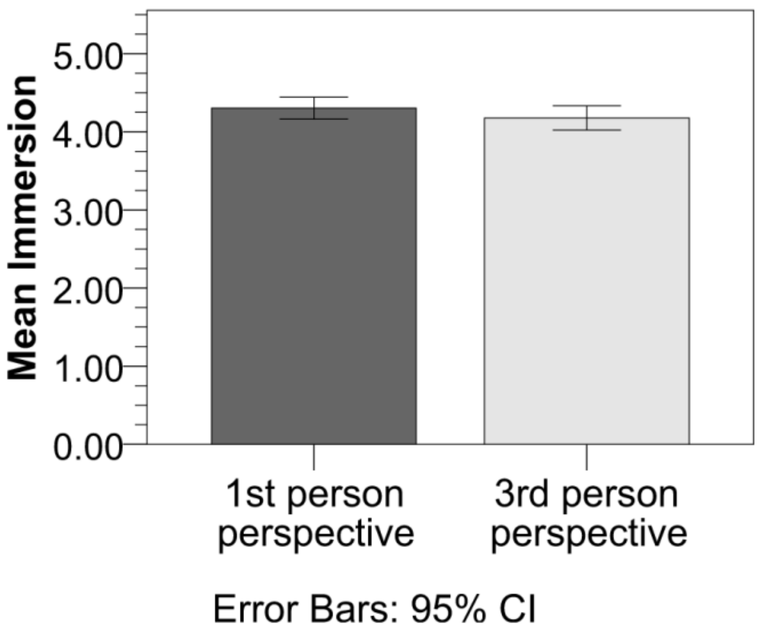

Figure 1: Immersion scores in stories with 1st and 3rd person pronouns referring to the protagonist. Participants on average scored higher on the immersion questionnaire when reading 1st person pronoun narratives compared to 3rd person pronoun narratives. Error bars represent 95% confidence intervals.

For the **attention subscale** of the immersion questionnaire, the best model fit was produced when only including random intercepts. The model did not show an effect of *pronoun* (β=-0.14, s.e.=0.10, t=-1.45, p=0.15, see Figure 2). The EQ score however, explains a significant part of the attention scores, similarly to the overall immersion scores (β=0.02, s.e.=0.01, t=2.03, p<0.05), meaning that a higher EQ predicts higher levels of attention during reading.

For the **transportation subscale,** the best model fit was produced when only including random intercepts**.** Here, we observe an effect of *pronoun* (β=-0.22, s.e.=0.08, t=-2.66, p<0.01, see Figure 2) showing that transportation scores were significantly higher when participants read stories with 1st person pronouns. Again, EQ scores show an effect in the same direction as above (β=0.03, s.e.=0.01, t=2.08, p<0.05), meaning that a higher EQ predicts higher levels of transportation during reading.

The best model fit for **the emotional engagement subscale** data was produced when including both random intercepts and random slopes for participants and stories. *Pronoun* shows no effect on the emotional engagement subscale (β=-0.11, s.e. =0.17, t=-0.67, p=0.50, see Figure 2). None of the individual differences measures contributed to the model.

The best model fit was produced when only including random intercepts for the **mental imagery subscale**. The model shows an effect of *pronoun*, indicating that less mental imagery occurred in stories with 3rd person pronouns compared to 1st person pronoun stories (β=-0.21, s.e.=0.10, t=-2.20, p<0.05, see Figure 2). None of the individual differences measures contributed to the model.

The best model fit was produced when only including random intercepts for the **narrative understanding subscale.** There was no effect of *pronoun* (β=-0.09, s.e.=0.10, t=-0.90, p=0.37, see Figure 2). None of the individual differences measures contributes to this model.

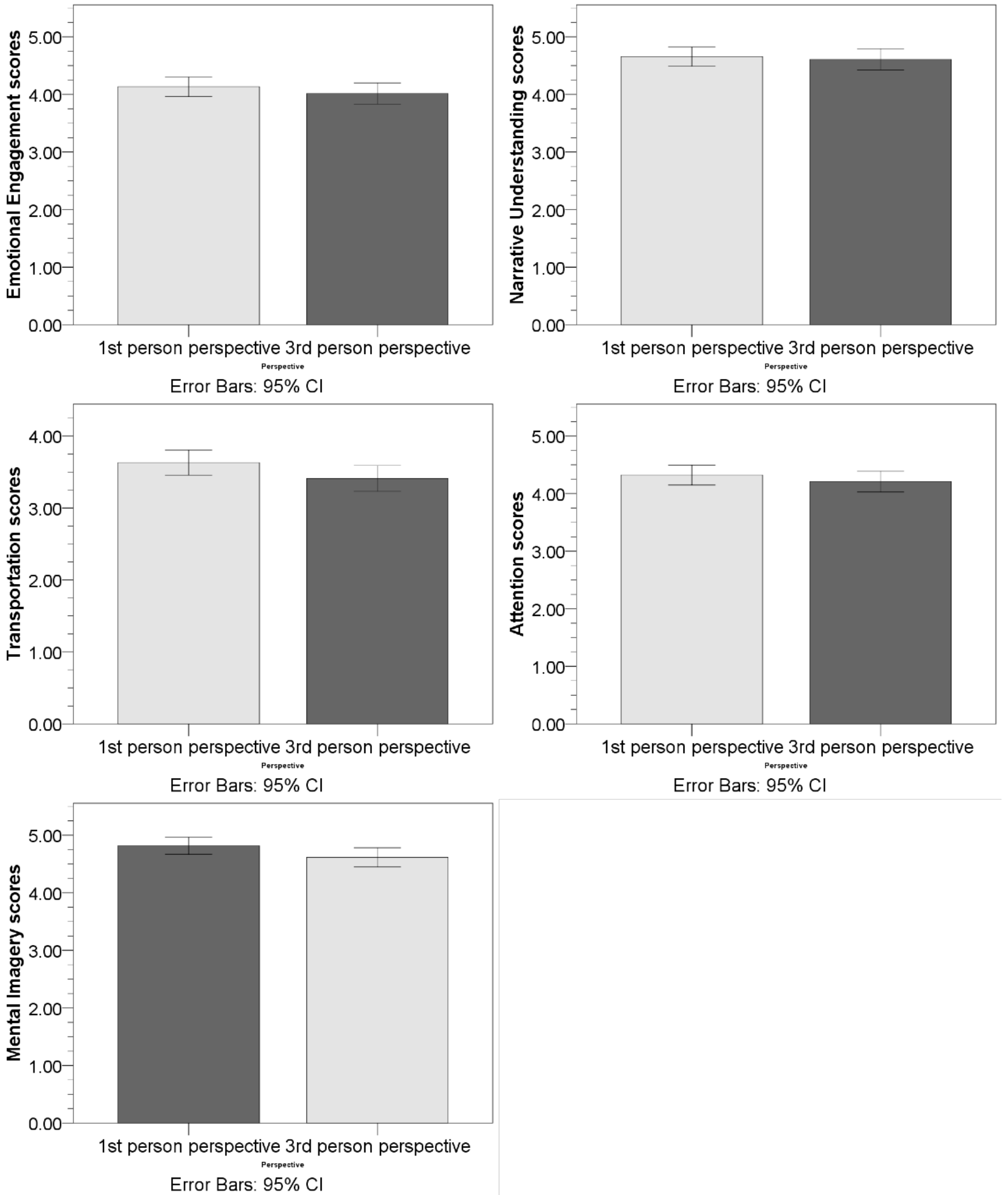

Figure 2: Subscales of the immersion questionnaire. The subscales were emotional engagement, narrative understanding, transportation, attention, and mental imagery. Differences between stories with 1st and 3rd person pronouns referring to the protagonist were significant for the transportation and the mental imagery subscale.

Rating

The best model fit was produced when only including random intercepts for *Rating*. *Rating* is the only measure for which we observe an effect of text modification. Stories which were not modified for the experiment were rated better than stories which were modified (β=-0.33, s.e.=0.15, t=-2.27, $p<0.05$). There was no effect of *pronoun* (β=-0.18, s.e.=0.14, t=-1.24, p=0.22). In addition, we see that *Immersion* shows a highly significant effect as a predictor of *Rating* (β=1.18, s.e.=0.07, t=16.87, $p<0.001$), indicating that higher degrees of immersion lead to higher rating scores. Finally, in the model including individual difference measures we see that ART shows an effect on *Rating* (β=0.12, s.e.=0.05, t=2.37, $p<0.05$), meaning that the ART score partly explains the rating data, whereby a higher ART score predicts a higher rating.

Ranking

The best model fit was produced when only including random intercepts for *Ranking*. The effect of *pronoun* for *Ranking* is significant at p=0.06 (β=0.39, s.e.=0.21, t=-1.87, p=0.06, Figure 3). None of the individual difference measures contribute to the model. *Immersion* shows a highly significant effect as a predictor of *Ranking* (β=0.59, s.e.=0.14, t=4.35, $p<0.001$).

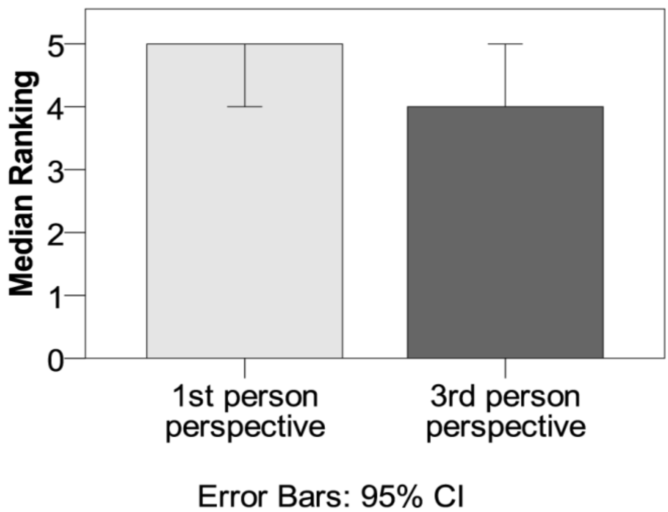

Figure 3: Effect of Pronoun type on ranking of the stories for appreciation. **The effect of pronoun type on appreciation of stories as measured by the ranking of all stories by how much participants liked them was statistically at p=0.06. Note that Ranking is a non-normally distributed variable, so medians are plotted instead of means. Error bars represent 95% confidence intervals.**

EDA

The best model fit for the EDA data was produced when including both random intercepts and random slopes for participants and stories. *Pronoun* shows an effect on the

EDA measure meaning that stories with 3rd person pronouns showed a higher number of peaks in the EDA signal compared to 1st person pronoun stories, a difference which almost reached statistical significance (β=1.04, s.e.=0.55, t=1.89, p=0.06, Figure 4). None of the individual differences measures contributed to the effect, and neither did any of the other dependent variables show a significant link with the number of peaks in the EDA signal.

The control model with durations instead of peaks as the dependent variable showed no effect of *pronoun* (β=1138, s.e.=2191, t=0.52, p=0.60).

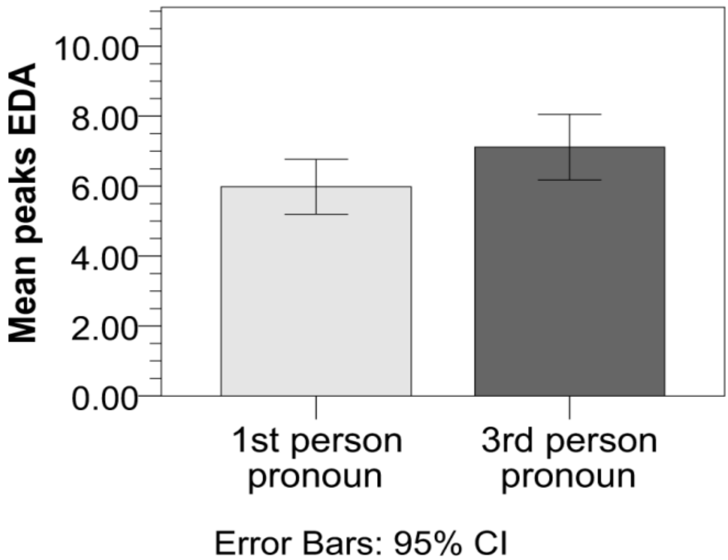

Figure 4: Peaks in EDA during reading stories with 1st and 3rd person pronouns referring to the main character. Number of peaks and valleys were computed using a peak detection algorithm in which peaks are defined as local maxima surrounded by valleys (d=0.15). Number of peaks was significantly higher when participants read 3rd person compared to 1st person pronoun stories at p= 0.06. Error bars represent 95% confidence intervals.

Discussion

The present study investigated the impact of personal pronouns referring to protagonists on readers' engagement with literary stories. Participants read short stories from Dutch literature in which either 1st or 3rd person pronouns referred to the main character, whose viewpoint the story is narrated from. Electrodermal activity (EDA) was measured while participants read the stories. After reading each story, participants rated the story and filled out an immersion questionnaire. Finally, we asked participants to rank all stories for appreciation and collected several measures of inter-individual difference such as EQ score and prior print exposure.

The results show that stories with 1st person pronouns lead to higher levels of overall immersion as measured by the questionnaire, which is in line with our predictions. We qualified this general difference by investigating the subscales of the immersion questionnaire. The effect of pronoun was present in the subscales *transportation* and *mental imagery*, again with 1st person pronouns leading to higher scores. Additionally, we observed a relation between the scores on the immersion questionnaire and appreciation of a story. This shows that a story in which a participant scores high on immersion also receives a higher score in the appreciation rating and the story is more likely to be ranked high for appreciation. The relation between immersion and appreciation confirms the link between immersion and enjoyment of reading, as suggested earlier (Busselle & Bilandzic, 2009; Green, 2004). In addition, our results suggest that people who score high on the EQ questionnaire also seem to become immersed more easily. Interestingly, the effect of our second major dependent measure, EDA during reading, showed an effect in the opposite direction. Here we observe more peaks in the EDA signal when participants read stories with 3rd as compared to 1st person pronouns, which is contrary to the direction of the effect in the scores of immersion and the appreciation measures. EDA is a measure for arousal, which can reflect emotional response, increased mental workload, and startle (Figner & Murphy, 2011), thus there may be several reasons for observing more peaks in the EDA signal when participants read stories with 3rd person pronouns, some of which will be discussed below. We want to point out that the direction of the effect in the EDA signal was not hypothesized and that the following interpretation is post hoc. Moreover, the effect on EDA peaks was not large, and we interpret this finding with caution.

An obvious explanation is that the peaks in the EDA in fact reflect the level of immersion and emotional engagement (suspense) with the story and that the online measure of arousal is a better indicator of immersion. This would mean, however, that all behavioural measures used in this experiment are completely off. We consider this possibility unlikely given their status as standard measures (Busselle & Bilandzic, 2009; Kuijpers et al., 2014) and the limited knowledge we have regarding EDA measures in experiments with longer trials.

Another possible explanation is related to embodied cognition accounts, according to which language is processed in 1st person perspective by default (e.g. Wilson & Golonka, 2013). According to this view, linguistic input in 1st person perspective as with 1st person pronouns is already tailored to the cognitive system and promotes processing by decreasing mental workload. This means that language in 1st person perspective can be processed directly by mapping information to the relevant modalities in way similar to a 1st person experience. Language in 3rd person perspective in contrast requires additional processing before integration of information can take place. That means that 3rd person linguistic input has to be 'translated' to fit a 1st person experiencing system. Those additional processes could for example comprise a form of 'translation' of the information by transposition and mapping information to the reader's perceptual system. Any additional processes require cognitive resources and effort, which can potentially be reflected as an effort effect in the EDA signal. This interpretation is supported by the fact that we do see the effect of the pronoun manipulation in the story- or plot-related components like *transportation* and *mental imagery* of the immersion questionnaire, while this was not the case for the component *emotional engagement* which is directly related to the character. This suggests that the effect we observe in the EDA is not related to 'social perspective taking' or emotional response, but rather showing an effect of decreased processing demands for 1st person perspective. This interpretation supports accounts which claim that language in 1st person perspective has processing benefits as compared to language in 3rd person perspective (e. g. Wilson & Golonka, 2013; Zwaan, 2004). However, we want to be cautious with this interpretation as we do not observe an effect of pronoun type in the *understanding* and the *attention* components of the immersion questionnaire. This is likely due to the fact that the self-reported questionnaire taps into a different level of comprehension, but with the present data we are not able to distinguish clearly between different levels of comprehension.

Alternatively, the effect could also reflect perspective shifts, which are typical for narratives with internal focalization with 3rd person pronouns referring to the character (Miall & Kuiken, 1998). This means that perspective shifts in comprehension occur with several characters and not only with the protagonist. The reader steps in the shoes of the characters when trying to understand information about them, but otherwise processes the narrative from the perspective of an observer or another character. Those perspective shifts lead to increased processing cost. With 1st person narration, the perspective of the narrator is identical to the protagonist from whose viewpoint the events are constructed, whereas with 3rd person narrative and internal focalization, the viewpoint remains with the character, but now the story is presented by a (presumably) absent narrator.

Another potential explanation for the direction of the EDA effect relates to the scope of anticipation people have in language comprehension. While for a 1st person perspective simulation it is only necessary to anticipate from the viewpoint of one character (and his or her understanding of other characters), an observer in the 3rd person perspective is likely to anticipate from multiple viewpoints and potentially takes the perspective of multiple characters into account, keeping information from other characters active. This is clearly illustrated when we think about watching a horror movie: people are already excited or even scared before something is about to happen and feel the urge to warn the protagonist. For instance, since Alfred Hitchcock's famous shower scene in 'Psycho', we anticipate a terrible incident as soon as a camera is depicting a remarkably ordinary scene for just a bit too long. In such cases, the respective character however is not scared at all, because he or she only anticipates from his/her very own viewpoint. The reason for this is because we do not only take the perspective of the protagonist, but also the perspectives and motivations of other characters and the narrator (in this case the director) into account, and make predictions based on our knowledge about the story (e.g. genre) or its characters. However, we know little about which type of information readers anticipate and if the perspective of multiple characters is taken into account. Future research is needed to test this objective. While it is intuitive that the 1st person narrative has more "immediacy" and might promote identification (van Krieken, Sanders, & Hoeken, 2015), the mechanism behind this is unclear.

The latter three potential explanations of the EDA effect are not mutually exclusive and it is likely that an interaction of all three causes leads to the observed effect. In contrast, the first explanation which argues for an effect of stronger immersion for 3rd person stories is not compatible with the other three alternatives.

We have shown that personal pronouns can indeed be a crucial factor in how readers experience fiction. However, personal pronouns are only one possible facet of narrative viewpoint and narrative perspective. Whether the effects we observed can be generalized across several features of narrative style remains an open question (Sanford & Emmott, 2012). Our results show that readers are more easily immersed when reading 1st person stories, as proposed by narrative theory (Oatley, 1999a). We add to this assumption not only by providing experimental evidence, but in addition, we show that the difference in processing 1st or 3rd person viewpoints in story engagement mainly relates to arousal and immersion, particularly transportation and experiencing mental imagery during reading. Further, our study adds to the field of discourse comprehension by showing that 3rd person pronouns as discourse anchors seem to induce increased processing demands as compared to 1st person pronouns, which in turn could account for lower immersion. This finding can be interpreted as evidence in support of embodied models of language processing. In addition, this study confirms the link between immersion and appreciation of the story and reveals evidence that appreciation of stories is positively linked to prior reading experience as measured by the ART. Finally, our study confirms previous findings that individual differences in empathy skills (as measured by the EQ) are related to subjective experience during reading (Keen, 2007; Kidd & Castano, 2013; R. a. Mar et al., 2006, 2009).

A remaining issue is whether pronouns are a major force in driving narrative perspective. It could be that people tend to identify with the character from whose viewpoint the story is told (Dancygier, 2014), which is independent of pronoun choice. As all stories that we selected were internally focalized, the main character always told the story from his or her perspective. Another very plausible reason is variability between individuals. It has been shown that subjects differ substantially in perspective taking preferences (Vukovic & Williams, 2015). Textual features such as personal pronouns are not always sufficient to overcome personal preferences. Future research is needed to confirm our findings, also for different types of discourse.

Chapter 3:

Readers select a comprehension mode independent of pronoun choice: evidence from fMRI during narrative comprehension

Abstract

Perspective is a crucial feature when it comes to communicating about events. Yet it is unclear how linguistically encoded perspective relates to cognitive perspective taking. There is evidence that personal pronouns referring to agents can influence perspective taking. However, most evidence is based on non-contextual language, and several concerns have been raised that these effects are mainly driven by task strategy instead of true correlates of natural comprehension. Here, we aimed to test the effect of pronouns on perspective taking in more contextual language with personal pronouns referring to the protagonists of short literary stories. Participants (N=52) listened to literary narratives with 1^{st} or 3^{rd} person pronouns referring to the protagonist, while brain activity was measured with fMRI. After each story, participants responded to questionnaires regarding their engagement with the story including two items for subjective experience of perspective. When looking into action events with 1^{st} and 3^{rd} person pronouns, we found no evidence for a neural dissociation depending on the pronoun. However, a split sample approach based on the questionnaire responses for subjective perspective taking revealed 3 groups of comprehension preferences. One group showed a strong preference for 1^{st} person perspective (Enactors), while another group showed a strong preference for 3^{rd} person perspective (Observers), and a third group seemed to engage in 1^{st} and 3^{rd} person perspective taking simultaneously (Hypersimulators). Comparing brain activations of the 3 groups revealed that readers with different preferences indeed activated different neural networks when engaged in the narratives. Our results suggest that comprehension and situation models are perspective dependent, but this dependency does not rely on the perspective suggested by the text, but on the reader's (situational) preference.

Introduction

In most languages it is impossible to talk about an event without specifying the agent. Yet, we know relatively little about how the linguistically encoded agent relates to our cognitive representation of events. Recent experimental research on perspective-taking in language comprehension has shown that the linguistic encoding of the agent of an event (e.g. with the use of personal pronouns referring to the agent) can have consequences for its cognitive representation. An action event is more likely to be represented from an observer's perspective when the agent of the action is referred to with a 3rd person pronoun (*He is slicing the tomato*) as compared to a potentially self-referential pronoun (*you*, *I*) (e.g., *I am slicing the tomato*). In contrast, self-referential pronouns can facilitate 1st person perspective taking (Borghi, 2004; Brunyé et al., 2009, 2011; Buccino et al., 2005; Ditman et al., 2010; Sato & Bergen, 2013; Tettamanti et al., 2005). Yet, simulating the agent and therefore perspective does not seem to be necessary for comprehension (Sato & Bergen, 2013).

Personal pronouns are also important in literature theory, where they contribute to narrative perspective. First person perspective narration is thought to invite a closer relationship between readers and characters (Stanzel, 1979) by making them share experiences and perceptions. It is therefore assumed that 1st person fiction feels more direct and immediate to the reader (Keen, 2007; see also Lodge, 2002). This means that in comparison with a 3rd person narration, 1st person narration creates a stronger illusion of realism (Lodge 2002; but see discussion in Keen 2007) and promotes empathy and identification with fictional characters (Keen 2007; see also Booth 1983).

The effects of using 1st and 3rd person pronouns referring to agents of actions also seem to influence neural activation patterns. Some regions seem to show more activation of the processing of 1st person pronouns. Papeo and colleagues (2011) found that primary motor cortices are only activated when reading action verbs in 1st person as compared to 3rd person. In addition, Tomasino and colleagues (2007) found that sentences presented in 1st person relative to 3rd person, differentially activated areas in the posterior middle cingulate cortex (mPCC) and the left dorsal occipital cortex. There is further evidence for the tendency to adopt a 1st person perspective when comprehending isolated action verbs (Hauk, Johnsrude, and Pulvermuller 2004; Pulvermuller 2005; Willems et al. 2010). There is also evidence for brain regions which are more involved in processing language in 3rd person. Papeo and Lingnau (2015) for instance showed that brain regions associated with the *action observation network*, like the posterior superior temporal gyrus (pSTS) and visual motion areas (MT), are more activated when an action verb is presented in the 3rd person form compared to 1st person, e.g. *he grabs* vs. *I grab*. This finding has been associated with the so called *3rd person bias effect* in action observation, whereby activation levels within the action observation network are systematically higher when observing other agents performing an action as compared to perceiving movements or body parts from a 1st person perspective. This effect is taken as evidence for the higher salience of other agents and higher working memory demands based on the prediction of others' actions (Allison, Puce, & McCarthy, 2000; see Peelen & Downing, 2007 for an overview; Saxe, Jamal, & Powell, 2006). If the 3rd person bias effect turns out to play a role in language comprehension as well, it might explain the findings reported in Chapter 2, where we found that reading 3rd person stories is associated with increased arousal, as compared to 1st person stories.

These differences in neural activation between the types of personal pronouns have been taken as evidence that the manner in which perspective is encoded linguistically affects whether an event is simulated in the 1st or 3rd person perspective. Although perspective effects have been reported by multiple studies, there are several concerns at hand.

First, these effects might be a results of task and strategy rather than of stimulus properties (Gardner, Brazier, Edmonds, & Gronholm, 2013; Tomasino & Rumiati, 2013). In their comprehensive review on the role of motor representations in comprehension, Tomasino and Rumiati (2013) concluded that activations in primary motor areas during action verb comprehension are not a systematic effect of action language, but depend on strategies suited to the experimental task.

Second, much of the research on perspective taking in language has focused on the comprehension of single words or sentences, when in fact perspective is especially crucial in regular communicative situations, where language comprehension depends on the context, such as in narratives or route descriptions.

Third, there is little empirical work on perspective in literary reading. In one experimental study, it has been found that narrative perspective as manipulated by personal pronouns referring to the protagonist of a story influences experiential effects of fiction reading (Hartung, Burke, Hagoort, & Willems, 2016, see Chapter 2). First person stories in which the protagonist is referred to with 'I' lead to higher scores for mental imagery and immersion during reading and are liked better by readers. Third person stories in which the protagonists are referred to with 'he' or 'she' on the other hand lead to higher arousal as measured by peaks in electrodermal activity. With these limitations, it remains to be seen whether the effects of 1st vs. 3rd personal pronouns are indeed guiding perspective taking systematically in more natural context.

Aims of the present study

To address the aforementioned issues, the present study aimed to extend prior research on narrative perspective, as encoded by personal pronouns, by investigating the neural correlates of simulating action events during narrative comprehension. In doing so we had 3 aims. First, we wanted to explore the interaction of text perspective and perspective taking in comprehension, on the level of narrative. Second, we wanted to test the influence of readers' preferences for perspective taking on comprehension and network involvement. Third, to determine whether there is evidence for the effect of a 3rd person bias for fiction comprehension, as indicated by stronger or broader activation of neural structures for 3rd person narratives, especially in the action observation network. This third aim, builds on the work done in Chapter 2 (Hartung et al., 2016). Such an effect would be independent of whether perspective taking is based on text features or comprehension preference. We proposed that narratives in the 3rd person perspective could induce a higher cognitive load compared to 1st person perspective narratives (see discussion above). We expected such an effect to be reflected in the form of increased activation levels in cortical areas associated with action observation, similar to the 3rd person bias effects in action perception (Peelen & Downing, 2007).

We used functional MRI to investigate the comprehension of stories in 1st and 3rd person perspective, using 1st or 3rd person pronouns that refer to the protagonist of the story in the agent's position. We measured brain activity while participants listened to 2 literary stories, one from a 1st and the other from a 3rd person perspective. After each story, participants rated the story for appreciation and reading immersion. In order to dissociate strategy and pronoun effects (see discussion in Tomasino & Rumiati, 2013), we also included a measure of subjective experience of mental imagery after each story, with two items directly addressing perspective taking. Here, participants indicated how far they experienced a 1st or 3rd person imagery during listening. We used a task in which participants listened to unintelligible speech as a baseline condition. The story condition was always tested first, followed by three tasks. Of these three tasks, one was the baseline condition, and the order of these tasks was randomized for each subject (for details see Chapter 4). We chose action events as classical example of simulation to compare events with 1st and 3rd person pronouns because sufficient prior research was available to formulate clear hypotheses regarding brain areas associated with perspective.

Hypotheses

Based on the literature reviewed above we expected to find stronger involvement of sensorimotor cortices for action events with 1st person pronouns compared to 3rd person pronouns, as well in the mPCC, the left dorsal occipital cortex and the dorsolateral prefrontal cortex (Saxe et al., 2006; Tomasino et al., 2007). For 3rd person pronouns compared to 1st person pronouns we expected increased activation levels in the action observation network including right extrastriate body area (EBA) and left postcentral gyrus (Saxe et al., 2006), as well as pSTS and area MT, which both have previously been shown to be implicated in language (Papeo & Lingnau, 2015). In addition, we expected a 3rd person bias effect, where we expected stronger of broader activations in relevant areas for 3rd person stories.

Materials and Methods

Participants

We used a subset of neuroimaging and behavioural data from the study described in Chapter 4. This data set was comprised of 52 native speakers of Dutch (23 male, 29 female, mean age=23.06 years, s.d.=3.40, range 18-35) after exclusion of 8 participants (see below) who listened to stories while undergoing MRI. The participants were naive to the purpose of the study, had no neurological or psychological problems, had normal or corrected-to-normal vision, and had no hearing difficulties. Written informed consent was obtained from each individual prior to the experiment, and ethical approval in line with the Declaration of Helsinki was obtained from the local ethics committee (CMO Committee on Research Involving Human Subjects, Arnhem-Nijmegen, Netherlands, protocol number 2001/095). Participants received monetary compensation at the end of the study.

Data exclusions

One participant aborted the experiment due to pain from wearing the headphones. Another participant was removed from the analysis because of falling asleep during the scan. Five more datasets were excluded from the analysis due to data quality because of artefacts from the scanner and/or excessive movement (> 1 voxel, 3.5 mm). One additional dataset was removed due to scanner artefacts in the baseline condition. In total 8 datasets were removed from the analysis and all group average results reported are for N=52.

The behavioural data of one task (appreciation rating, see below) from one participant could not be analysed due to an error in the log file for one of the stories.

Stimuli

Stories

Two short stories from Dutch fiction, *De Mexicaanse hond* ('the Mexican dog') by Marga Minco (published 1990, 1236 words) and *De muur* ('the wall') by Peter Minten (published 2013, 1121 words) were used as stimuli for the experiment. Both were typical short stories describing a single incident in the respective protagonist's life. They had a limited number of characters, no introduction, and an open ending (see supplementary material for translations of the stories). The stories were narrated with internal focalization, which means that the protagonist is always in focus, allowing readers to access the protagonists' mental states, and viewpoint which act as the source of construal for the events in the story reflecting her subjective perception.

In both original versions of the stories the protagonists are referred to with 1st person pronouns ('I', condition A). For the experiment a second version of each story was created by changing the personal pronouns that referred to the protagonist into their respective 3rd person forms ('she', condition B). Each participant was presented with both stories, one in condition A and one in condition B, counterbalanced across subjects.

The stories were presented in an auditory manner. Stories were recorded at a regular speaking rate in a music recording studio by a native Dutch. All versions of the stories were recorded separately in one shot and speech errors were corrected afterwards. The recordings were about 7 minutes long (*De Mexicaanse hond:* version 1 = 7 minutes 17 seconds, version 2 = 7 minutes 23 seconds; *De muur:* version 1 = 7 minutes 01 seconds, version 2 = 7 minutes 04 seconds). As a baseline condition we used the reversed audio signal of half of each story (7 minutes 25 seconds; first half of *De muur* and second half of *De Mexicaanse hond*). For a volume test we used the first 56 seconds of another story (*De invaller* by Rene Appel, published 2003, excerpt = 157 words).

Appreciation rating

Story appreciation was measured directly after listening. Participants were presented with 10 adjectives, which correspond to different dimensions of appreciation (translated into Dutch from Knoop, Wagner, Jacobsen, & Menninghaus, 2016). The list consisted of the following items: *interesting*, *well-written*, *of high literary quality*, *easy to understand*, *accessible*, *thrilling*, *beautiful*, *fascinating*, *emotional*, and *sad*. Participants responded to the items on a 4-point scale ranging from 'I totally disagree' (1) to 'I totally agree' (4) to how much the adjective describes the feelings evoked by the story.

Emotional engagement with the protagonist and imagery

A second questionnaire with 15 items tested a) emotional engagement of participants with the protagonists (9 items), and b) the experience of mental imagery during listening (6 items). The items were based on the emotional engagement and imagery scale of the story world absorption scale (SWAS, Kuijpers et al 2014, see supplementary material for details), with two additional items addressing perspective taking. The two additional items were 'At times, I had the feeling of seeing right through the eyes of the protagonist' (1st person perspective) and 'During reading, I saw the situations in my mind as if I was an eyewitness' (3rd person perspective). Participants responded to the items on a 4-point scale ranging from 'I totally disagree' (1) to 'I totally agree' (4).

Individual Differences

We collected several measures for individual differences from each subject. Before participants could participate in the study, they filled out an online version of the ***Vividness of Visual Imagery Questionnaire*** (***VVIQ***, Marks 1973/1995) with some additional items. After the experiment, participants filled in a battery of questionnaires consisting of self-reported measures of reading preferences and behaviour, the fantasy scale of the Interpersonal Reactivity Index questionnaire, Need for Cognition, Need for Affect, Author recognition test, and the Empathy Quotient questionnaire in this order (see below for details).

The **reading habits and preferences** consisted of 4 items. The first two items were *How much attention do you pay to narrative and rhetoric style when reading a text or a book?*, and *Do you like reading fiction?.* Participants responded on a scale from 1 (not at all) to 7 (totally). An additional question asked *How many novels did you read last year?.* This question was answered by a numerical estimate entered into an empty field by the participant. In the last item *How often do you read fiction?* subjects chose between daily, more than twice per week, once per week, not regularly, and never.

In addition, we used the 6 items from the ***Fantasy scale*** of the ***Interpersonal Reactivity Index*** (***IRI***, Davis 1983). IRI is a self-report measure of individual differences in empathy, consisting of 4 subscales. The Fantasy scale of the IRI tests individual readiness to get transported imaginatively into the feelings and actions of fictive characters in books, movies, and plays.

We used the ***Need for Cognition Scale*** (***NCS***, Cacioppo et al 1996) to measure motivation to solve complex tasks, and the ***Need for Affect Scale*** (***NAS***, Maio & Esses 2002) to assess motivation to approach or avoid emotions.

For an estimate of print exposure we used a Dutch version of the ***Author Recognition Test*** (***ART***, Acheson et al 2008; Koopman 2015). This standard measure contained 42 names, of which 30 are existent fiction authors and 12 made up names (see supplementary material). The score of each participant is computed by subtracting the sum of all incorrect answers from the sum of all correct answers. The total score can vary between -12 (only non-existent author names selected) to 30 (all correct names selected).

We also included the ***Empathy Quotient*** questionnaire to measure individual differences in empathy, (***EQ***, Baron-Cohen and Wheelwright 2004; standardized Dutch version http://www.autismresearchcentre.com/arc_tests).

Procedure

The experiment, including parts which are not relevant for the current report, consisted of one two-hour session. After the participant was placed in the MRI scanner, the experiment began with a volume test, to adjust to subject-specific hearing levels. This involved listening to a fragment of a story that was not used in any other part of the experiment. The first task consisted of listening to two recordings of the stories (one with 1^{st} and one with 3^{rd} person pronouns referring to the main character). Participants were instructed to listen to the materials carefully and attentively, and they were informed that this would be followed by questions on their appreciation of the story and narrative engagement. After each story, participants responded to the appreciation items, the emotional engagement, and mental imagery questions. This was followed by 3 more tasks which were presented in random order. One of the 3 tasks was a baseline condition in which participants listened to a reversed speech recording of the two story recordings. They were instructed to pay attention and listen carefully, even though comprehension was impossible (see Chapter 4 for details about the other two tasks). There was a break after each task and the participant decided when to continue. After the experiment, a ToM localizer task was conducted (~7 min; see below) followed by a high resolution anatomical scan (~5min). For all tasks in the scanner, participants gave responses with a 4-button response device with their right hand (index finger = disagree (1), little finger = agree (4), numbers manually reversed for one participant who responded with the left hand due to hand injury).

After the scanning session, participants completed a post-scan test battery on a paper version (~10 min) including reading behaviour and preferences, the *Fantasy scale* of the *Interpersonal Reactivity Index* (IRI, Davis, 1983), *Need for Cognition Scale* (Cacioppo, Petty, Feinstein, & Jarvis, 1996), *Need for Affect Scale* (Maio & Esses, 2001), *Author Recognition Test* (Acheson et al., 2008; Koopman, 2015), and the *Empathy Quotient* questionnaire (Baron-Cohen & Wheelwright, 2004), in this order. In addition, all participants completed a modified online version of the Vividness of Visual Imagery Questionnaire (Marks, 1972, 1995) as part of signing up for the experiment. The entire experiment took about 120 minutes, including about 70 minutes scanning time.

Stimulus presentation

Stimuli were presented with Presentation software (version 16.2, http://www.neurobs.com), and recordings were presented through MR-compatible earphones combined with hearing protection. All visual stimuli (questionnaires, instructions, etc.) were projected onto a screen using a projector outside the MR scanner room, which could be seen by participants through a mirror mounted over the head coil. Responses to the questionnaire items and the localizer task were recorded with a 4 button response device.

FMRI data acquisition and pre-processing

Images of blood-oxygen level dependent (BOLD) changes were acquired with a 3T Siemens Magnetom Trio scanner (Erlangen, Germany) with a 32-channel head coil. We used cushions and tape to minimize head movement. Functional images were acquired using a fast T2*-weighted 3D EPI sequence (Poser, Koopmans, Witzel, Wald, & Barth, 2010a), with high temporal resolution (TR: 880ms, TE: 28ms, flip angle: 14 degrees, voxel size: 3.5 x 3.5 x 3.5mm, 36 slices). High resolution (1 x 1 x 1.25mm) structural (anatomical) images were acquired using an MP-RAGE T1 GRAPPA sequence. Data were pre-processed using the Matlab toolbox SPM8 (http://www.fil.ion.ucl.ac.uk/spm). After removing the first five volumes of each scanning block to control for T1 equilibration, images were motion corrected and registered to the first image of each scanning block. The mean of the motion-corrected images was co-registered with the individual participants' anatomical scan. The anatomical and functional scans were spatially normalized to the standard MNI template. Finally, all data were spatially smoothed using an isotropic 8mm full width at half maximum (FWHM) Gaussian kernel.

Data analysis

Behavioural

Two-sided, paired t-tests were used to test for differences in behavioural responses to the questionnaires for personal pronouns (condition A vs. condition B). As a control analysis we additionally tested for between story differences (story A vs. story B). For a follow up analysis, the two perspective specific items from the imagery questionnaire were used to split the sample for perspective preference into 4 groups (see below).

fMRI

In order to create regressors for the analysis, the auditory recordings of the stories were scored for sequences containing action content in which the protagonist was the agent (see Kurby & Zacks, 2013; Nijhof & Willems, 2015 for a similar approach). We scored action verbs, implied actions (e. g. sound caused by action mentioned instead of action itself), and sequences which express motion. In addition, the model also contained mentalizing events, which were used for a different analysis (see Chapter 4). Scoring was performed by three native speakers who were naive to the purpose of the study. In case of disagreement, a fourth native speaker was consulted.

De muur contained 46 action events and 46 mentalizing events, *De Mexicaanse hond* contained 26 action events and 39 mentalizing events. We controlled collinearity between regressors by calculating the Variance Inflation Factors (VIFs) for all regressors. VIFs were low (action events: mean=1.14, median=1.12, range=1.12-1.17; mentalizing events: mean=1.15, median=1.17, range=1.06-1.22) and well below values considered critical for estimability of regressors (Kleinbaum, Kupper, Muller, & Nizam, 1998; Mumford, Poline, & Poldrack, 2015). At the single-subject level, statistical analysis was performed using a general linear model, in which beta weights for each regressor of interest are estimated for the time course of each voxel, using multiple regression analysis (Friston et al., 1995). In this model, the two regressors (*mentalizing* and *action* events) were modelled as their true durations, and convolved with a canonical hemodynamic response function (Friston, Holmes, Poline, Price, & Frith, 1996). The motion estimates of the motion correction algorithm were modelled as regressors of no interest to account for head motion. The same analysis was done on the data acquired while participants listened to the reversed speech fragments, for which the mentalizing and action regressors are meaningless. This served as a baseline condition.

Whole brain analysis (WBA)

We first performed a whole-brain analysis in which a statistical group analysis by contrasting the action regressor during story presentation between the two pronoun conditions (1^{st} versus 3^{rd} person pronouns). Results were corrected for multiple comparisons by combining a voxel-wise threshold of $p<0.005$ with a cluster extent threshold of 54 voxel for the first WBA and 68 voxels for the second WBA. These settings were obtained by performing a large number of randomizations (5.000) to assess which cluster extend level leads to false positive correction at a family-wise error rate of 5%. The combinations of voxel level threshold with a cluster extend threshold is a good compromise between statistical sensitivity on the one hand and false positive error control on the other hand (Bennett, Wolford, & Miller, 2009; Woo, Krishnan, & Wager, 2014). The simulations took the amount of autocorrelation in the data into account, which leads to different thresholds for the two analyses (Bennett et al., 2009; Woo et al., 2014). The scripts used were taken from (https://www2.bc.edu/~slotnics/scripts.htm).

To account for potential differences in strategies, independent of pronoun, a second WBA was performed in a split sample approach based on the behavioural responses to the two perspective-specific items in the imagery questionnaire. For both stories, individuals who scored greater than or equal to 3 (of 4 possible) for the 1^{st} person item ('At times, I had the feeling of seeing right through the eyes of the protagonist') were grouped in the *Enactor* group (N=15). Individuals who scored greater than or equal to 2 on the 3^{rd} person item ('While listening to the story, I saw the situations which were described in my head as if I was an uninvolved observer') were placed in the *Observer* group (N=14). The different threshold for these two items was due to a ceiling effect for the 1^{st} person item. Participants who scored above threshold for both items in both stories were labelled as *Hypersimulators* (N=12). The remaining participants (N=10) showed high variation without a consistent pattern and were excluded in the second analysis. In the WBA we only compared Enactors and Observers directly with each other and Hypersimulators against the enactor and observer group in two separate models. An independent sample t-test was performed to compare whether Enactors and Observers differ on any of the individual differences variables tested in the post scan test battery.

For anatomical labelling we used the SPM Anatomy toolbox.

ROI analysis

We defined apriori ROIs based on previous fMRI studies (Papeo & Lingnau, 2015; Saxe et al., 2006; Tomasino et al., 2007) and one TMS study (Papeo et al., 2011) in which an effect of perspective or pronoun was observed. The selected ROIs in which we expected increased activation for 1st person action events were left and right primary motor cortices (left MNI: -36, -19, 48; right 38, -18, 45; Lacadie, Fulbright, Arora, Constable, & Papademetris, 2008; pronoun effect reported by Papeo et al., 2011), medial posterior cingulate cortex (-6, -54, 2; Tomasino et al., 2007), left calcarine gyrus (-10, -76, 16; Tomasino et al., 2007), and dorsolateral prefrontal cortex (51, 27, 27; Saxe et al., 2006). Increased activation for 3rd person during action events was expected in left posterior superior temporal sulcus (pSTS; -52, -50, 5), left MT (-46, -61, 0) (Papeo & Lingnau, 2015), as well as right exastriate body area (EBA; -6, -54, 2) and left postcentral gyrus (-12, -33, 66; Saxe et al., 2006). ROIs were spheres with an 8mm radius and mean activations levels per regressor were extracted for each participant separately using the Marsbar toolbox (http://marsbar.sourceforge.net/) (Brett, Anton, Valabregue, & Poline, 2002). The model was estimated for both event types (action and mentalizing), but we only report action events here. The analysis was done as paired sample t-tests for each ROI comparing events with 1st and 3rd person pronouns.

Results

Behavioural

We observed a statistical trend for 1st person stories to be rated higher than 3rd person stories on *easy to understand* (appreciation questionnaire, mean difference=0.33, s.d.=1.29, $t_{df=50}$=1.84, p=0.07) and more likely to evoke mental imagery of the situations narrated in the story (imagery questionnaire, mean difference=0.26, s.d.=1.00, $t_{df=50}$=1.91, p=0.06). For all other items, we observed no significant differences between 1st and 3rd person pronouns for either appreciation or the emotion or mental imagery items (all $|t|<1.24$, $p>0.21$). In contrast, for between story differences, we observed several statistically significant differences. Story B (*De muur*) was rated higher for appreciation by participants on the items *well written* (mean difference=0.33, s.d.=1.07, $t_{df=50}$=2.22, p<0.05), *easy to understand* (mean difference=0.45, s.d.=1.25, $t_{df=50}$=2.57, p<0.01), *beautiful* (mean difference=0.41, s.d.=1.08, $t_{df=50}$=2.72, p<0.01), and *emotional* (mean difference=0.45, s.d.=1.25, $t_{df=50}$=2.57, p<0.01) as compared to story A (*De Mexicaanse* *hond*). Moreover, story B was rated significantly higher on two items of the mental imagery questionnaire. Participants were more likely to report experiencing a mental image of the protagonist (mean difference=0.48, s.d.=1.39, $t_{df=50}$=2.49, p<0.05) and the scenery in which the story took place (mean difference=0.23, s.d.=0.73, $t_{df=50}$=2.28, p<0.05) for story B as compared to story A. In sum, for the behavioural measures we did not observe statistically significant differences for pronoun type, but we did observe differences between stories.

FMRI

Whole brain analysis: Null- effect of pronoun

No contrast activations between 1st and 3rd person pronouns survived thresholding. Below the corrected threshold (clusters > 10 voxels), 2 clusters showed higher activations for action events with 1st person pronouns as compared to 3rd person pronouns, in the left hippocampus (k=49, x=-42, y=20, z=6, Tmax=3.02, p<0.005 uncor.) and in the right insula (k=28, x=42, y=-14, z=-8, Tmax=2.90, p<0.005 uncor.), and 1 cluster showing higher activation for 3rd person as compared to 1st person pronouns in the right middle and superior frontal gyrus (k=34, x=18, y=20, z=62, Tmax=2.98, p<0.005 uncor.).

For completeness, we report the results of the comparisons of the action regressors in 1st and 3rd person pronoun conditions compared to the baseline. Events with 1st person pronouns showed increased activations in the left and right precentral and postcentral gyri, as well as in left inferior occipital gyrus (see Table 3, Figure 5). Events with 3rd person pronouns on the other hand showed activations in right inferior occipital gyrus, and a region stretching from the left middle temporal gyrus (MTG) towards hippocampus (see Table 3, Figure 5).

ROI analysis

For the ROI analysis, a paired sample t-test (two-tailed) was conducted for each ROI, comparing the activations of events with1st or 3rd person pronouns. We observed no effect of pronoun in any of the ROIs (see Table 4 for details).

Table 3: Results of activations for 1st and 3rd person pronouns in action events as compared to baseline.

Contrast	Location / Brodmann Area	x	y	z	T max.	Nr.
Action 1st person pronoun > baseline	R precentral, postcentral gyrus	18	-30	58	3.90	439
		26	-32	56	2.92	
		8	-30	56	2.90	
	L precentral, postcentral gyrus	-20	-28	54	3.61	305
		-22	-26	62	3.47	
		-18	-36	54	2.99	
	L inferior occipital gyrus	-44	-74	-4	3.52	56
Action 3rd person pronoun > baseline	R inferior occipital gyrus	18	-86	-16	3.58	157
	L middle temporal gyrus, hippocampus	-40	-6	-22	3.53	115
		-34	-12	-22	2.81	

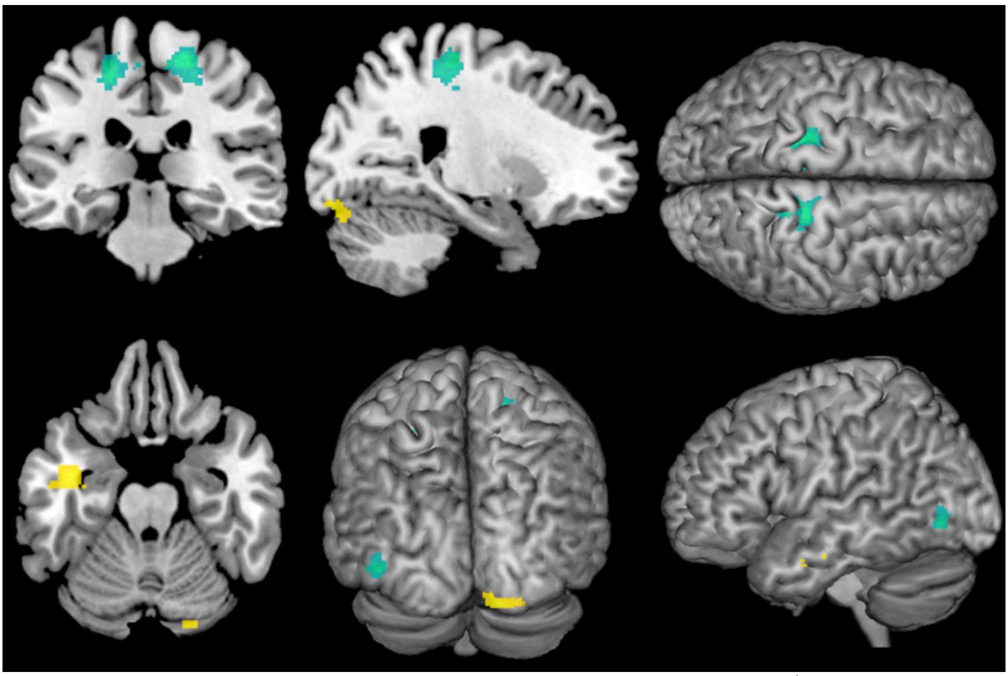

Figure 5: Regions which show higher activation during action events with 1st person pronouns (blue) and 3rd person pronouns (yellow) referring to the protagonist as compared to baseline.

Table 4: Differences in events with 1st and 3rd person pronouns referring to the agent of an action tested with a two-tailed paired sample t-test. No significant differences were observed in any of the a priori ROIs.

ROI	Pronoun	Mean activation	s. d.	Mean diff.	s. d.	t-value (df=51)	p-value
R M1	I She	0.05 -0.03	0.40 0.41	0.08	0.41	1.38	0.17
L M1	I She	0.03 -0.05	0.35 0.36	0.08	0.37	1.47	0.15
Dorsolateral prefrontal cortex	I She	-0.10 -0.08	0.48 0.42	-0.02	0.47	-0.35	0.73
Left dorsal occipital cortex	I She	-0.01 -0.02	0.54 0.63	0.01	0.62	0.15	0.88
Mpcc	I She	0.13 0.00	0.80 0.80	0.12	0.75	1.19	0.24
Psts	I She	0.01 0.04	0.40 0.37	-0.03	0.41	-0.44	0.66
L MT	I She	0.07 0.03	0.36 0.35	0.04	0.34	0.90	0.37
R EBA	I She	0.13 0.00	0.80 0.80	0.12	0.75	1.19	0.24
L postcen-tral gyrus	I She	0.07 0.05	0.26 0.30	0.02	0.24	0.57	0.57

Split sample analysis

To test if individual preferences for comprehension and for mental model construction can account for the absence of a pronoun effect on the group level, we used a split sample approach. Based on the behavioural responses to the two perspective items in the imagery questionnaire we identified 3 groups which showed a consistent pattern across both stories. Participants who scored high for 1st person perspective taking were grouped in the *Enactor* group (N=15), whereas those who scored high for 3rd person perspective taking were grouped in the *Observer* group (N=14, see Data analysis for more details). Participants who scored high for both items were put in a separate group labelled *Hypersimulators* (N=12). To test the initial hypotheses regarding different activations for 1st and 3rd person simulation, we compared enactors and observers directly in a WBA with independent samples t-tests. Hypersimulators were compared to enactors and observers separately.

Table 5: Resulting activation clusters of comparing action events in enactors with the observer group and vice versa.

Contrast	Location	x	y	z	T max	Nr of voxels
Enactors > Observers	R frontolateral pole	16	60	10	4.49	96
		18	58	2	3.36	
Observers > Enactors	L middle and inferior occipital gyrus / lingual gyrus	-10	-96	0	4.95	1576
		-16	-92	8	4.32	
		-18	-86	-2	4.17	
	R middle and inferior occipital gyrus, lingual gyrus, calcarine gyrus	26	-86	8	4.52	1127
		16	-92	-2	4.13	
		36	-80	-12	3.83	
	R inferior frontal gyrus	38	34	22	4.87	503
		54	26	30	3.64	
		48	28	22	3.56	
	L postcentral gyrus, supra-marginal gyrus, posterior superior/middle temporal gyrus	-54	-18	48	4.46	665
		-58	-36	16	4.03	
		-56	-24	20	3.92	
	L cerebellum	-34	-60	-50	4.29	91
	R posterior superior temporal gyrus	52	-40	10	4.22	324
		50	-32	2	3.86	
		64	-38	14	2.77	
	R middle temporal gyrus	44	2	-26	4.15	169
		56	-6	-22	4.12	
		62	-14	-18	2.87	
	R middle orbital gyrus	38	42	-12	3.93	109
		46	46	-12	3.8	
		24	40	-12	3.01	
	R caudate nucleus	20	2	22	3.47	152
		22	-8	22	3.43	
		28	-12	32	3.07	
	R lingual gyrus	16	-72	-12	3.21	71

During action events, enactors compared to observers showed higher activation in an area in the right frontolateral pole (area Fp1, see Bludau et al., 2014) (see Table 5, Figure 6). Observers compared to enactors showed increased activations bilaterally in the occipital cortex and the lingual gyri. In addition, observers as compared to enactors showed activations in right inferior frontal gyrus, right posterior superior temporal gyrus and right middle temporal gyrus, right middle orbital gyrus, and right caudate nucleus, as well as left cerebellum and an area stretching from left postcentral gyrus to supramarginal gyrus and posterior superior and middle temporal gyri (see Table 5, Figure 6).

Shared activations of Enactors and Observers as indicated by conjunction analysis (global) of both groups against baseline were found bilaterally in precentral and central sulci, and cuneus, as well as right insula, right thalamus, and right posterior inferior temporal gyrus (see Table 6, Figure 7).

Participants who scored high for both 1st and 3rd person perspective taking (*Hypersimulators*) showed activations (compared to reversed speech baseline) in a bilateral network with large overlaps with the networks of both the observer and the enactor group when comparing story comprehension with baseline (see Figure 7 in purple).

Table 6: Shared activations between Enactors and Observers

Contrast	Location	x	y	z	T max.	Nr. voxels
Enactors ∩ Observers	L/R precentral sulcus, L/R central sulcus	18	-28	64	2.75	1603
		-4	-26	70	2.63	
		-24	-20	64	2.56	
	L/R cuneus	4	-38	50	2.49	96
		-6	-32	48	1.65	
	R posterior insula	44	-6	6	2.46	138
		48	2	10	2.03	
		58	0	14	1.81	
	R thalamus	18	-40	6	2.44	347
		14	-22	6	2.42	
		24	-44	14	2.20	
	R posterior inferior temporal gyrus	50	-52	-6	2.05	90
		54	-58	-12	1.92	
		52	-42	-8	1.75	

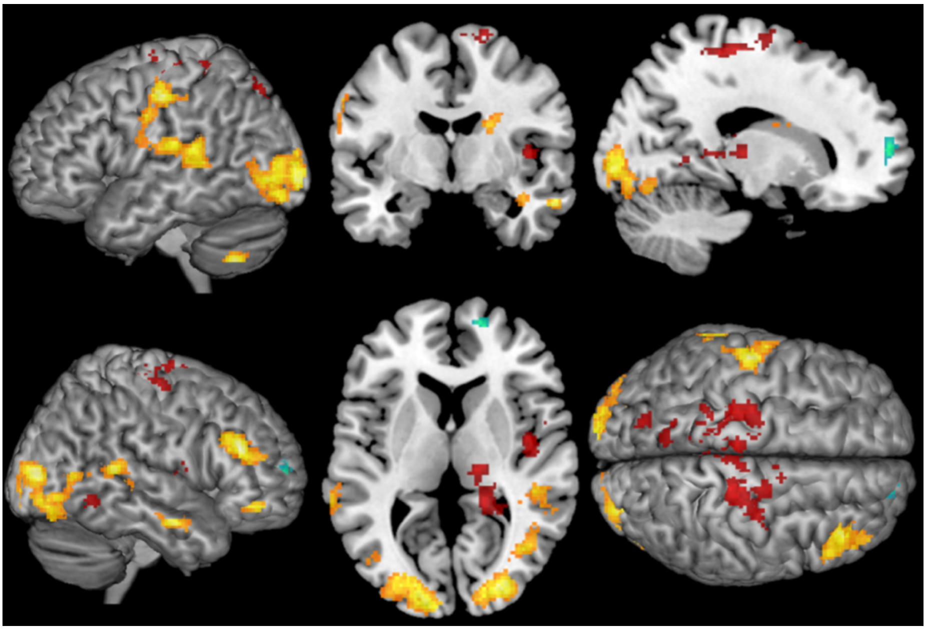

Figure 6: Activations to action events depending on participants' comprehension preference. Areas in which enactors showed higher activations than Observers (Enactors>Observers) are displayed in blue. Areas in which Observers showed higher activations than Enactors (Observers>Enactors) are displayed in yellow. In red, the conjunction of both groups is plotted (Enactors∩Observers). All activations are significant at $p<0.05$, corrected for multiple comparisons.

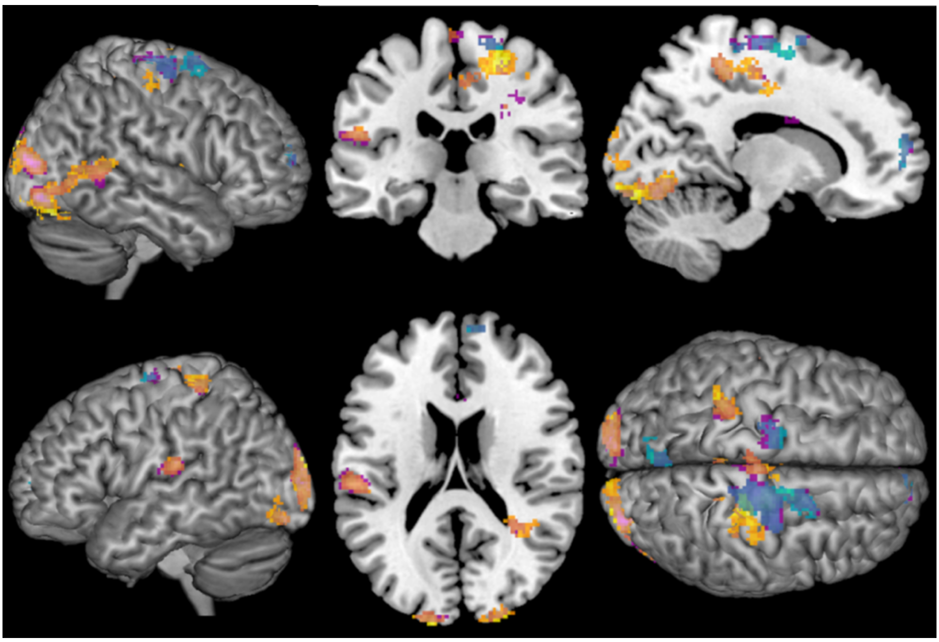

Figure 7: Activations in which the Hypersimulator group shows higher activations as compared to the baseline (Hypersimulators > Baseline) are plotted in purple. These activations show large overlap with both the Enactor as well as the Observer group when compared to baseline (>Baseline). All activations are significant at $p<0.05$, corrected for multiple comparisons.

Individual differences

There were no significant differences between enactors and observers for any of the individual differences measured in the post scan test battery (see Table 7). In the appreciation measure, the enactor group rated our two stories higher on the item well written (see Table 8 for details).

Table 7: Individual differences measures between enactors and observers as tested in an independent two-sided t-test (two-tailed). There were no significant differences between the groups.

	Group	**Mean**	**s. d.**	**Mean diff.**	**t-value (df=27)**	**p-value**
How much attention do you pay to writing style?	Enactors Observer	5.6 5.14	1.06 1.51	0.46	0.95	0.35
Do you like reading?	Enactors Observer	5.20 5.07	1.57 1.69	0.13	0.21	0.83
How many books did you read last year?	Enactors Observer	8.13 5.53	7.50 7.05	2.60	0.96	0.35
How often do you read	Enactors Observer	3.20 2.57	0.94 0.94	0.63	1.80	0.08
IRI_fantasy scale	Enactors Observer	24.13 23.57	2.80 2.44	0.56	0.57	0.57
NfC	Enactors Observer	87.40 86.21	12.35 11.62	1.19	0.27	0.79
NfA	Enactors Observer	47.20 51.93	8.77 7.45	-4.73	-1.56	0.13
ART	Enactors Observer	8.53 8.71	4.84 4.36	-0.18	-0.11	0.92
EQ_score	Enactors Observer	43.53 44.14	8.70 10.11	-0.61	-0.17	0.86

Table 8: Differences in appreciation of stories between enactors and observers as tested in an independent two-sided t-test (two-tailed).

	Group	Mean	s. d.	Mean diff.	t-value (df=27)	p-value
interesting	Enactors Observer	1.93 2.00	0.86 0.65	-0.07	-0.23	0.82
well written	Enactors Observer	1.57 2.14	0.68 0.50	-0.58	-2.62	0.02
Literary	Enactors Observer	2.20 2.14	0.92 0.53	-0.06	0.20	0.84
easy to understand	Enactors Observer	2.00 2.11	0.87 0.81	-0.11	-0.34	0.73
accessible	Enactors Observer	2.17 2.36	0.79 0.77	-0.19	-0.66	0.52
thrilling	Enactors Observer	1.80 2.18	0.68 0.54	-0.38	-1.66	0.11
beautiful	Enactors Observer	2.37 2.68	0.88 0.58	--0.31	-1.12	0.27
fascinating	Enactors Observer	1.93 2.21	0.80 0.54	-0.28	-1.10	0.28
emotional	Enactors Observer	2.50 2.79	0.85 0.67	-0.29	-1.00	0.33
Sad	Enactors Observer	3.20 3.07	0.17 0.15	0.13	0.57	0.57

Discussion

In the present study, we tested the effect of perspective on neural activations during language comprehension. We manipulated perspective with 1st or 3rd person pronouns that refer to the protagonist in literary narratives. Our results showed no evidence for an overall effect of perspective in the stories. Despite showing different focal areas of activation between the action regressors during listening and the low level baseline condition, no differences were found in the WBA when comparing events in 1st and 3rd person perspective directly with each other.

Given our relatively large sample size and the combination of behavioural and neuroimaging methods, we were able to inspect for whether individual differences accounted for the lack of difference between personal pronouns. We conducted a split sample analysis based on the behavioural responses to two items in which participants explicitly reported whether they took a 1st or 3rd person perspective during comprehension.

Indeed, readers seemed to employ different strategies in comprehension. We identified 3 different modes in reading comprehension associated with perspective. However, these effects were not driven by narrative perspective, but rather by individual preferences in comprehension. Readers who scored high on the item, ‘At times, I had the feeling of seeing right through the eyes of the protagonist’ (*Enactors*) showed activations in a different network than readers who scored high on the question ‘During reading, I saw the situations in my mind as if I was an eyewitness’ (*Observers*). Another group seemed to simulate 1st and 3rd person perspective simultaneously (*Hypersimulators*), as evidenced by high scores on both behavioural items as well as large overlap in activated networks with both the Enactor and the Observer group.

Comparing brain activations of Enactors and Observers, we found significant differences between the two groups. When listening to action events, Enactors showed stronger activations in a region in the right frontolateral pole. In contrast, Observers showed stronger activations in bilaterally visual areas, which are associated with motion processing (Braddick et al., 2001; Lui, Bourne, & Rosa, 2007) and the lingual gyri. The Observer group showed stronger activations in a large fronto-temporo-occipital network, including the right inferior frontal gyrus, left postcentral, left supramarginal, and left and right posterior superior and middle temporal gyri. In addition, we found activations in areas like, right middle orbital gyrus, right caudate nucleus, and left cerebellum. Shared activations between Enactors and Observers were found in (pre-) motor areas (bilaterally) and cuneus (also bilaterally) as well as in regions in the right insula, right thalamus, and right posterior inferior temporal gyrus.

Our null-result for personal pronoun does not replicate previous findings on pronouns being effective tools for guiding cognitive perspective. Even in the ROI analysis, where ROI choice was motivated by previous studies reporting pronoun effects, we did not find evidence for a pronoun-dependent modulation in neural activation. In fact, our findings provide evidence that comprehension is not affected by manipulating personal pronouns. A follow-up analysis for which we split the sample based on the individual preferences in perspective taking during comprehension however revealed substantial differences in neural networks associated with 1st or 3rd person simulating. What is striking when looking at the activations in Observers and Hypersimulators, as compared to Enactors, is the difference in the size of the neural networks being engaged during comprehension. Observers seem to recruit a much larger and wider network as compared to Enactors. This could be taken as evidence for increased saliency, working memory load, and processing difficulty similar to a 3^{rd} person bias effect in action observation.

The suggestion that perspective effects in simulation are a matter of strategy more than experimental manipulation (the actual perspective in the text) has been raised before (see Tomasino & Rumiati 2013). Our study adds strong experimental evidence for this idea. However, none of our behavioural measures related to reading experience indicates that selecting a perspective for comprehension has consequences for affective and experiential aspects of reading fiction. Therefore, it remains an open question why individuals select a particular perspective to construct a mental model and how selection of this perspective relates to reading experience.

The fact that both original stories were in 1^{st} person perspective is a confound in our design which could have influenced our results. By having native speakers check the readability of the stories we tried to overcome this issue, but cannot claim that there are no other features (beyond our pronoun manipulation) in the text which could have one pronoun condition more than the other. However, it is unlikely that modifications to one of the story (from 1^{st} to 3^{rd} person) can account for the absence of an effect as we did not observe behavioural differences for the comparison between the two pronoun conditions (whereas we do find differences between stories). Participants were equally likely to select one comprehension mode or another as indicated by comparable group size in all three groups. If the fact that the stories were originally written in 1^{st} person would be a strong influence, we would expect that the majority of participants would select an Enactor mode for comprehension, which is not the case. Another limitation of the study is that our interpretations are restricted to action events. For future research, we advocate the importance of accounting for different types of events and contexts. The insight that strategy or preference effects can overrule the effect of a well-established experimental manipulation is a valuable insight for future studies. This finding raises the question on how far experimental effects regarding linguistic perspective based on artificial stimuli can be generalized to more natural language.

Chapter 4:

Is simulation a reduced form of mental imagery? Evidence from fMRI during narrative comprehension.

Abstract

Simulation during language comprehension is often assumed to entail mental imagery. However, there is little evidence that simulation and imagery activate the same neural networks. In the present study, we critically investigated the similarities and differences between simulation and mental imagery, during the comprehension of narratives. With functional MRI, we tested if simulation during comprehension shares neural resources with mental imagery, which can be from the perspective of the agent (1st person) and the perspective of an observer (3rd person). Participants (N=60) listened to two literary stories, during an fMRI session. Subsequently, the same stories were presented twice again and participants were instructed to 'imagine being the main character' (1st person perspective imagery, IM1) or to 'imagine being an observer' (3rd person perspective imagery, IM3). In the analysis, we focused on neural responses to action and mentalizing events as these are canonical examples of simulation. When looking at the brain activation during simulation of action events, we found little evidence that simulation and imagery shared neural resources. Rather, they seem to recruit independent neural networks. Mentalizing events in contrast seemed to share some resources with 3rd person imagery indicating that 3rd person imagery is involved in narrative comprehension. Aside from this overlap in neural regions, the 3 tasks (listening, IM1, IM3) activated independent sets of regions even when taking into account individual preference for perspective in comprehension. The results provide evidence that despite sharing some resources, simulation is at qualitatively different from mental imagery. Our findings call for a more differentiated understanding of simulation and a more careful interpretation of simulation effects.

Introduction

As discussed in Chapter 1, sensorimotor (or 'motor') simulation is the most investigated form of mental simulation during language comprehension. This is supported by the well-established finding that sensory and motor regions in the brain become active when people are presented with words related to action and perception (e.g. Hauk et al. 2004; Aziz-Zadeh et al. 2006; Bergen & Wheeler 2010; Tettamanti et al. 2005; Willems et al. 2010; see Kiefer & Pulvermüller 2012 for review). Simulation is supposed to be based on (partial) re-activations of perceptual, motor and introspective states (e. g. Barsalou 2009; Barsalou 2008). There is evidence that action execution, motor imagery, action observation, and action language processing activate at least partially the same set of brain regions. This is taken as support for the hypothesis that all these processes share neural resources and rely on the same cognitive mechanisms (see review in Taylor & Zwaan, 2009). However, the typical simulation effects of modality specific activations in sensorimotor areas are not always present (e.g. Bedny et al. 2008; de Zubicaray et al. 2010; Postle et al. 2008; Raposo et al. 2009; Sato et al. 2008, see discussion in Chapter 1), and there is only limited evidence for a causal contribution of simulation in language processes (e.g. Willems, Labruna et al., 2011; see Binder & Desai 2011 for review). Typically, it has been found that comprehension is possible without engaging in simulation, but processing times might be increased (e. g. Papeo et al. 2011).

Another type of simulation is mentalizing, which is understood as the social cognition equivalent to sensorimotor simulation. Mentalizing refers to the understanding and processing of mental states of other agents by using the own mind as a proxy for simulating other agents' states of mind (Decety & Chaminade 2003; Frith & Frith 2006). At the conceptual level, sensorimotor simulation and mentalizing can be considered two aspects of mental simulation, as was argued by Goldman (Goldman, 2006). Mentalizing has been associated with activation of a set of regions referred to as the 'mentalizing network' (Decety & Chaminade, 2003; Frith & Frith, 2006; Tamir & Mitchell, 2010).

Aside from the existing evidence that there are different types of simulation, which potentially work at different levels of cognition, there is also a debate over the general role of simulation for cognition. The typical sensorimotor simulation effects are mostly associated with semantic processing of modality specific word meaning. Other accounts (e.g. Barsalou, 2008, 2009, Jeannerod, 2001, 2006) understand simulation is also as a much more basic computational mechanism which unifies information across various forms of cognition like perception, imagery and social cognition (see also Chapter 1). As such, simulation functions as a working memory mechanism which enables multimodal representations of events. The function of simulation has further been linked to prediction (Binder & Desai, 2011; Moulton & Kosslyn, 2009) and episodic memory (e.g. Rosenbaum et al., 2004; for review see e.g. Wagner et al., 2005).

The process of simulation itself is often understood as a subconscious or reduced form of mental imagery, which differs from the latter in terms of detail, specificity, consciousness, automaticity and long term memory involvement (e.g. Barsalou 2008; Hétu et al. 2013; Iachini 2011). In a direct comparison of action verb reading ('simulation') and mental imagery of the same actions, Willems and colleagues (2010) found that activations linked to both mental imagery and verb reading are modality specific and adjacent to each other, but the regions activated by the language and the motor imagery task were mutually exclusive. These results seem to contradict accounts on embodied semantics which propose that the retrieval of action word meaning comprises of a subconscious form of covert re-enactment similar to motor imagery (e.g. Gallese & Lakoff 2005). In the present study we set out to further qualify the relationship between simulation during language comprehension and mental imagery.

Simulation beyond individual concepts

We know that simulation in language processing is flexible and highly dependent on its contextual setting (van Dam et al. 2012; Papeo et al. 2012; for review see Kiefer & Pulvermüller 2012; Willems & Casasanto 2011). It has further been argued that sensorimotor simulations play a more central role for comprehension in more situated (natural) language use by facilitating the construction of situation models (Bower & Morrow 1990; Jacobs 2015; Schrott & Jacobs 2011; Zwaan 2004; Zwaan & Radvansky 1998; see Zwaan 2014 for a review, see Chapter 1). Situation models are globally coherent representations of specific situations, which integrate simulations from multiple modalities. The events in a situation model are thought to be connected along the five dimensions space, time, protagonist (agent), causality, and intentionality (Zwaan et al., 1995; Zwaan & Radvansky, 1998).

Fiction stories seem highly appropriate to test simulation in language comprehension at the level of situation models (Willems & Jacobs, 2016, see discussion in Chapter 1). Indeed, there is a growing body of research on sensorimotor simulation and mentalizing advanced to the level of discourse comprehension (e.g. Nijhof & Willems 2015; Wallentin et al. 2011; Speer et al. 2009; Kurby and Zacks, 2013). Consistent with the idea that simulation has a more fundamental function on the level of discourse, Kurby and Zacks (2013) demonstrated in two studies that modality specific sensorimotor simulation and the generation of mental images is strongest in connected discourse comprehension as compared to single sentences (see also Madden-Lombardi et al., 2015).

Perspective as a core feature of mental simulation

Mental representations of events (e.g. spatial or motor cognition) or mental states can be from 1st or 3rd person perspective (Vogeley & Fink, 2003). This relates to the distinction Moulton and Kosslyn (2009) proposed between instrumental or first order simulations (i.e. observant non-involved simulation; 3rd person perspective) and emulation or second order simulation (involving re-enactment of mental states and their causators; 1st person perspective). Perspective taking has not received much attention from embodied accounts on language (but see Brunyé et al., 2009; Ditman et al., 2010). Yet it is commonly assumed in embodied theories that language processing and resulting mental representations are constructed from a 1st person perspective by default (Barsalou, 1999a; Bergen & Wheeler, 2010; see review in Beveridge & Pickering, 2013; Borghi & Scorolli, 2009; Glenberg & Kaschak, 2002; Wu & Barsalou, 2009; Zwaan & Taylor, 2006). Given the concerns on the effects of individual differences and task –dependent requirements on perspective taking, the perspective being taken may not default from a 1st person processing mode (e.g. Tomasino & Rumiati, 2013). Recent experimental research has shown that readers show different preferences in perspective taking during narrative comprehension (see Chapter 3; Hartung, Hagoort, & Willems, in prep.): whereas some rely on an enactive strategy during comprehension (1st person), others prefer simulating from a 3rd person perspective. In addition, some seem simulate 1st and 3rd person simultaneously.

The effects of perspective on motor imagery are better known. Typically, motor imagery is defined as a default 1st person perspective simulation without overt physical movement (Hanakawa, Dimyan, & Hallett, 2008; Jeannerod & Decety, 1995; Lorey et al., 2009). Willems and colleagues found that left- and right-handed participants imagine simple hand actions according to their dominant hand (Willems, Toni, et al., 2010b). Ruby and Decety (2001) directly tested the effect of 1st and 3rd person perspective on motor imagery. They found that 1st person imagery showed a strong left lateralization including activations in areas in inferior parietal gyrus, precentral gyrus, occipito-temporal junction and anterior insula, whereas 3rd person perspective was associated more with the right hemisphere including inferior parietal regions, precuneus, and posterior cingulate and fronto-polar cortex (see also Guillot et al., 2009; Ruby & Decety, 2001). Moreover, there was substantial similarity between 1st and 3rd person motor imagery as shown by common activations in supplementary motor area (SMA), precentral gyrus, precuneus and area MT (V5).

A study by Vogeley and colleagues (2001), which focused on mentalizing about oneself and others found similar dissociations: Mentalizing about others activated anterior cingulate cortex and left temporo-polar regions, whereas self-related mentalizing was associated with activations in right temporo-parietal junction (TPJ), anterior cingulate cortex, and precuneus. Furthermore, evidence from studies on agency suggest a crucial role of posterior superior temporal sulcus and TPJ in perspective taking (Frith & Frith 2006). In addition it has been shown that anterior insula is activated when subjects are aware of causing an action, whereas inferior parietal regions were associated with observing another agent causing the action (e.g. Farrer & Frith 2002).

Aims of the present study

In the present study, we used fMRI to investigate similarities and differences between simulation of action and mentalizing events and motor imagery, in 1st and 3rd person perspective during comprehension of literary stories. We wanted to know whether simulation during comprehension activates the same neural regions as imagery. Based on the findings reported in Chapter 3, we compared activations from participants with a strong preference for either 1st or 3rd person simulation during comprehension with 1st and 3rd person imagery tasks. Moreover, we wanted to find out whether action and mentalizing events show similar effects for perspective.

The study was based on the same dataset as the study reported in Chapter 3 with two additional tasks. In the experiment, participants (N=60) listened to two stories, three times – the first time without a specific task (Listening), followed by two more times where participants were instructed to 'imagine the story from the perspective of the protagonist' (1st person imagery, IM1), and to imagine the story from the perspective of an observer who is not participating in the ongoing events' (3rd person imagery, IM3). It was assumed that the listening condition led to a situation in which simulation can naturally occur. A baseline run with unintelligible (reversed) speech was used as a control condition. The order of the two imagery and the baseline tasks was counterbalanced across participants, whereas the listening condition was always tested first to avoid priming. We analysed neural activation during action and mentalizing events as these are canonical examples of simulation.

Hypotheses

Following the assumption that simulation is a reduced form of conscious imagery (e. g. Barsalou, 2008; Hétu et al., 2013; Iachini, 2011) we expected substantial overlap of activations during comprehension and imagery. Specifically, we expected overlap in motor and premotor areas for action events and in areas linked to the mentalizing network for mentalizing events (see Introduction). In terms of the relationships between simulation and perspective, we expected that the overlap between simulation and 1st person imagery is more likely in participants with 1st person preference (Enactors), whereas overlap of simulation and 3rd person imagery is more likely in participants with 3rd person preference. Moreover, we expected that the imagery tasks would result in additional involvement of neural resources from the imagery network (McNorgan, 2012), and areas of executive function and cognitive control for imagery. These additional activations, we expected to be particularly pronounce for 3rd person imagery (see Ruby & Decety 2001; Ruby & Decety 2003, see also discussion in Chapter 3).

Materials and Methods

Participants

Sixty healthy, native speakers of Dutch without psychiatric or neurological problems were recruited for the experiment (27 male, 33 female, mean age=22.95 years, s.d.=3.72, range 18-35). Participants were naïve as to the purpose of the experiment, had normal or corrected-to-normal vision and no hearing problems. Written informed consent was obtained prior to the study, and ethical approval was obtained from the local ethics committee (CMO Committee on Research Involving Human Subjects, Arnhem-Nijmegen, The Netherlands, protocol number 2001/095), in line with the Declaration of Helsinki. Participants were paid in money at the end of the study. After data exclusion (see below for details), the data of 52 participants were used in the final analysis for the group average (23 male, 29 female, mean age=23.06 years, s.d.=3.40, range 18-35). The comparison groups for the listening task were subsets from this sample grouped for comprehension preference. We used the Enactor group (preference for comprehension in 1st person perspective, N=15) and the Observer group (preference for 3rd person perspective, N=14; see Chapter 3 for details).

Data exclusions

One participant aborted the experiment due to pain from wearing the headphones. We removed the entire dataset because one of the imagery tasks was missing. Another participant was removed from the analysis because of falling asleep during the scan. Five more datasets were excluded from the analysis due to data quality because of artefacts from the scanner and/or excessive movement (> 1 voxel, 3.5 mm). One additional dataset was removed due to scanner artefacts in the baseline condition. In total 8 datasets were removed from the analysis and all group average results reported are for N=52.

Stimuli

Stories

We selected two short stories from Dutch fiction as stimuli for the experiment, *De Mexicaanse hond* ('The Mexican dog') by Marga Minco (published 1990, 1236 words) and *De muur* ('The wall') by Peter Minten (published 2013, 1121 words). Both stories are typical short stories with a limited number of characters, no introduction, and open ending (see supplementary materials for details). The story plots focus on a single incident in the respective protagonist's life, narrated with internal focalization, which means that the style of narration reflects the subjective perception of the protagonist (Genette, 1980; Rimmon-Kennan, 2002). The narrative voice is identical with the narrative point of view.

In both original stories, the protagonists are referred to with 1st person pronouns. In order to counterbalance text perspective (see e.g. Brunyé et al., 2009), we made a second version of each story by changing the personal pronouns referring to the protagonist and their related verb forms into 3rd person (changing 'I' to 'she'), so that each participant was presented with one story with 1st and one story with 3rd person pronouns referring to the main character.

The stories were presented as audio recordings in the experiment. Recordings were spoken at a normal rate, in a music recording studio by a female native speaker of Dutch. The recordings were between 7.00 and 7.30 minutes long (*De Mexicaanse hond:* original=7 minutes 17 seconds, version 2=7 minutes 23 seconds; *De muur:* original=7 minutes 01 seconds, version 2=7 minutes 04 seconds). For the volume test we used the first 56 seconds of another story which was not used in any other part of the experiment (*De invaller* by René Appel, published 2003, excerpt=157 words). The recordings were made in one continuous reading session for each story. When speaking errors occurred, the speaker started again from several words before. The audio files were processed by cutting out speech errors and other random noises such as page turning and coughing, and the transitions were smoothed with crossfades if necessary to make the recording as continuous and natural as possible. We used simple audio compression over the entire file to smooth out volume peaks for a more even volume and the total volume was raised by 15dB. For the baseline condition we used the reversed audio signal of half of each story (7 min 25 sec; first half of *De muur* and second half of *De Mexicaanse hond*).

Practice sentences for imagery tasks

For each imagery task, we prepared a short practice narrative consisting of 8 sentences which describe a consistent short narrative and contain both action and mentalizing events (see supplementary materials) which were presented before each of the imagery tasks.

Questionnaires

Appreciation rating

Appreciation of the stories after first presentation (Listening) was measured for reasons not reported in the present report (see Chapter 3 for details).

Emotional engagement with the protagonist and imagery

We used a 15 items questionnaire to assess participants' emotional engagement with the protagonists of the stories (9 items) and experience of mental imagery (6 items) after each story presentation (for a complete list see supplementary material). The items were based on the emotional engagement and imagery scale of the story world absorption scale (SWAS, Kuijpers et al., 2014) with two additional items addressing perspective taking. These two additional items were 'At times, I had the feeling of seeing right through the eyes of the protagonist' (1st person perspective) and 'During reading, I saw the situations in my mind as if I was an eyewitness' (3rd person perspective). Participants responded to the items on a 4-point scale ranging from 'I totally disagree' (1) to 'I totally agree' (4).

Individual differences measures

For reasons not reported in Chapter 3 and 4, we collected several measures for individual differences from each participant (see Chapter 3 for more details). Before participants could participate in the study, they filled out an online version of the *Vividness of Visual Imagery Questionnaire* (*VVIQ*, Marks 1972,1995) with some additional items. After the experiment, participants filled in a battery of questionnaires consisting of self-reported measures of reading behaviour and preferences, the *Fantasy scale* of the

Interpersonal Reactivity Index (*IRI*, Davis 1983), *Need for Cognition Scale* (*NCS*, Cacioppo et al. 1996), *Need for Affect Scale* (*NAS*, Maio & Esses 2001), *Author Recognition Test* (*ART*, Acheson et al. 2008; Koopman 2015), and the *Empathy Quotient* questionnaire (Baron-Cohen & Wheelwright 2004; standardized Dutch version http://www.autismresearchcentre.com/arc_tests) in this order.

Procedure

The laboratory part of the experiment took place in one session on the same day. First, subjects did a volume test in which they were presented with a fragment of a story which was not used in any other part of the experiment. The scanner was turned on during the volume test and participants indicated a volume level which was comfortable for them. This was followed by the main experiment (~60 min), which consisted of 4 tasks. The first task was always the listening task, in which subjects listened to two story recordings and after each of them responded to the appreciation rating, and the emotional engagement and mental imagery questionnaire. One of the stories was presented with 1st and one with 3rd person pronouns referring to the protagonist and we counterbalanced across participants which story was presented in which text perspective. There was no additional task but to listen for comprehension and participants were informed that each story would be followed by questions regarding their appreciation and engagement with the narrative.

Tasks 2 to 4 were the two imagery tasks and the baseline condition in randomized order counterbalanced across participants. In the two imagery tasks participants were instructed to engage in mental imagery by either taking the perspective of the main character (*1st person perspective imagery,* IM1) or the perspective of an uninvolved observer (*3rd person perspective imagery*, IM3). The instructions for IM1: ‘While listening, imagine that you experience the story from the perspective of the main character. Put differently, try to understand the story as if you are the main character yourself.’ For IM3 the instruction was: ‘While listening, imagine that you are an observer, who is not part of the story. Listen to the stories and try to take the perspective of an observer, just like watching a movie.’

After each story, participants again responded to the narrative engagement items. Every imagery task was preceded by a practice task, in which the subject practiced the perspective taking in imagery, while listening to short narratives consisting of 8 sentences. For the baseline condition, participants were presented with the reversed speech recording of the two stories and instructed to pay attention and listen to it carefully, even though comprehension is impossible. There was no questionnaire following the baseline recording.

There was a short break after each task and the subject decided on when to continue with the following task. In total participants listened to 6 recordings (3 tasks by 2 stories per task) plus the baseline recording. In addition, we did a ToM localizer task and a high resolution anatomical scan (~5min) at the end of the scanning session. Finally, the participant was taken out of the scanner and after a short rest, filled in the post scan test battery on a paper version (~10 min). The entire experiment took about 120 minutes, including about 70 minutes scanning time.

Stimulus presentation

Stimuli were presented with Presentation software (version 16.2, http://www.neurobs.com). Auditory stimuli were presented through MR-compatible earphones. All visual stimuli (questionnaires, instructions, etc.) were projected onto a screen using a projector outside the MR scanner room, which could be seen by participants through a mirror mounted over the head coil. Responses to the questionnaires and the mentalizing localizer task were recorded with a 4 button response device (right hand). While an auditory stimulus was presented, no response was expected.

FMRI data acquisition and pre-processing

Images of blood-oxygen level dependent (BOLD) changes were acquired on a 3T Siemens Magnetom Trio scanner (Erlangen, Germany) with a 32-channel head coil. We used cushions and tape to minimize participants' head movement. We used earphones, which combined hearing protection from the scanner noise and audio presentation of the stories. Functional images were acquired using a fast T2*-weighted 3D EPI sequence (Poser, Koopmans, Witzel, Wald, & Barth, 2010b) with high temporal resolution (TR: 880ms, TE: 28ms, flip angle: 14 degrees, voxel size: 3.5 x 3.5 x 3.5mm, 36 slices). High resolution (1 x 1 x 1.25mm) structural (anatomical) images were acquired using an MP-RAGE T1 GRAPPA sequence. Data were pre-processed using the Matlab toolbox SPM8 (http://www.fil.ion.ucl.ac.uk/spm). After removing the first five volumes of each scanning run to control for T1 equilibration, images were motion corrected and registered to the first image of each scanner run. The mean of the motion-corrected images was co-registered with the individual participant's anatomical scan. The anatomical and functional scans were spatially normalized to the standard MNI template. Finally, all data were spatially smoothed using an isotropic 8 mm full width at half maximum (FWHM) Gaussian kernel.

Scoring of Action and Mentalizing events

The auditory recordings of the stories were scored for time windows in which action and mentalizing events were presented explicitly or implicitly (we also scored an action when the action was implied e.g. by mentioning the sound caused by action instead of the action itself). The scoring was done by three native speakers who were naive as to the purpose of the study (see Kurby & Zacks, 2013; and Nijhof & Willems, 2015 for a similar approach). In case of disagreement, a fourth naive native speaker was consulted. For action events, we scored action phrases, implied actions, and sequences which express motion, in which the protagonist of the story was the agent. For mentalizing events, we scored expressions referring to mental states, thoughts, beliefs, or descriptions of characters as projected from the viewpoint of the protagonist (see Table 9 for examples).

De muur contained 46 action events and 46 mentalizing events, *De Mexicaanse hond* contained 26 action events and 39 mentalizing events. We controlled collinearity between regressors by calculating the Variance Inflation Factors (VIFs) for all regressors. VIFs were low (action events: mean=1.14, median=1.12, range=1.12-1.17; mentalizing events: mean=1.15, median=1.17, range=1.06-1.22) and well below values considered critical for estimability of regressors (Kleinbaum et al., 1998; Mumford et al., 2015).

Table 9: Examples for fMRI regressors for action and mentalizing events in the two version of the story. As action events we scored text sequences containing action phrases, implied action and motion. Mentalizing was scored for sequences containing information about mental states, feelings, thoughts and character traits. To control for text perspective, half of the stories were presented with 1st and the other half with 3rd person pronouns.

1st person pronoun: Action events	3rd person pronoun: Action events
[...] **With my index finger I carefully scratch the leftover from the can.** [...] **I lift up my skirt, lower myself to my hands and knees** and **drag my old body to the living room** [...] I have to lure that man away from the wall. Now is the time to do so. **Without any sound I creep towards the front door** and **press my eye against the round peephole**. The elevator in the hallway produces a zooming sound. [...] **On hands and feet I creep to the kitch-en, grab the pill case** and **fill a glass of wa-ter**. In the living room, **I crawl upon the pillow**. For a while I lie there motionless. **I then lick the sleeping pill from my opened hand**.	[...] **With her index finger she carefully scratches the leftover from the can.** [...] **She lifts up her skirt, lowers herself to her hands and knees** and **drags her old body to the living room** [...] She has to lure that man away from the wall. Now is the time to do so. **Without any sound she creeps towards the front door** and **presses her eye against the round peephole**. The elevator in the hallway pro-duces a zooming sound. [...] **On hands and feet she creeps to the kitchen**, **grabs the pill case** and **fills a glass of water**. In the living room**, she crawls upon the pillow**. For a while she lies there motionless. **She then licks the sleeping pill from her opened hand**.

[...] **Slowly I open my eyes**. Sunbeams burn through the thin curtains. Someone flushes the toilet. A woman cries, a man laughs loud. The usual midday sounds. **I hoist up my body, stumble to the kitchen** and **open a can**.	[...] **Slowly she opens her eyes**. Sunbeams burn through the thin curtains. Someone flushes the toilet. A woman cries, a man laughs loud. The usual midday sounds. **She hoists up her body, stumbles to the kitchen** and **opens a can.**
1st person pronoun : Mentalizing	**3rd person pronoun: Mentalizing**
[...] **The scratching just woke me up**. It's two o' clock. Never before had I heard the scratching noise during the night. My throat tightens. Rolled up I lie on the pillow. My arms come into motion. Tonight it will happen, this is the night the man has been waiting for. The neighbours have withdrawn themselves into the cocoon of sleep. **I am all by myself. It's now solely between the man and me.** [...]A truck horns in the street, the city comes back to life. The neighbours come out of their bed. **Why do I not hear anything? It's morning. It must be morning.** [...] At last, the trusted sounds of the building. **I survived the silence of the night.** I drop myself to the pillow again, pull my legs up and close my eyes. **The chains of sleep shan't disturb me no more.** [...] I lie on the pillow and roll myself up. **Why did this beast not want to share this pillow with me? Why did I have to throw the cat out just to keep this sleeping area in my own apartment?**	[...] **The scratching just woke her up**. It's two o' clock. Never before had she heard the scratching noise during the night. Her throat tightens. Rolled up she lies on the pillow. Her arms come into motion. Tonight it will happen, this is the night the man has been waiting for. The neighbours have withdrawn themselves into the cocoon of sleep. **She is all by herself. It's now solely between the man and her.** [...]A truck horns in the street, the city comes back to life. The neighbours come out of their bed. **Why does she not hear anything? It's morning. It must be morning**. [...] At last, the trusted sounds of the building. **She survived the silence of the night.** She drops herself to the pillow again, pulls her legs up and closes her eyes**. The chains of sleep shan't disturb her no more**. [...] She lies on the pillow and rolls herself up. **Why did this beast not want to share this pillow with her? Why did she have to throw the cat out just to keep this sleeping area in her own apartment?**

FMRI data analysis

At the single-subject level, statistical analysis was performed using a general linear model, in which beta weights for each regressor of interest are estimated using multiple regression analysis (Friston et al., 1995). In this model, the two regressors (*mentalizing* and *action* events) were modelled as their true durations, and then convolved with a canonical hemodynamic response function (Friston et al., 1996). The motion estimates of the motion correction algorithm (linear, quadratic and first-derivative regressors for three translations and three rotations) were included as regressors of no interest to account for head motion. As a control analysis, the same analysis was done on the data acquired while participants listened to the reversed speech fragments (baseline condition), for which the mentalizing and action regressors are meaningless.

Statistical group analysis was performed by directly contrasting one of the regressors with themselves in another condition. We contrast the two imagery tasks with each other, as well as with the baseline condition. As the listening task was always presented before the imagery tasks we refrained from statistically comparing listening and imagery to avoid confounds due to order effects. Instead, we used the statistically thresholded maps of listening to stories compared to baseline, depending on the preferred perspective of the listener (see Chapter 3) to look for shared regions between simulation depending on preferred perspective and imagery. This allowed us to focus on the similarities of Enactors with IM1 and Observers with IM3 and we were able to rule out potential dissimilarities based on strategy effects. Results were corrected for multiple comparisons by combining a voxel-wise threshold of $p<0.005$ with a cluster extent threshold (Slotnick, Moo, Segal, & Hart, 2003) of 54 voxels for the group average of the imagery tasks, and 68 voxels for the activation maps for Enactors and Observers (see Chapter 3 for details).

Results

Behavioural

We used the behavioural responses to the questionnaire following the listening task to group the participants for comprehension strategy (see Chapter 3 for details). Based on the responses to the two perspective items in the imagery questionnaire, we identified 3 groups which showed a consistent behavioural pattern across both stories. People who scored high on the question 'At times, I had the feeling of seeing right through the eyes of the protagonist' (1^{st} person perspective) for both stories were grouped in the Enactor group (N=15). People who scored high on the question 'During reading, I saw the situations in my mind as if I was an eyewitness' (3^{rd} person perspective) were grouped in the Observer group (N=14). There were two more groups with participants who scored above threshold for both items in both stories (Hypersimulators, N=12) and a group without consistent pattern (N=10), but for the purpose of the present research question, we focus on the Enactor and the Observer group only.

The behavioural data from the questionnaires after the imagery tasks was used to test whether subjects complied with the tasks. For all questionnaire items, the scale ranged from 1, (absolutely disagree) to 4 (absolutely agree). Differences between the 1^{st} and 3^{rd}

person imagery task were tested with a two way repeated measures ANOVA, see results below.

In the imagery scale, there were two contrasting items addressing the perspective directly (*'At times, I had the feeling of seeing right through the eyes of the protagonist.'* vs. '*While listening to the story, I saw the situations which were described in my head as if I was an observer*.') which we used as an indication that participants were able to do the task without problems. The separate analysis of these two items indicate that there was a significant main effect of task (IM1 vs. IM3, $F_{(1,51)}$=6.91, p<0.05, see Figure 8) and item ($F_{(1,51)}$=1.92, p<0.05). Moreover, there was a significant interaction effect between whether the task was 1st or 3rd person imagery and the two perspective specific questionnaire items ($F_{(1,51)=}$89.18, p<0.001). Paired t-tests showed that participants reported significantly higher agreement with *'At times, I had the feeling of seeing right through the eyes of the protagonist.'* after the IM1 task ($t_{(51)}$= 8.38, p<0.001, mean difference=1.17, s.d.=1.01), than after IM3. Vice versa, for '*While listening to the story, I saw the situations which were described in my head as if I was an observer*.' participants scored significantly lower for IM1 ($t_{(51)}$=-6.00, p<0.001, mean difference=-0.79, s.d.=0.81) compared to IM3. The results indicate that subjects complied with the task and were able to engage in mental imagery as instructed.

For the scorings on the *mental imagery* scale and the *emotional engagement* with the protagonist scale, there were significant main effects for imagery task ($F_{(1,51)}$=25.53, p<0.001) and scale ($F_{(1,51)}$=88.42, p<0.001) as well as a significant interaction between task and scale ($F_{(1,51)}$=46.84, p<0.001). Paired t-test showed that participants scored lower during IM3 compared to IM1 for the *emotional engagement* with the protagonist scale ($t_{(51)}$=6.54, p<0.001, mean difference=0.51, s.d.=0.56). There was no effect for the comparison of IM1 and IM3 for the *imagery* scale ($t_{(51)}$=1.35, p=0.18, mean difference=0.07, s.d.=0.36).

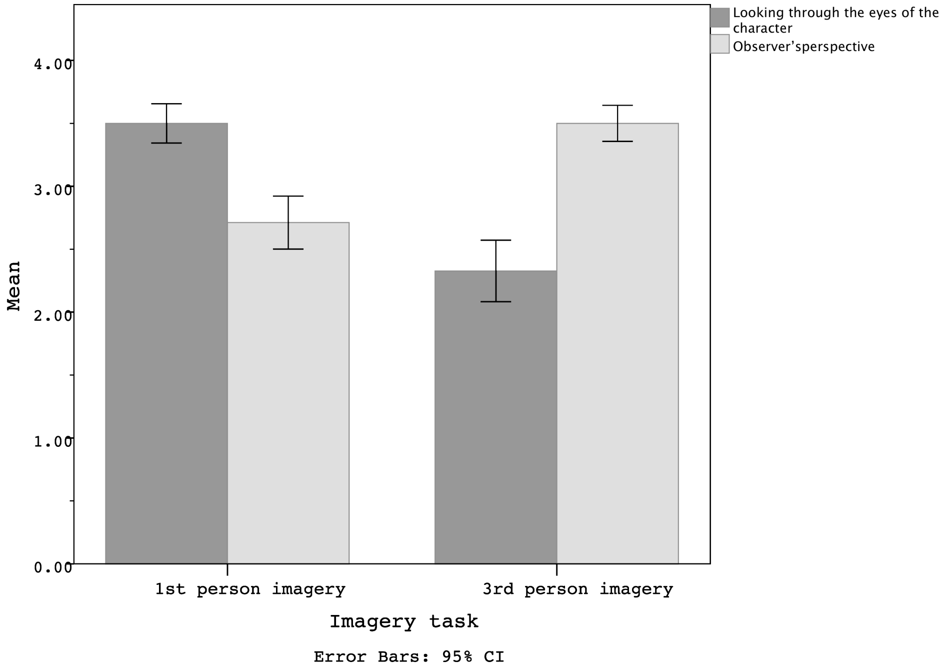

Figure 8: Results of the behavioural responses to the two perspective specific items of the imagery questionnaire during IM1 and IM3. The item measuring 1st person perspective taking was *At times, I had the feeling of seeing right through the eyes of the protagonist.* (dark grey) which showed that people show higher agreement with during the 1st person imagery task as we expected. The item measuring perspective taking from an observers view (3rd person) was *While listening to the story, I saw the situations which were described in my head as if I was an observer* (light grey) on the other hand showed higher agreement during the 3rd person imagery task. Responses were given on a 1-4 scale.

FMRI whole brain analysis

There were no significant activations when comparing IM1 and IM3 directly regardless of event type.

Action events

When looking at activations linked to action events, IM1 showed stronger activation in the right precuneus, posterior right middle temporal gyrus, and left calcarine gyrus stretching towards left cuneus (see Table 10, Figure 9) when compared to baseline. There was no overlap of activations during IM1 and activations from Enactors during the listening task, but there was some overlap between IM1 and the activations from Observers during the listening task in the right precuneus (see Figure 9).

IM3 compared to baseline on the other hand showed increased activation in a region in the anterior cingulate cortex bilaterally (see Table 10, Figure 10). There was no overlap of activated regions during IM3 with Enactors or Observers during Listening.

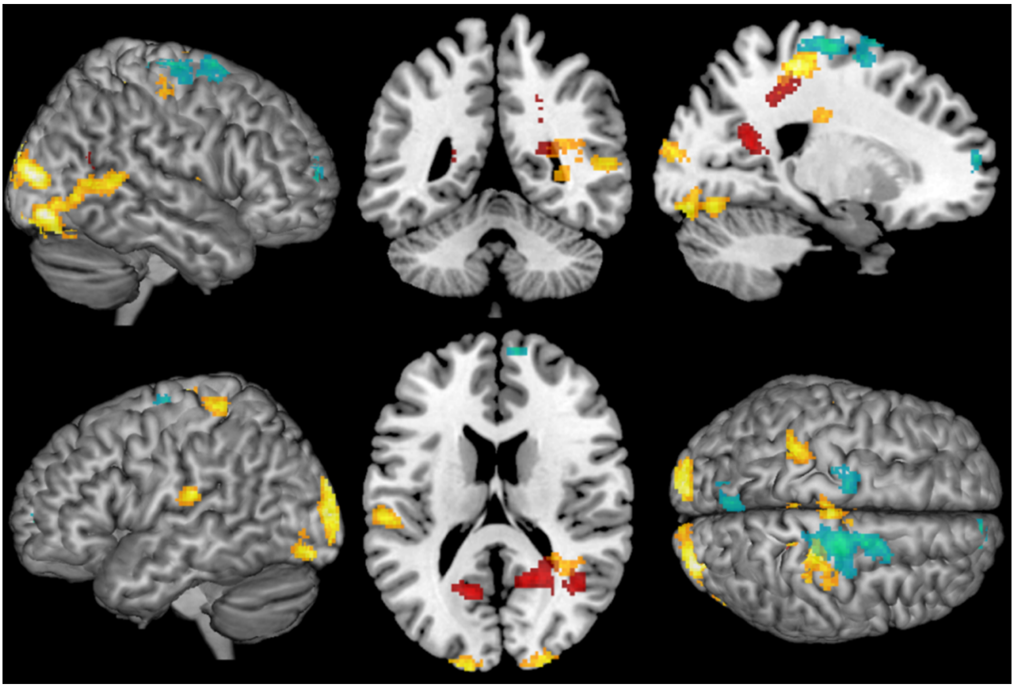

Figure 9: Activations to Action Events in 1st person Imagery (IM1; red), and Listening of Enactors (blue) and Observers (yellow), all results are displayed at $p<0.05$ corrected for multiple comparisons, and compared to baseline. No overlap of IM1 with IM3 was found in any regions.

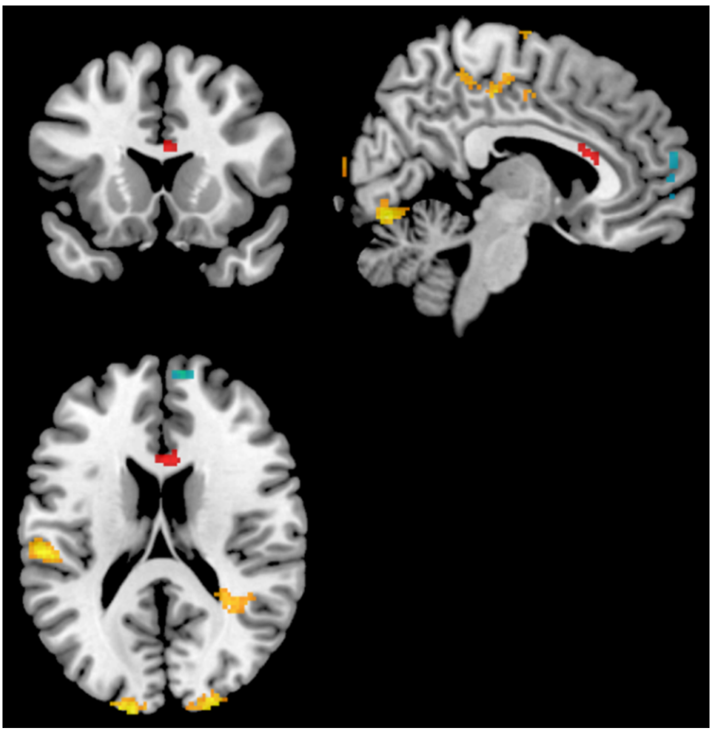

Figure 10: Activations to Action Events in 3rd person Imagery (IM3; red), and Listening of enactors (blue) & Observers (yellow), all results are displayed at $p<0.05$ corrected for multiple comparisons, and compared to baseline. No overlap of Listening with IM3 was found in any regions.

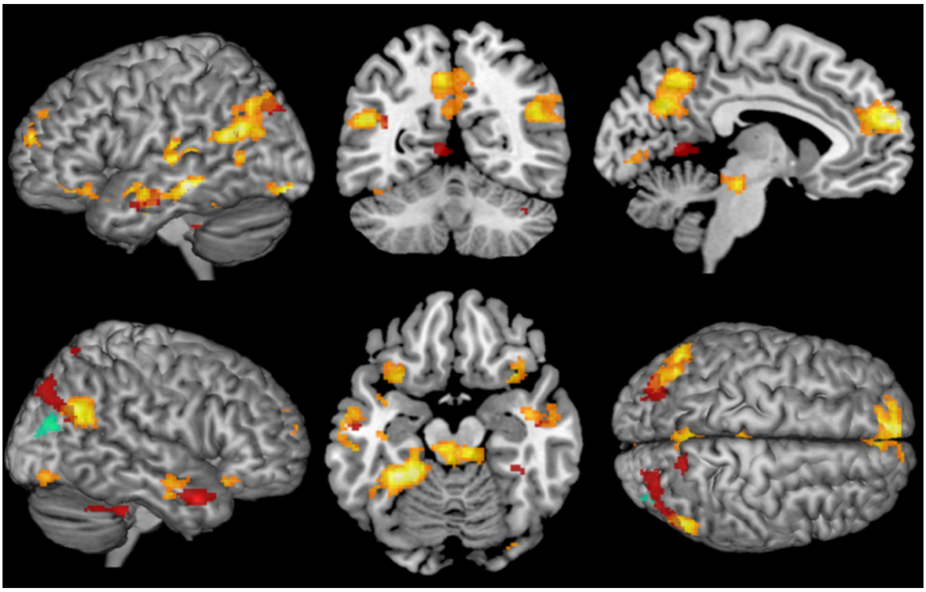

Figure 11: Activations to Mentalizing Events in 1st person Imagery (IM1; red). Acti-vations during listening without engaging in imagery by enactors (blue) and Observers (yellow), are plotted on top. All results are displayed at $p<0.05$ corrected for multiple comparisons, and compared to the baseline. There was no overlap in activations of the 1st person imagery task with enactors during comprehension. Overlap of observers during comprehension IM3 was found in left and right middle temporal gyri, left middle occipital gyrus, and right superior occipital gyrus.

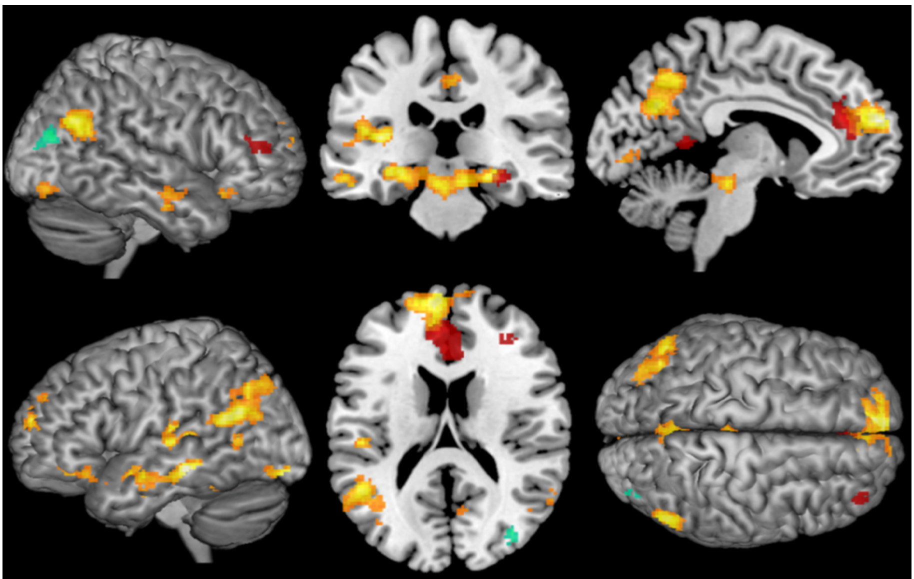

Figure 12: Activations to Mentalizing Events in 3rd person Imagery (IM3; red). Activations during listening without engaging in imagery by enactors (blue) and Observers (yellow), are plotted on top. All results are displayed at $p<0.05$ corrected for multiple comparisons, and compared to the baseline. There was no overlap in activations of the 3rd person imagery task with enactors during comprehension. Overlap of observers during comprehension and IM3 was found in left ACC.

Table10: Activations in areas associated with action events during IM1 and IM3 as compared to baseline.

	Location	equivk	T max	x	y	z {mm}
Action IM1>Baseline	R precuneus	329	3.97	22	-54	20
			3.73	14	-56	16
	L calcarine gyrus / cuneus	260	3.81	-12	-60	18
			3.4	-24	-50	10
			3.21	-32	-56	10
	R posterior middle temporal gyrus	138	3.66	38	-56	20
	R precuneus	143	3.49	18	-38	48
			3.22	20	-44	42
			2.68	20	-30	50
Action IM3>Baseline	R/L anterior cingulate cortex	60	3.28	2	20	18
			2.75	10	20	22

Table 11: Activations in areas associated with mentalizing events during IM1 and IM3 as compared to baseline.

	Location	equivk	T max	x	y	z {mm}
Mentalizing IM1 > Baseline	R anterior middle temporal gyrus	153	4.42	46	6	-28
			3.04	40	14	-26
			2.84	50	-10	-18
	L middle occipital gyrus	112	3.9	-32	-82	40
			3.02	-26	-76	36
	R cerebellum	93	3.7	30	-36	-34
			2.99	38	-52	-32
			2.81	38	-44	-34
	L posterior middle temporal gyrus / angular gyrus	71	3.57	-38	-60	18
	R superior occipital gyrus	209	3.55	44	-78	34
			3.49	30	-80	46
			3.03	26	-86	40
	L middle temporal gyrus	57	3.48	-54	-12	-22
			2.95	-54	-2	-22
	L lingual gyrus	58	3.38	-6	-58	2
	R superior parietal lobule	57	3.33	16	-64	56
			3.16	16	-64	66
	L cerebellum	58	3.24	-26	-40	-40
	R parahippocampal gyrus / fusiform gyrus	58	3.22	36	-36	-14
			2.72	30	-38	-20
Mentalizing IM3	L/R anterior cingu-	558	4	-6	42	20

> Baseline	late cortex		3.41	6	28	14
			3.36	-2	32	18
	R middle orbital gyrus	102	3.62	14	50	-6
	R parahippocampal gyrus/ fusiform gyrus	61	3.41	28	-26	-14
			2.72	30	-36	-14
	L precuneus	56	3.22	-6	-48	8
			2.81	2	-54	6
	R middle frontal gyrus	99	3.13	32	36	20
			2.89	38	48	16
			2.87	38	42	10

Mentalizing events

For the mentalizing events, we also found no difference when contrasting 1^{st} and 3^{rd} person imagery directly.

IM1 compared to baseline was associated with activations in areas in right anterior middle temporal gyrus, right parahippocampal and fusiform gyrus, right superior parietal lobule, and right superior occipital gyrus, as well as left middle, and posterior middle temporal gyrus stretching to left angular gyrus, left lingual gyrus, left middle occipital gyrus, and cerebellum bilaterally (see Table 11, Figure 11). There was some overlap of activations during IM1 with Listening in the Observer group in left and right middle temporal gyri, left middle occipital gyrus, and right superior occipital gyrus (see Figure 11).

IM3 was associated with activations in left and right anterior cingulate cortex, right middle frontal and right orbital gyrus, as well as right parahippocampal gyrus and fusiform gyrus, and left precuneus (see Table 11, Figure 12). There was some overlap of IM3 with the Observer group during Listening in the left ACC (see Figure 12).

Discussion

In the present study, we investigated functional similarities and differences of simulation during language comprehension and mental imagery in 1^{st} and 3^{rd} person perspective when people listen to literary stories. Taking individual preference in perspective taking into account, we wanted to find out if simulation activates the same or similar neural networks as imagery. To account for potential differences between different types of events, we looked into action and mentalizing events separately.

Action events

There was hardly any neural overlap between imagery and listening for comprehension regardless of perspective. We found no indication that action language comprehension is similar to imagery of action, be it from the 1^{st} or 3^{rd} person perspective, even accounting for individual preferences in comprehension strategy. The fact that we found almost no overlap of activation during simulation (listening) with mental imagery in either perspective is tentative evidence against the hypothesis that simulation and mental imagery are processes with shared neural resources. Instead, we found specializations for each perspective (1^{st} and 3^{rd}) in both imagery and simulation during comprehension. Thus, despite the conceptual similarity of action simulation and action imagery, we have evidence that these two processes differ considerably when looking into their associated neural activations (see also Willems, Toni, et al., 2010b) with perspective taking being a modulating factor.

We did not replicate previous findings on 1^{st} or 3^{rd} person perspective imagery of actions (e.g. Ruby & Decety 2001). Imagery of actions from the 1^{st} person perspective was associated with regions in right posterior middle temporal gyrus, left calcarine gyrus, left cuneus, and right precuneus, but not in motor and premotor regions. In contrast, imaging actions from 3^{rd} person perspective was associated with activation of the anterior cingulate cortex. Our data does not support a strong specialization for perspective in motor imagery. The direct comparison of action events in 1^{st} and 3^{rd} person imagery did not reveal any specific activation patterns.

Mentalizing events

We replicated previous findings on perspective taking in mentalizing during imagery (Vogeley et al., 2001), but found no significant activations when contrasting 1^{st} and 3^{rd} person imagery directly. Imaging mental states from the 1^{st} person perspective activated a wide network including regions in right anterior middle temporal gyrus, right parahippocampal and fusiform gyrus, right superior parietal lobule, as well as left middle, and posterior middle temporal gyrus, left angular gyrus, and left lingual gyrus. Imaging mental states from 3^{rd} person perspective was associated with a different set of regions, namely activation in anterior cingulate cortex, right middle frontal gyrus and right orbital gyrus, as well as right parahippocampal and fusiform gyrus, as well as left precuneus.

Regarding the relation of imagery and simulation, there was some overlap of imagery in 3^{rd} person perspective with the activations in the Observer group during Listening in the left anterior cingulate cortex. Mentalizing in comprehension therefore shares resources with 3rd person imagery and that 3rd person imagery is potentially involved in narrative comprehension.

General discussion

Action simulation during story comprehension was found to activate different areas compared to imagery in both 1st person and 3rd person perspective, even when taking comprehension preference into account. In fact, our results indicate that simulation and imagery do not share many neural resources, indicating that the underlying processes seem to be qualitatively different. Therefore, our results do not support the hypothesis that people generally engage in mental imagery during action language comprehension. In studies with similar findings (e.g. Willems, Toni, et al., 2010) it has been pointed out that the observed difference between imagery and simulation could be attributed to asymmetry in the level of detail and specificity between the tasks, e.g. reading an infinitive verb compared to motor imagery of the associated action. Because we tested this hypothesis on the level of narrative, we can rule out this potential confound.

In contrast to action events, activations during comprehension of mentalizing events partially overlapped with the activations which we found during mental imagery in 3rd person perspective. This is an indication that people do not use a 'putting yourself in the shoes of the other' strategy to understand mental states and feelings of fictional characters in narrative comprehension. This inference is based on our results indicating that not only different modalities, but also different cognitive mechanisms are involved in processing different types of event. This is in line with the findings of Wallentin and colleagues (2013), who found that emotions experienced during narrative comprehension are based on different cognitive processes for action and mentalizing events.

Although we found no evidence that imagery from 1st and 3rd person perspective rely on different networks, we do find evidence that 3rd person imagery is associated with increased activation in frontal areas linked to executive function in 3rd person imagery as suggested earlier for both mentalizing and action events (Ruby & Decety 2001; 2003). This can be taken as evidence that 3rd person perspective taking indeed requires additional resources compared to 1st person perspective (see also discussion in Chapter 2 and 3).

As we only tested two narratives, and there are limitations to our design, we have to be careful with generalizing across different types of stories and language comprehension tasks. One limitation of the present study is that both texts were originally written from a

1st person viewpoint. There is evidence that narrative style can guide mental representations, and despite our efforts to balance this confound with replacing personal pronouns referring to the protagonist in one of the narratives, we cannot exclude the possibility that other stylistic features have influenced simulation. However, given the results presented in Chapter 3 (based on the same dataset) in which we found that individual preference in comprehension strategy is much stronger than stimulus guided perspective in comprehension, we are confident to rule out this concern.

It is unclear whether the effects we found are specific for fiction comprehension. Further research is needed to determine whether the effects we found are valid for different types of narratives.

Our results provide evidence that simulation in language comprehension does not share relevant functional properties with mental imagery. We find no evidence for shared resources of simulation and imagery for action events, and therefore cannot support the idea that simulation is just a reduced form of conscious imagery. Rather, simulation and imagery seem to be two different processes. In contrast, we found tentative evidence that mentalizing in comprehension involves 3rd person imagery, when engaging with stories.

Chapter 5:

Fiction is just as real as fact: Readers do not differentiate between stories based on true or fictional events.

Abstract

Studies on fiction reading have shown that the perspective in which a story is told can influence the subjective reading experience. However, there is also evidence that readers have different preferences for immersing themselves in a story from 1^{st} or 3^{rd} person perspective regardless of narrative perspective. It is unclear whether these effects are specific for fiction reading or reflect general processes in narrative comprehension. Fiction seems to be read differently from factual texts. Experiments have shown that readers read factual texts faster than texts labelled as fiction and that readers have better memory for situations described in factual texts. Reading fictional texts on the other hand seems to improve memory for exact wordings and expressions, e.g. how something is expressed rather than the information itself. Most studies that tested for differences in reading factual and fictional texts used a 'newspaper' versus 'literature' comparison. In the present study, we investigated the effect of genre expectation on experiential aspects of reading with a more subtle 'fact versus fiction' manipulation labelling short stories as either based on true events or as fictional stories made up by the writer. In addition, we tested whether narrative perspective or individual preference in perspective taking affects reading fact or fiction differently. We tested a large and heterogeneous sample (N=2100) in an online experiment. Participants read one out of four stories in 1^{st} or 3^{rd} person perspective, which was introduced as based on true events or as fictional. After reading the story, participants filled in a questionnaire assessing their immersion in the story and an appreciation rating. Finally, participants did a picture recognition task in which they were presented with pictures of events from 1^{st} or 3^{rd} person perspective and had to decide whether the event depicted on the picture happened in the story they just read or not. Results show that the perspective from which a story is narrated can partially influence perspective taking and some experiential aspects of reading. Perspective taking during reading generally increases how much readers get immersed and how much they like the story, regardless of whether readers prefer 1^{st} or 3^{rd} person perspective. This confirms the important role of perspective in narrative comprehension. However, prior knowledge about the events of a story being real or fictional does not affect experiential aspects of reading or how fast participants read. From this null finding on the fact versus fiction manipulation we conclude that it is not the fact whether a story is true or not which influence reading behaviour, but rather expectations towards certain reading situations (e.g. reading newspaper or reading for entertainment) which activate appropriate reading goals and affect behaviour.

Introduction

We know that perspective taking is an important strategy in language comprehension especially on the level of situation models. For example, when reading a novel, readers can get immersed as if they would experience the situations from the viewpoint of the protagonist or from the viewpoint of an eyewitness who is merely observing. Narrative techniques like focalization and the use of personal pronouns or proper names referring to agents of actions are thought to guide perspective taking during comprehension and to influence how readers relate to characters in narratives (Gerrig, 1999). Indeed, recent studies showed that whether the protagonist is referred to with 1st or 3rd person pronouns can influence perspective taking and experiential aspects of reading (Chapter 2) as well as spatial memory of events (Brunyé et al., 2009; Ditman et al., 2010). People seem to align the perspective with the pronoun referring to the agent of an action meaning that they are more likely to picture an event from 1st person perspective when the event is presented with a 1st person pronoun like 'I' (Brunyé et al., 2009, but see 2011). Conversely, readers are more likely to picture an event from a 3rd person perspective when it is presented with a 3rd person pronoun like 'he' or 'she' (Brunyé et al., 2009)). Moreover, Hartung and colleagues (Hartung et al., 2016; see also van Krieken, Sanders, et al., 2015) showed that readers get more immersed when reading stories in 1st person perspective and that readers like these stories better as well. At the same time, there is evidence that individuals differ regarding their preference in perspective taking during comprehension and that this preference is stronger than the effect of pronoun referring to the protagonist (see Chapter 3).

It is unclear, whether the effects of narrative perspective and individual preference in perspective taking on reading are specific to comprehension of fictional stories. There is evidence that the subjective intensity of negative valence is weaker to fictional than to factual information, even when arousal is the same for both (Sperduti, 2016). Other studies suggest on the contrary that there is no difference in emotional response to fact and fiction (Goldstein, 2009), but rather that observed differences in emotional response to factual or fictional information are mediated by individual variation in how much participants scrutinize the information they are presented with (Green, Garst, Brock, & Chung, 2006; Wolfe & Mienko, 2007). Some accounts argue that the expectation of reading fiction triggers a genre specific reading strategy which allows us to get immersed and experience strong emotions while engaging with fiction(R. A. Mar & Oatley, 2008; Oatley, 1999b). This would mean that readers would get more immersed, and experience stronger emotions in a fictional story compared to factual stories. Other accounts argue however, that it is not the knowledge about the factuality of a narrative, but rather an engaging narrative style which is causing readers to get more immersed and to experience stronger emotions, regardless of whether the information is believed to be true or not (van Krieken, Hoeken, & Sanders, 2015; van Krieken, Sanders, et al., 2015). For instance Van Krieken and colleagues (2015) showed that when reading public reports about crimes, readers identify more with eyewitnesses and feel more present when reading a narrative eyewitness report than when reading a non-narrative report of the same event.

Research on reading behaviour and comprehension seems to argue in favour of a role for the belief whether a text is factual or fictional. For instance, Zwaan (1994) showed that knowing that a text was taken from a newspaper (factual) or a novel (fictional) influences reading behaviour and memory. In two studies he reported that texts labelled as factual were read faster compared to fictional texts (see also Altmann, Bohrn, Lubrich, Menninghaus, & Jacobs, 2014; Wolfe, 2005). Moreover, readers showed a better performance on situational memory for factual texts, but better memory for the text's surface structure for fictional texts (Zwaan, 1994).

Readers seem to use prior knowledge about the genre to systematically select criteria and strategies for comprehension linked to different reading goals (van den Broek, Lorch, Linderholm, & Gustafson, 2001; see van den Broek, Rapp, & Kendeou, 2005 for review; Zwaan, 1994). Reading goals for factual texts are to obtain information about reality (e.g. reading for study purposes or reading the news) and are thought to prompt reading strategies which emphasize connections in the text in order to reconstruct the contents (van den Broek et al., 2001). Reading for enjoyment on the other hand is associated with a stronger motivation for subjective experience and is linked to reduced scrutiny and attention to detail (R. A. Mar & Oatley, 2008; van den Broek et al., 2001; Zwaan et al., 1995). Processing of fictional and factual information also seems to be supported by different neural networks (Abraham, von Cramon, & Schubotz, 2008; Altmann et al., 2014; Han, Jiang, Humphreys, Zhou, & Cai, 2005; R. A. Mar, Kelley, Heatherton, & Macrae, 2007; Metz-Lutz, 2010). For instance, Altmann and colleagues (2014) found evidence for different neural networks involved depending on whether the text was believed to be factual or fictional. The activation pattern while reading factual texts was associated with motor areas suggesting 'an action-based [...] reconstruction of what happened' in the story' (Altmann et al., 2014, p. 26). Reading fictional stories on the other hand was associated with networks linked to social cognition and imagining possible events suggesting 'a constructive simulation of what might have happened' (ibid, p. 27).

Aim of the study

In the present study we wanted to extend the research on perspective taking and experiential effects during reading and test whether processing of perspective is affected by reader's expectations about factuality of the stories. We tested a large and diverse sample in an online experiment in which participants read a short story labelled as factual or fictional and afterwards indicated how immersed they felt during reading and how much they liked the story. In addition, we tested memory of situations in the story with a picture recognition task with pictures of events from 1st and 3rd person perspective. The overall goal was to test if perspective taking and experiential aspects of reading are influenced by reader's expectations about a text being based on true or fictional events and characters.

Hypotheses

In line with previous research (e.g. Zwaan, 1994) we expected that factual texts are read faster and result in better memory performance in the picture recognition task. At the same time, other accounts argue for a stronger role of narrative style and less influence of expectations towards factuality (van Krieken, Sanders, et al., 2015). Therefore, as an alternative hypothesis, it is also possible that factual texts in a narrative form as we used it do not show a different behavioural pattern from fictional texts.

Moreover, in line with previous research on narrative perspective, we expect that 1st person stories compared to 3rd person stories promote immersion, appreciation (Hartung et al., 2016), and mental imagery from the perspective of the protagonist (Brunyé et al., 2009). In line with Mar and Oatley (Mar & Oatley, 2008; Zunshine, 2008) we expected that people show stronger emotional engagement and are more likely to immerse with stories in 1st person. This effect might be more pronounced for fictional texts as suggested by accounts arguing for a stronger involvement in fictional narratives (R. A. Mar & Oatley, 2008; Oatley, 1999b).

Methods

Participants

All participants were naïve as to the purpose of the experiment. They gave informed consent in accordance with the declaration of Helsinki on the first screen before the experiment started by accepting the use of their data and continuing to the instructions. The study fell under the approval of the local Ethics Committee of the Social Sciences faculty of the Radboud University (Ethics Approval Number ECG2013-1308-120).

Online sample

Participants were recruited via different online sources. Advertisements for the study were posted on several blogs, websites, and Facebook or Twitter accounts specifically targeting Dutch readers interested in language, reading, and research. Examples include regional libraries, the national foundation for reading (*Stichting lezen*), a Dutch language magazine (*Taalpost*), a literature collective (*Wintertuin*), and the Max Planck Institute (MPI) websites including related pages (e.g. *www.hettaligebrein.nl*).

A total number of 2100 people participated in our study. We restricted the analysis per task to datasets from participants who completed the task and were within a reasonable time per item (<3 times the next slowest time). This means that the dropout rate increased per task in the experiment. For the first task (reading the story and fill in the immersion questionnaire) participants who took more than 5 min to read the instructions (N=5), or did not fill in the immersion questionnaire at all (N=186), or only partially (N=60), as well as participants who took more than 1.5 min on average per item to respond to the questionnaire items were excluded from the analysis. In addition, 4 more subjects who took disproportionally long (>3 times longer than the next slowest subject) to read the stories were excluded from the analysis. This adds up to a total exclusion of 257 participants for the immersion questionnaire task.

The data of 1843 subjects (1326 female, 497 male, 19 other) entered the analysis in its initial stage for the immersion questionnaire. Age varied considerably with a mean age of 51.33 years (s.d.=17.08, range=12-93 years, see Figure 13, Table 12). Most participants indicated that their highest educational level was university or technical college (specialized vocational or applied training; N=1485), but education level ranged from primary education (primair onderwijs basisschool, N=4), high school (voortgezet onderwijs, N=175), or community college (middelbaar beroepsonderwijs MBO, N=145; other forms of education N=27) to university level. Most participants (N=1651) were native speakers of Dutch. Non-native speakers (N=87) were learning Dutch on average since 24.32 years (s.d.=21.71, range=1-82 years).

For the second task (the appreciation rating), further subjects were excluded from the analysis who did not participate in the appreciation rating at all (N=28) or only partially (N=6), as well as one participant who took more than 3 times as long as the next slowest participant to complete the task. This adds up to a total additional exclusion of 35 more participants for the appreciation rating (total N=1808). For the third task (reaction time picture task), additional datasets were excluded in which participants did not complete the task (N=62), gave responses faster than 1 second on average per item (N=1) or took on average more than 2x the time the next slowest participant did (N=3), leading to a total exclusion of 66 participants (N=1742).

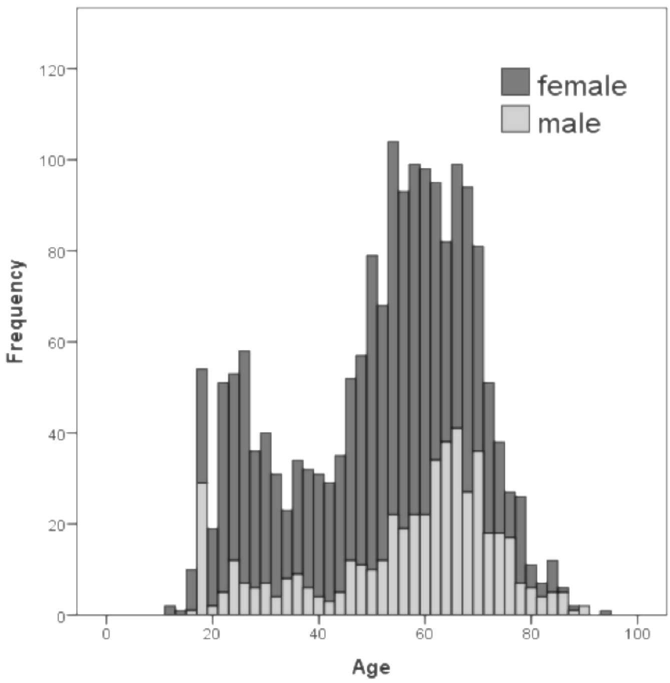

Figure 13: Distribution of age in the tested sample. Participants from 12 to 93 years participated in the study with a mean age of 51.33 years (s.d.=17.08).

Table 12: Overview over demographic data in the sample

	N	Min	Max	Mean	Std. Deviation
Age	1836	12	93	51.33	17.06
Education	1809	1	4	3.72	0.64
Do you like fiction?	1842	0	7	5.24	1.83
Do you like factual stories?	1842	0	7	5.2706	1.63
Dutch is native language	1836	1 (yes)	2 (no)	1.10	0.30
If no, years learning Dutch	87	1	82	24.32	21.71

Reference group

In order to have a reference group for identifying participants in the online sample who did not seriously participate in the experiment and to have a group with a more controlled setting for the reaction time task (picture task), we tested the experiment with a reference sample in the lab. We recruited 46 (30 female, 16 male) proficient speakers of Dutch without reading impairments via the Max Planck participant database in Nijmegen.

Participants were students between 18 and 20 years old (mean age=19.07). They were tested in a small, comfortable meeting room at the Max Planck Institute individually or in small groups (max. 3 participants) with the experimenter present in the room. Participants in the reference group were paid for compensation.

Stimuli

Stories

We used 4 short stories written by a young Dutch writer who studies creative writing (see supplementary material). Each story was used in 2 versions, one with 1st in which the protagonist is referred to with 'I' and one with 3rd person pronouns in which the protagonist is referred to with 'he' or 'she'(see Table 13 for more information). This way, we created the impression that the 1st person stories are told by the protagonist from a 1st person viewpoint whereas the 3rd person story seemed to be told about the protagonist by an invisible narrator who has access to the protagonist's thoughts. The stories were written to fit this manipulation.

Table 13: Number of words per story in both pronoun conditions.
The stories differed in the pronouns and the dependent verb forms, as well as some minor changes (1 change in Emotioneel and 3 changes in Koffiemolen) for readability (e.g. more colloquial expressions or writing conventions for 1st person stories).

Title	1st person pronoun	3rd person pronoun
Emotioneel (*Emotional*)	336	338
Meesterwerk (*Master piece*)	571	573
Koffiemolen (*Coffee mill*)	884	880
Matroesjka (*Matryoshka*)	396	396

All stories were narrated from the perspective of the protagonist with internal focalization. This means that the stories are told from the protagonist's subjective experience, see example below from the story 'Matroesjka' (full transcript of the story in the supplementary material).

[...]There is a picture in a photo book in the filing cabinet upstairs, showing all cousins sitting around grandma in similar looking blue dresses. It was taken on her birthday. Every girl looks adorably into the camera as they should. Cheese.

Except you and grandma. You're both looking naughty, as if grandma had just told you she has discovered where grandpa keeps his candy jar. Two pairs of straight noses with a small valley close to the tip, four bright blue eyes, grandmother's white hair sticking out *from under her headscarf, your mouth slightly open, no idea yet what posing means, two pairs of apple cheeks, glowing like match heads. You don't remember it, you were only three when grandma died and I recently read that you don't remember anything before the age of four. But I just don't get it, when I look at that picture I just don't get it. Grandma so beautiful, you so beautiful - you were different, extraordinary. [...]*

Immersion questionnaire

For the immersion questionnaire we used the Story World Absorption Scale (SWAS) (Kuijpers et al., 2014) with the subscales *attention*, *emotional engagement with the protagonist*, *mental imagery*, and *transportation into the story world*. We extended the subscale for mental imagery by adding two items, to account for differences depending on perspective taking: '*At times, I had the feeling of seeing right through the eyes of the protagonist*' and '*During reading, I saw the situations in my mind as if I was an eyewitness*' (see supplementary materials for details). Apart from the added items, the SWAS is a standardized measure of reading immersion with its subscales representing individual dimensions of absorption into narratives. Participants responded to the items on a 7-point scale ranging from '*I totally disagree*' (1) to '*I totally agree*' (7).

Appreciation rating

Story appreciation was measured directly after the immersion questionnaire. Participants saw ten adjectives, which correspond to empirically established dimensions of appreciation (Knoop et al., 2016). For each adjective participants indicated how much they agreed that the adjective was applicable to the story (7-point scale ranging from '*I totally disagree*' (1) to '*I totally agree*' (7)). The measure contained the following adjectives: *interesting*, *well-written*, *of high literary quality*, *easy to understand*, *accessible*, *thrilling*, *beautiful*, *fascinating*, *emotional*, and *boring*.

Picture task

For the picture task, we took photographs of situations similar to the ones described in the stories. For each story, we depicted 2 action events (16 pictures in total). Each picture was taken from both the actor's perspective (1st person) and from an observer's perspective (3rd person, see Table 14). The photos were converted into stencil like pattern drawings with *Free Picture Stencil Maker* (Patrick Roberts Software, http://online.rapidresizer.com/photograph-to-pattern.php).

Individual differences in engagement with fiction and non-fiction

We had 6 items addressing people's regular reading habits and other types of engaging with factual and fictional narratives like films or popular science books. Participants responded to the items on a 7-point scale ranging from '*not at all*'/'*never*' (1) to '*very much*'/'*daily*' (7). The 3 fiction items were: *Do you like reading fiction?*; *Do you engage with other types of fiction (e.g. movies or series, comic books, etc.)?*; *How often do you engage with fiction?*. The 3 factual items were: *Do you like reading non-fiction (stories based on true events)?*; *Do you engage with other types of non-fiction media (e.g. journal articles, science reports, (auto-) biographies, etc.)?*; *How often do you engage with non-fiction?*

Table14: Examples of picture stimuli taken from 1st and 3rd person perspective for the stories *Meesterwerk* and *Koffiemolen.*

1st person perspective	3rd person perspective
	
	

Procedure

The data for this experiment was collected online by the use of a self-contained web application and a separate data submission / reporting web service, both of which were produced with FRINEX, (framework for interactive experiments) developed at Max Planck Institute for Psycholinguistics, Nijmegen. Participant responses were collected by the web application as time series data, which were sent to the server when a connection was available. The data submission / reporting web service was run in a Java Tomcat server using a Postgres database. Communication between the web application and the server was done over a JSON / REST interface. If the connection to the server failed during this communication process then the web application stored the data and retried later in the experiment. This retry / store process could continue if required until specific points in the experiment such as the registration screen, where a successful submission was mandated before proceeding. This combination allowed users to do the experiment on desktop computers or mobile devices and in environments with periodic internet access such as when commuting.

The application flow was restricted to linear navigation with each screen being visible once in its sequence. Neither refreshing the browser nor using the browser back button would alter this linear application flow. The participant could exit the experiment at any stage; with the data from their participation having already been stored on the server provided internet access was available.

The experiment started with a screen giving an overview of the goal of the experiment. Informed consent was acquired on this page when the subjects confirmed willing to participate by button click. On the subsequent screen, information about age, gender, education level, and proficiency in Dutch was acquired. Then, participants were randomly assigned to either the Fiction or Fact condition, which prompted a different instruction screen for the two conditions:

Fact	**Fiction**
You are going to read a story written by Martin Rombouts. He is a young Dutch columnist. He writes about his everyday life, always inspired by a real event.	*You are going to read a story from Martin Rombouts. He is a young Dutch writer. He writes short fictional stories that are inspired by his imagination.*

The introduction about the factuality of the stories was the only difference between the two conditions. On the next screen, the story was presented. Each participant only read one of the stories in one version with either 1st or 3rd person pronouns referring to the protagonist. There was no time limit and participants had to click a button at the end of the page to continue with the experiment. Total reading time of the story was measured from story screen onset to button click. After participants read the story, they responded to the items of the immersion questionnaire followed by the appreciation rating. Items were presented individually per screen in random order and subjects answered on a 7-point scale ranging from ‘I totally disagree’ (=1) to ‘I totally agree’ (=7). Selecting a value on the scale prompted the next screen. After this participants were presented with the picture task. Participants saw pictures and decided whether the scene displayed on the image happened in the story they just read or not. Participants were instructed to react as fast as possible. Each participant saw all 16 pictures. Finally, participants responded to the 6 questions regarding their regular engagement with fiction and non-fiction. After these participants were debriefed and received some information about the writer and the research. Participants were given the option to sign up for receiving the results of the study. In total, the experiment took about 10 to 15 minutes.

Data analysis

The data were analysed with R, using the nlme library (Rstudio) for testing linear mixed models (Pinheiro et al., 2014). Each of the measures was analysed in a separate model with genre (fact or fiction) and pronoun (1st or 3rd person pronoun) as predictors which were allowed to interact, and story as random effect with random intercept (Baayen et al., 2008). In addition, individual differences in perspective taking, gender, age, education level, whether Dutch was native language or not, and the two mean scores for general exposure to fictional and factual stories were included as factors in the model. For the 2 models testing reaction time in the picture recognition task we also included whether the response was correct or not. Age, education level, and whether they were native speakers of Dutch were not included in the model for the reference group because of the homogeneity of the sample. P-values for specific effects were obtained by a model comparison procedure with asymptotic chi square distribution. Statistical details about all models and results can be found in the supplementary materials.

Results

Summary of results

Because of the number of measures, we first report a summary of findings, followed by statistical details per measure. We want to point out that due to our large sample size, effects with small effect sizes can become statistically significant. Here, we only report main effects and effects with effect sizes |β|>0.004. The results of the reference group are only reported for the picture task.

Whether the stories were presented as fictional or factual (genre) had no influence on how long participants spent on reading the stories, or on any of the immersion subscales. There are also no statistically significant effects for genre for any of the appreciation measures, but there was a trend suggesting that fiction stories were rated as less easy to understand than factual stories (β=-0.58, s.e.=0.31, t=-1.86, p=0.06). In sum, whether stories were presented as fictional or as factual did not influence reading experience as we measured it.

For perspective (1^{st} or 3^{rd} person pronouns), the second factor of interest, several statistically significant effects were observed. Stories in 1^{st} person showed higher scores for emotional engagement with the protagonist (β=-0.13, s.e.=6.44, t=-2.09, p<0.05) and people were more likely to engage in 1^{st} person perspective taking in 1^{st} person stories (β=-0.24, s.e.=0.11, t=-2.16, p<0.05). There was no effect of perspective on reading time, as well as the immersion subscales attention, transportation, and mental imagery. Stories in 3^{rd} person were rated as sadder (β=0.31, s.e.=0.10, t=2.97, p<0.005), and there was a statistically significant interaction between perspective and genre on this item (β=-0.31, s.e.=0.15, t=-2.13, p<0.05). In addition, there was a trend suggesting that 3^{rd} person stories were rated as less fascinating (β=-0.15, s.e.=0.09, t=-1.79, p=0.07). Otherwise, none of the appreciation measures were affected by the perspective of the story and there were no interaction effects.

Regarding individual differences, liking fiction was associated with faster reading (β=-3.31, s.e.=0.71, t=-4.64, p<0.0001), higher probability for 1^{st} person perspective taking (β=0.03, s.e.=0.01, t=2.03, p<0.05), and lower ratings on the items well written and literary (-0.03<β<-0.02, s.e.=0.01, -2.44,t<-2.21, p<0.05). High scores for both 1^{st} person perspective preference and 3^{rd} person perspective preference were associated with higher scores on all scales of the immersion questionnaire (0.24<β<0.47, 0.01<s.e.=<1.67, 14.89<t<28.91, p<0.0001) and on almost all items of the appreciation rating (0.24<β<0.47, 0.01<s.e.=<1.67, 14.89<t<28.91, p<0.0001). In addition, 1^{st} and 3^{rd} person preference were associated with lower scores on the rating whether the stories were perceived as sad. There was a small age effect throughout most measures indicating that older readers score slightly lower on the immersion scales transportation, emotional engagement, and mental imagery (-0.42<β<-0.01, 0.00<s.e.=<0.00, -4.15<t<-2.94, p<0.005). Age was negatively correlated with liking fictional texts (r=-0.16, p<0.0001, N=1792)) and positively with liking factual texts (r=0.07, p<0.05) as tested by a partial correlation analysis controlling for gender and education.

In the picture task, we observe no effect for genre or perspective. There were no differences in the reaction times to pictures associated with condition, perspective, or perspective taking preference.

Full description of results

Perspective taking

For the **1^{st} person perspective taking** questionnaire item we observe a main effect of perspective (β=-0.24, s.e.=0.11, t=-2.16, p<0.05, see Figure 14) meaning that readers are less likely to engage in 1^{st} person perspective taking when reading a story with 3^{rd} person pronouns referring to the protagonist. There is no main effect of genre (β=0.39, s.e.=0.43, t=0.91, p=0.36) and no interaction effect with perspective (β=0.15, s.e.=0.15, t=0.96, p=0.34). People who report to like fiction are more likely to engage in 1^{st} person perspective taking (β=0.03, s.e.=0.01, t=2.03, p<0.05).

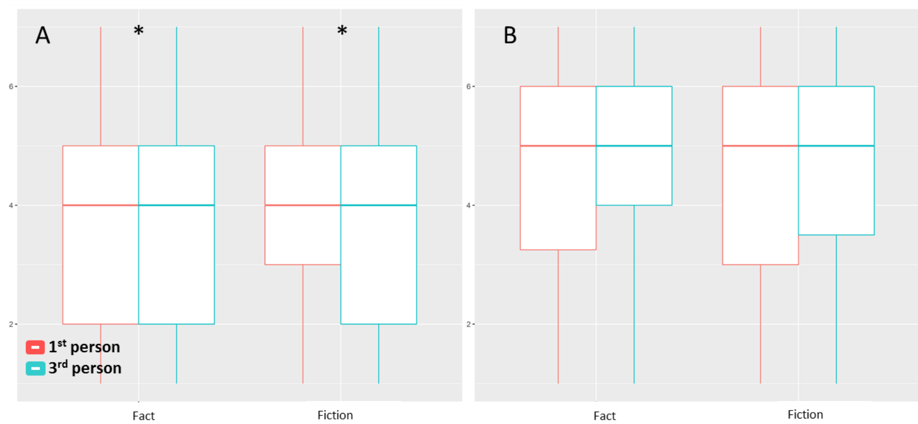

Figure 14: A=1^{st} person perspective taking, B=3^{rd} person perspective taking
There was no difference in perspective taking depending on whether the stories were presented as factual or fictional. Stories with 1^{st} person pronouns were rated significantly higher for 1^{st} person perspective taking than stories with 3^{rd} person pronouns.

For the **3^{rd} person perspective taking** questionnaire item we observe no main effect of perspective (β=-0.06, s.e.=0.11, t=-0.58, p=0.56, see Figure 14) or genre (β=0.01, s.e.=0.41, t=0.03, p=0.98), and no interaction effect (β=0.12, s.e.=0.15, t=0.81, p=0.42). Moreover, we found that older (β=-0.01, s.e.=0.00, $-4.03<t<-3.03$, $p<0.005$) and male readers ($-0.31<\beta<-0.26$, $0.08<s.e.<0.09$, $-3.77<t<-3.00$, $p<0.005$) are less likely to engage in perspective taking regardless of perspective.

Reading time

For the measure of how long participants took to read the story, there were no effects for genre (β=2.53, s.e.=21.39, t=0.12, p=0.91, see Figure 15) or perspective (β=9.17, s.e.=5.85, t=1.57, p=0. 12), and no interaction effect (β=-0.14, s.e.=8.25, t=-0.02, p=0.99). When looking at individual differences, we observe that readers for whom Dutch is the native language read faster (β=-28.60, s.e.=6.81, t=-4.20, $p<0.0001$). Liking fiction was also associated with shorter reading times (β=-3.31, s.e.=0.71, t=-4.64, $p<0.0001$).

Immersion

For the **attention** ratings, we observe no main effect of perspective (β=-0.12, s.e.=0.07, t=-1.69, p=0.09), or genre (β=0.04, s.e.=0.26, t=0.14, p=0.89), and no interaction (β=0.13, s.e.=0.10, t=1.32, p=0.19; see Figure 16). Both 1^{st} (β=0.36, s.e.=0.02, t=19.91, $p<0.0001$) and 3^{rd} (β=0.29, s.e.=0.02, t=15.70, $p<0.0001$) person perspective taking were associated with higher scores on the attention scale.

For **transportation**, there were no main effects of genre (β=0.09, s.e.=0.23, t=0.41, p=0.69) and perspective (β=-0.01, s.e.=0.06, t=-0.24, p=0.81), and no interaction (β=0.03, s.e.=0.09, t=0.34, p=0.73; see Figure 16). Both 1^{st} (β=0.42, s.e.=0.02, t=26.87, $p<0.0001$) and 3^{rd} (β=0.27, s.e.=0.02, t=16.52, $p<0.0001$) person perspective taking were associated with higher scores for transportation.

For **emotional engagement with the protagonist** we observe a main effect of perspective (β=-0.13, s.e.=0.01, t=-2.09, $p<0.05$) showing that readers are less engaged when reading a story with 3^{rd} person pronouns (β=0.01, s.e.=0.00, t=0.92, p=0.36; see Figure 16). There was no effect of genre (β=0.00, s.e.=0.0.23, t=0.13, p=0.89) and no interaction of genre and perspective. Both 1^{st} (β=0.46, s.e.=0.00, t=28.91, $p<0.0001$) and 3^{rd} person perspective taking (β=0.25, s.e.=0.00, t=14.89, $p<0.0001$) were associated with higher scores for emotional engagement with the protagonist.

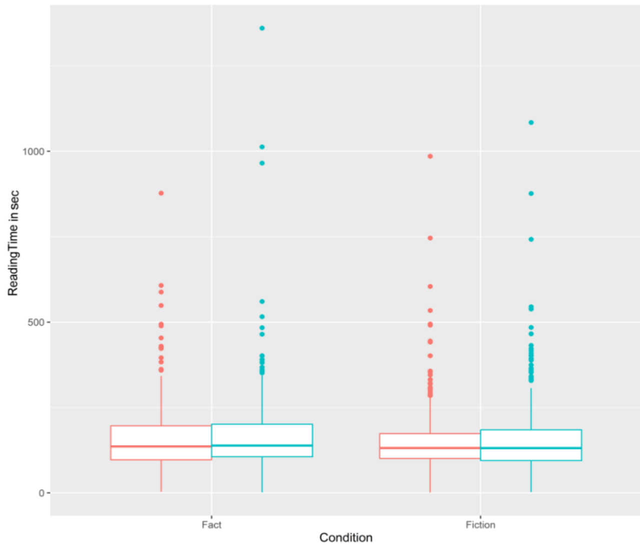

Figure 15: Time in seconds participants took to read the story. There was no difference between reading times in the fictional or factual condition, as well as no difference in reading time dependent on pronoun.

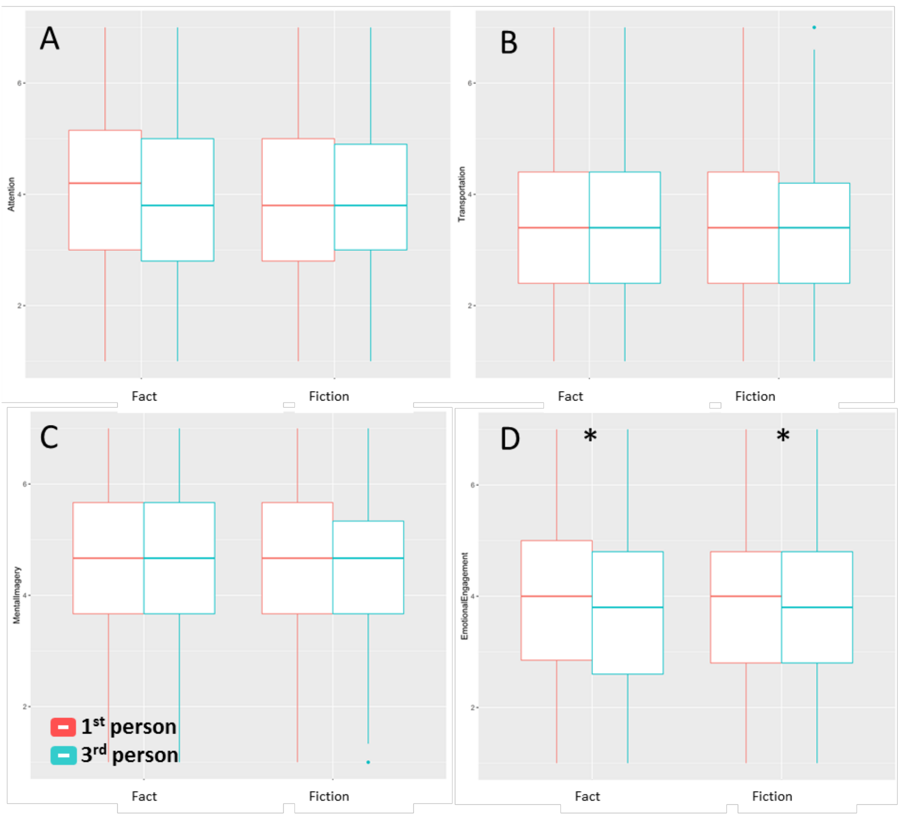

Figure 16: Immersion subscales. A=Attention, B=Transportation, C=Mental imagery, D=Emotional engagement. There was no difference in immersion depending on whether the stories were presented as factual or fictional. Stories with 1st person pronouns had significantly higher scores for attention and emotional engagement with the protagonist, but not for transportation and mental imagery during reading.

For **mental imagery**, we observe no main effect of perspective (β=0.02, s.e.=0.06, t=0.37, p=0.71) or genre (β=0.11, s.e.=0.23, t=0.46, p=0.64), and no interaction (β=-0.07, s.e.=0.09, t=-0.75, p=0.45; see Figure 16). Both 1st (β=0.30, s.e.=0.02, t=19.26, p<0.0001) and 3rd (β=0.38, s.e.=0.02, t=23.95, p<0.0001) person perspective taking were associated with higher scores for mental imagery.

Appreciation

For the rating how **interesting** the story was, we observe no main effect of perspective (β=-0.13, s.e.=0.09, t=-1.47, p=0.14) or genre (β=-0.23, s.e.=0.27, t=-0.83, p=0.41), and no interaction (β=0.02, s.e.=0.13, t=0.16, p=0.87). Both 1st (β=0.32, s.e.=0.02, t=14.17, p<0.0001) and 3rd (β=0.28, s.e.=0.02, t=11.63, p<0.0001) person perspective taking were associated with higher appreciation scores for interesting.

The rating of how **well written** the story was rated revealed no effect for perspective (β=-0.16, s.e.=0.10, t=-1.62, p =0.10) or for genre (β=-0.20, s.e.=0.29, t=-0.68, p=0.50), and no interaction (β=-0.10, s.e.=0.14, t=-0.71, p=0.48). Readers who scored high on liking fiction rated the stories as less well written (β=-0.02, s.e.=0.01, t=-2.21, p<0.05). Both 1st (β=0.30, s.e.=0.02, t=12.58, p<0.0001) and 3rd person perspective taking (β=0.30, s.e.=0.03, t=12.01, p<0.0001) were associated with higher appreciation scores for interesting.

The rating of how **literary** the stories were showed no main effect for perspective (β=0.03, s.e.=0.09, t=0.39, p=0.70) and genre (β=0.03, s.e.=0.26, t=0.12, p=0.90), and no interaction (β=-0.22, s.e.=0.13, t=-1.73, p=0.08). Both 1st (β=0.26, s.e.=0.02, t=11.70, p<0.0001) and 3rd (β=0.26, s.e.=0.02, t=11.28, p<0.0001) person perspective taking were associated with higher scores for the rating if the story was considered literary. Older readers rated the stories as less literary (β=-0.01, s.e.=0.00, t=-2.89, p<0.0001), and readers who score high on liking fictional stories rated them as less literary (β=-0.03, s.e.=0.01, t=-2.44, p<0.05). There was a significant interaction of liking fictional texts and whether the participant was in the factual or fictional condition (β=0.03, s.e.=0.01, t=2.38, p<0.05).

The rating of how **easy to understand** the stories were showed no main effect of perspective (β=-0.14, s.e.=0.10, t=-1.36, p =0.09). There was a trend for an effect of genre (β=-0.58, s.e.=0.31, t=-1.86, p=0.06) showing that readers in the fiction condition rated the stories as less easy to understand, but no interaction with perspective (β=-0.19, s.e.=0.15, t=-1.27, p=0.20). Both 1st (β=0.18, s.e.=0.03, t=6.87, p<0.0001) and 3rd person perspective taking (β=0.14, s.e.=0.03, t=5.13, p<0.0001) were associated with higher scores for easy to understand. Looking at individual differences reveals that male readers rated the stories as less easy to understand (β=-0.20, s.e.=0.08, t=-2.37, p<0.005), whereas older readers were more likely to rate the story as easy to understand (β=0.01, s.e.=0.00, t=4.81, p<0.0001). There was a main effect of educational level (β=-0.17, s.e.=0.06, t=-2.80, p<0.01) showing that readers with higher education were less likely to rate the stories as easy to understand.

For the rating on how **accessible** the stories were, we find no main effect for perspective (β=-0.10, s.e.=0.10, t=-0.99, p=0.32) and genre (β=-0.28, s.e.=0.29, t=-0.95, p=0.34), and no interaction (β=-0.09, s.e.=0.14, t=-0.65, p=0.52). Both 1st (β=0.22, s.e.=0.02, t=9.19, p<0.0001) and 3rd person perspective taking (β=0.22, s.e.=0.03, t=8.49, p<0.0001) were associated with higher scores for accessible. Older readers rated the stories as more accessible (β=0.01, s.e.=0.00, t=2.37, p<0.05).

For the rating on how **thrilling** the stories were, we find no main effect for perspective (β=-0.08, s.e.=0.09, t=-0.92, p=0.36) and genre (β=0.16, s.e.=0.28, t=0.59, p=0.56), and no interaction (β=-0.07, s.e.=0.13, t=-0.54, p=0.59). Both 1st (β=0.27, s.e.=0.02, t=11.87, p<0.0001) and 3rd person perspective taking (β=0.22, s.e.=0.02, t=9.53, p<0.0001) were associated with higher scores for thrilling. Native speakers rated the stories as less thrilling (β=-0.24, s.e.=0.11, t=-2.30, p<0.05) while older readers rated the stories as more thrilling (β=0.01, s.e.=0.00, t=4.57, p<0.0001).

For the rating on how **beautiful** the stories were, we find no main effect for perspective (β=-0.07, s.e.=0.09, t=-0.87, p=0.38) and genre (β=-0.40, s.e.=0.27, t=-1.51, p=0.13), and no interaction (β=0.02, s.e.=0.13, t=0.17, p=0.86). Both 1st (β=0.32, s.e.=0.02, t=14.21, p<0.0001) and 3rd person perspective taking (β=0.27, s.e.=0.02, t=11.35, p<0.0001) were associated with higher scores for beautiful. Older readers rated the stories as less beautiful (β=-0.01, s.e.=0.00, t=-4.01, p<0.0001).

For the rating on how **fascinating** the stories were, we observe a trend that 3rd person stories are rated as less fascinating (β=-0.15, s.e.=0.09, t=-1.79, p=0.07). There was no effect for genre (β=-0.01, s.e.=0.26, t=-0.02, p=0.98) and no interaction with perspective (β=0.01, s.e.=0.12, t=0.12, p=0.90). Again, both 1st (β=0.34, s.e.=0.02, t=15.60, p<0.0001) and 3rd person perspective taking (β=0.31, s.e.=0.02, t=13.87, p<0.0001) were associated with higher scores for fascinating.

For the rating on how **emotional** the stories were, we find no main effect for perspective (β=-0.06, s.e.=0.09, t=-0.68, p=0.49) and genre (β=-0.46, s.e.=0.28, t=-1.68, p=0.09), and no interaction (β=0.01, s.e.=0.13, t=0.05, p=0.96). Both 1st (β=0.31, s.e.=0.02, t=13.40, p<0.0001) and 3rd person perspective taking (β=0.24, s.e.=0.02, t=9.81, p<0.0001) were associated with higher scores for emotional. Male readers rated the stories as more emotional (β=0.21, s.e.=0.07, t=2.77, p<0.01). Moreover, there was a significant interaction of genre and whether readers like fiction (β=0.04, s.e.=0.01, t=2.43, p<0.05).

The rating of how **sad** the stories were revealed that 3^{rd} person stories were rated as sadder (β=0.31, s.e.=0.10, t=2.97, p<0.005). There was no main effect for genre (β=-0.02, s.e.=0.31, t=-0.07, p=0.94). However, there was an interaction effect of genre and perspective (β=-0.31, s.e.=0.15, t=-2.13, p<0.05). In contrast to all other appreciation measures 1^{st} (β=-0.24, s.e.=0.03, t=-9.26, p<0.0001) and 3^{rd} person perspective taking (β=-0.11, s.e.=0.02, t=-4.07, p<0.0001) were associated with lower scores on the rating whether the stories were perceived as sad indicating that readers who engage in perspective taking rated the stories as less sad.

Picture task

The **accuracy** rates in the picture task on **pictures depicting events from the 1^{st} person perspective** showed no effect of perspective (β=-0.02, s.e.=0.09, t=-0.22, p=0.83) or genre (β=-0.21, s.e.=0.39, t=-0.53, p=0.60), and no interaction (β=-0.07, s.e.=0.13, t=-0.52, p=0.60; see Figure 17). Readers who engaged in 1^{st} person perspective taking responded more accurate (β=0.07, s.e.=0.02, t=3.14, p<0.005), but there was no advantage for readers who engage in 3^{rd} person perspective taking (β=-0.01, s.e.=0.02, t=-0.34, p=0.74). There was a main effect of age, showing that older readers responded slightly less accurate than younger readers (β=0.00, s.e.=0.00, t=-2.11, p<0.05). In the reference group, we also did not observe main effects for perspective (β=-0.49, s.e.=0.40, t=-1.25, p=0.23) or genre (β=-3.07, s.e.=2.22, t=-1.38, p=0.21), no interaction, and also no effects for perspective taking preference (|β|<0.10, s.e.<0.13, |t|<0.89, 0.40<p<0.46<).

The **accuracy** rates in the picture task on **pictures depicting events from the 3^{rdt} person perspective** also showed no effect of perspective (β=-0.00, s.e.=0.01, t=-0.22, p=0.83) or genre (β=0.02, s.e.=0.31, t=0.59, p=0.55), and no interaction (β=-0.01, s.e.=0.01, t=-0.74, p=0.46; see Figure 17). Both 1^{st} (β=0.05, s.e.=0.02, t=2.79, p<0.01) and 3^{rd} person perspective taking (β=0.05, s.e.=0.02, t=2.56, p<0.05) were associated with better accuracy in responding to pictures in from 3^{rd} person perspective. Native speakers responded more accurately than non-native speakers (β=0.21, s.e.=0.09, t=2.41, p<0.05). Likewise, in the reference group, there were no main effects of perspective (β=-0.37, s.e.=0.29, t=-1.25, p=0.22) or genre (β=-2.34, s.e.=1.71, t=-1.36, p=0.20), and no interaction. However, there were main effects for perspective taking preference: whereas 1^{st} person perspective taking was associated with lower accuracy (β=-0.23, s.e.=0.09, t=-2.48, p<0.05), 3^{rd} person perspective taking was associated with higher accuracy (β=0.26, s.e.=0.08, t=3.22, p<0.005).

The **reaction times** towards **pictures depicting events from the 1st person perspective** showed no effect of perspective (β=131.22, s.e.=126.90, t=1.03, p=0.30) or genre (β=-737.94, s.e.=559.07, t=-1.32, p=0.19), and no interaction (β=20.52, s.e.= 179.41, t=0.11, p=0.90; see Figure 17). Moreover, there are no effects for perspective taking (1st person: β=27.75, s.e.=31.77, t=0.87, p=0.38; 3rd person: β=56.83, s.e.=33.27, t=1.71, p=0.09). There was a main effect of whether the response was correct or not (β=-139.90, s.e.=34.80, t=-4.02, p<0.0001), and a main effect of age showing that older readers responded slower (β=34.53, s.e.=2.78, t=12.42, p<0.0001). In the reference group, we also did not observe main effects for perspective (β=785.67, s.e.=503.25, t=1.56, p=0.13) or genre (β=2.96, s.e.=2799.60, t=0.001, p=1.00), and no interaction, as well as no effects for perspective taking (1st person: β=42.56, s.e.=156.71, t=0.27, p=0.79; 3rd person: β=146.65, s.e.=136.31, t=1.08, p=0.32).

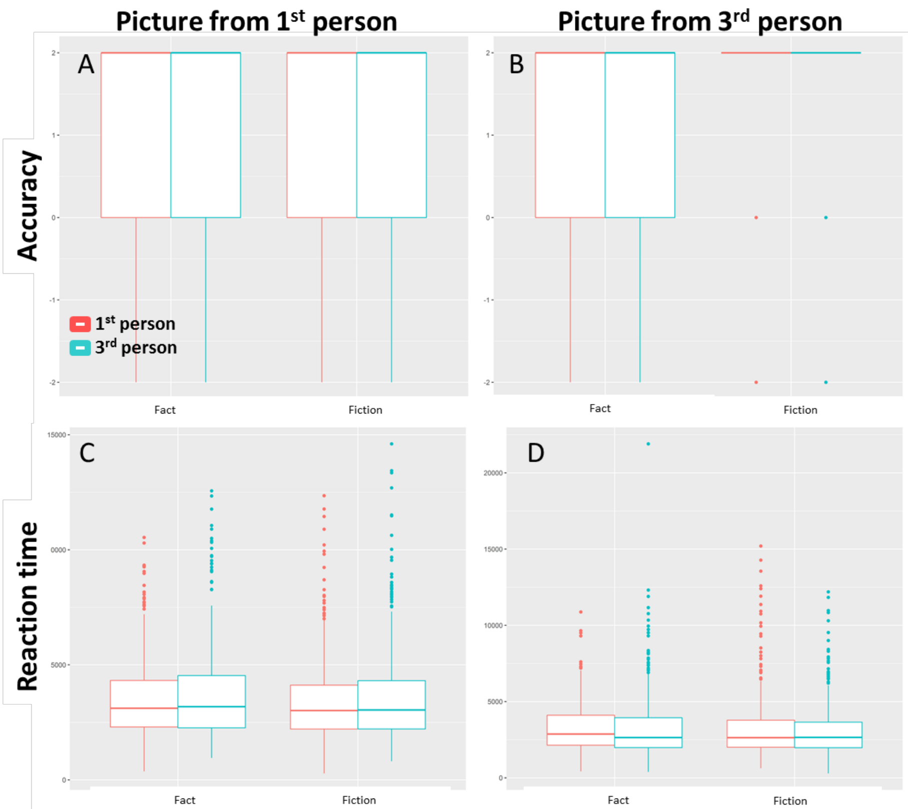

Figure 17: Accuracy and reaction times in responses to events pictured from 1st person perspective (A=accuracy, C=reaction time) and 3rd person perspective (B=accuracy, D=reaction time). There were no significant effects of genre or pronoun.

The **reaction times** towards **pictures depicting events from the 3rd person perspective** showed no effect of perspective (β=133.47, s.e.=116.92, t=1.14, p=0.25) or genre (β=-441.81, s.e.=514.98, t=-0.86, p=0.39), no interaction (β=-196.42, s.e.=165.50, t=-1.19, p=0.24; see Figure 17), and no effects for perspective taking (1st person: β=-13.13, s.e.=29.29, t=-0.45, p=0.65; 3rd person: β=45.26, s.e.=30.74, t=1.747, p=0.14). Male readers responded faster (β=-229.20, s.e.=94.89, t=-2.42, p<0.05) whereas older readers responded slower (β=30.38, s.e.=2.56, t=11.88, p<0.0001). Higher education level (β=-140.48, s.e.=67.39, t=-2.09, p<0.05) and liking fiction (β=-170.47, s.e.=43.02, t=-3.96, p<0.0001) were associated with faster reaction times. Liking factual texts on the other hand was associated with slower reaction times (β=117.51, s.e.=55.28, t=2.13, p<0.05). In the reference group, there was also no main effect of genre (β 2387.39, s.e.=1288.68, t=1.85, p=0.10) or perspective (β=19.91, s.e.=228.69, t=0.09, p=0.93), and no interaction. In addition, there were also no effects for perspective taking (1st person: β=124.78, s.e.=75.84, t=1.65, p=0.12; 3rd person: β=81.80, s.e.=67.17, t=1.22, p=0.29). Liking factual text showed a trend to be associated with slower reaction times (β=283.98, s.e.=146.40, t=1.94, p=0.07).

Discussion

In the present study, we tested the influence of personal pronouns referring to protagonists of short stories labelled as fictional or as based on true events. We measured immersion and appreciation as well as memory for events depicted in the stories with an online study reaching a broad sample of readers from all ages. We found throughout all our measures no evidence that knowing that a story is factual or fictional affects reading behaviour, experiential aspects of reading, or memory of events in the stories.

In line with previous research we found that 1st person stories facilitate 1st person perspective taking. In addition, we found that 1st person stories can lead to higher emotional engagement with the protagonist compared to 3rd person stories. However, we did not replicate earlier findings (Hartung et al., 2016) that 1st person stories generally increase immersion and are liked better by readers on any of our appreciation measures. The only appreciation measure in which we find a difference between 1st and 3rd person stories is the rating of the item ‘sad’. Here, 3rd person stories were rated as sadder than 1st person stories. Moreover, we found that people who like reading fiction generally read faster and are more likely to engage in 1st person perspective taking.

Despite not finding effects for the perspective in which the story is narrated, we find strong evidence that perspective taking influences immersion and appreciation of stories. Readers who engage in perspective taking, regardless of whether they select 1st or 3rd person perspective, report higher immersion during reading and like the stories better.

We did not replicate previously reported evidence that personal pronouns affect perspective taking of the memory representation (e.g. Brunyé et al., 2009). Instead, we found evidence that people who engage in 1st person perspective taking during reading respond more accurately to pictures from 1st and 3rd person perspective, whereas readers who engage in 3rd person perspective taking only have an advantage in responding to pictures from 3rd person perspective. We find no reaction time advantages in the picture recognition task associated with perspective taking.

Taken together, the results show that whether a story is based on a true event or not has no effect on the experiential aspects of reading that we tested here. This is in line with accounts that argue that an engaging narrative style is more important than readers' expectations about the factuality of the information. This means that readers get immersed into fiction or true stories in the same way, given that they are written in an engaging style (van Krieken, Hoeken, et al., 2015). The fact that we do not observe any difference between stories labelled as factual or fictional seems to be in contrast with previous experimental research on the effects of genre on reading behaviour which showed that factual and fictional stories are read differently (Altmann et al., 2014; Zwaan, 1994). Yet, we think that our findings are complementary rather than in contrast with previous findings. Typically, studies on genre effects used a 'newspaper' versus 'literature' labelling to manipulate readers expectations towards factuality (Zwaan, 1994). This manipulation does not only address factuality of the information, but likely is also associated with different reading contexts and goals. The manipulation we used is more subtle in a sense, because factuality was the only factor being manipulated. We can conclude that genre does not seem to matter in a sense of whether the information is factual or fictional but rather which reading goals are associated with certain contexts. Whereas the reading goals for newspaper texts and literature seem to be different, our results show that this difference is not based on knowledge about factuality. The previously reported effects might therefore be better attributed to systematic effects of reading situation rather than the factuality of the content. While expository texts like newspaper or textbooks are all about extracting relevant information in appropriate detail, narratives whether they are true or not are often about people and social knowledge. This is fully in line with the theory that readers activate the appropriate reading goals for the current situation and systematically select criteria and strategies for comprehension (van den Broek et al., 2001, see 2005 for review; Zwaan, 1994). Reading narratives clearly activates different reading goals than non-narrative texts, but factual and fictional narratives activate similar if not the same reading goals.

The finding that personal pronouns can influence some aspects of reading is in line with previous research (Hartung et al., 2016). However in contrast to the findings reported by Hartung and colleagues (Hartung et al., 2016) we found that 1st person stories compared to 3rd person stories mainly increase the probability that the reader engages emotionally with the protagonist and in 1st person perspective taking. Engaging in person perspective taking during reading in turn seems to increase immersion and appreciation across all measures, so the pronoun effect reported by earlier research is likely to be an indirect effect of perspective taking and might also vary for different stories. Future research is needed to scrutinize this finding in more detail.

Despite evidence that readers are more likely to engage in 1st person perspective imagery when reading 1st person stories, we cannot replicate the perspective effects for the picture recognition task. This could be attributed to the less controlled settings in our online study as compared to typical behavioural experiments in the lab. Yet, we also do not observe any trend for an effect in the reference group. These effects seem to be difficult to replicate (see this replication attempt of the same lab in response to a failed replication by another group: http://goo.gl/KR2Z4S). There is evidence for large individual variation in perspective taking (see e.g. Vukovic & Williams, 2015) and it is likely that individual differences have a stronger influence on memory of events than the pronoun manipulation.

There were some notable individual differences dependent on whether people like fictional or factual stories. We found that avid readers of fiction are also faster readers and are more likely to engage in 1st person perspective taking. This is in line with the notion that reading goals associated with fiction are linked to reduced scrutiny and attention to detail (Green et al., 2006).

The present study provides experimental evidence that prior knowledge about the factuality of a text does not influence reading behaviour. Rather it is assumed that reading goals associated with certain situations (and genres) influence reading behaviour. This finding could be of relevance for accounts arguing for an educational role of fiction reading in social learning (R. A. Mar & Oatley, 2008; Oatley, 1999b). We showed that that value of fiction narrative may have more to do the narrativity of the materials (the fact that they are *narratives*), compared to whether they are fiction.

Chapter 6:

General discussion

Summary of findings and implications

In this dissertation, I explored perspective as an important factor in mental simulation during language comprehension. I tested the influence of narrative perspective on experiential aspects of reading and individual preferences for perspective taking in narrative comprehension (Chapter 2, 3, and 5). In addition, I used fMRI to investigate neural network involvement associated with simulation in narrative comprehension (Chapter 3) and explored the relation between simulation and mental imagery by looking at shared neural activations (Chapter 4). Finally, I tested whether factual and fictional narratives are processed differently in terms of perspective taking and reading engagement (Chapter 5).

In Chapter 2 and 5 we found that narrative perspective can indeed influence how readers get immersed into stories. Chapter 2 also provides evidence that narrative perspective can affect enjoyment and appreciation of fiction. In addition, we found that the effect of narrative perspective on experiential aspects of reading is independent of whether narratives are fictional or factual (Chapter 5). Whether narrative perspective also affects comprehension is less clear. While we found some tentative evidence that narrative perspective influences arousal during reading (Chapter 2), we found no evidence that narrative perspective affects neural network involvement (Chapter 3) or memory performance (Chapter 5). Instead we found that individual preferences for perspective taking affect neural network recruitment (Chapter 3). When engaging with fiction, readers use 1st and 3rd person perspective taking independently from narrative perspective. However, we found some evidence that narratives in 1st person perspective can facilitate 1st person perspective taking. This suggests that there might be a relation between narrative perspective and perspective taking during comprehension (Chapter 5). In Chapter 4, we tested the long standing hypothesis that simulation during comprehension involves mental imagery of the events presented in the story. The results show that despite the fact that simulation shares some resources with mental imagery, both processes recruit different neural networks and seem to be mostly independent.

We found no evidence supporting that simulation in comprehension is enactive, that is from a 1st person perspective by default, or that 1st person perspective is preferred over 3rd person perspective (Chapter 3 and 4). Instead, perspective taking seems to comprise a set of possible comprehension modes from which readers can select according to their preference or the situation. Moreover, selecting one perspective over the other was not associated with differences in performance or experiential aspects of reading (Chapter 3 and 5). However, we found some tentative evidence that 3rd person perspective taking, is associated with increased processing loads in both comprehension (Chapter 3) and mental imagery (Chapter 4). Besides, we found that stories narrated from 3rd person perspective lead to higher arousal during reading (Chapter 2).

Taken together, the results presented in this dissertation show that perspective indeed is an important factor in simulation and situation model construction. Yet, the perspective from which the story is narrated seems not to be crucial for guiding perspective taking in narrative comprehension. Instead, readers seem to select from potential comprehension modes independent from narrative perspective. Whether this selection process is solely based on individual preferences or on situational needs is an open question for future research.

The results presented here are an important example that research should take individual preferences more seriously and try to disentangle task and strategy effects more. Yet, it is early days to draw strong conclusions from the present research. One limitation is that fiction stories are only one type of narrative, which is also associated with specific situational settings. It has been pointed out before that fiction takes a special position in communication (Mar & Oatley, 2008; Oatley, 1999). Whether the perspective (taking) effects reported here are specific to fiction or also play a role in different types of narratives remains an open question.

In the present dissertation, I investigated narrative perspective as one factor expected to influence perspective taking. However, narrative perspective as investigated here is limited to the use of personal pronouns referring to protagonists of stories. Therefore, a second limitation is that personal pronouns are only one aspect of narrative perspective and the conclusions drawn regarding narrative perspective can only account for the presented research on personal pronouns. Whether other narrative techniques like focalization or narrative viewpoint have a stronger effect compared to pronouns referring to protagonists needs to be tested. In addition, there might be other factors besides narrative style, which influence perspective taking. It is possible that social factors like how we relate to fictional characters are crucial for perspective taking. In how far simulation is affected by reader's expectations and intentions is another open question.

Future research should start to explore factors which influence perspective taking. Here, I present evidence that personal pronouns do not affect cognitive perspective taking, yet they do show an effect on how readers experience the engagement with the narrative. This finding points to a possible indirect relation of pronouns with other aspects of reading.

Whether perspective taking preferences are specific to fiction reading is beyond the scope of this dissertation. It would be interesting to see in how far these individual differences effects generalize over more interactive setting and storytelling. We have shown that the factuality of the story does not matter for narratives. However, this might be different if an actual interlocutor is telling a true or fictional story compared to reading a novel. For example, it is plausible that readers are more flexible in perspective taking with fictional characters because they are more abstract. When a real person is telling a story from his or her life I predict that readers are more likely to simulate from an observer's perspective. This might be similar for stories about well-known people.

What did we learn about the nature of simulation in language comprehension?

Simulation is suspected to play a fundamental role for language comprehension for highly contextual language such as narratives (see also discussion in Chapter 1). The results of the research presented in this dissertation indeed show that readers seem to simulate the events and situations unfolding on the pages when reading fiction. The most striking new insight is that readers seem to have certain preferences for simulating either in an enactive (1^{st} person), or observant (3^{rd} person) manner, or do both simultaneously. There is throughout all presented studies no evidence that simulation in comprehension is by default enactive, or that 1^{st} person perspective is overall preferred. Moreover, the perspective from which a story is narrated only has limited influence on perspective taking in comprehension. The finding that simulation is perspective specific might lead to the conclusion that simulation involves mental imagery. Yet, despite the conceptual similarity of simulation with imagery, we found little evidence that simulation recruits the same neural networks as imagery.

The fact that there are also readers who do not rely on only one perspective, but seem to simulate two perspectives simultaneously is surprising. It is unclear in how far this has consequences for processing demands or depth of processing compared to readers who consistently rely on one perspective. Interestingly, we found no evidence that selecting one perspective over the other affects understanding, immersion, or appreciation of the story. Neither did we find that individual differences in reading habits are linked to perspective taking preferences.

That readers rely on different strategies in simulation during fiction comprehension has been reported before. In a similar study as the one reported in Chapter 3, Nijhof and

Willems (2015) showed that some readers rely more on action simulation whereas others rely more on mentalizing. It seems that there are different simulation modes available when engaging with stories. These modes seem to affect different aspects of semantic processing (e.g. modality, perspective). It remains an open question whether these individual differences are linked to top-down expectations and in how far they are situation dependent. Either way, it is clear that individual preferences play much larger role in comprehension than assumed by previous research on simulation. Instead of trying to eliminate these factors as confounds, future research should acknowledge this variation and treat them as factors of interest. In order to gain a better understanding of natural comprehension, individual differences and context dependent variation need to be investigated more systematically. In the present dissertation, I tried to sketch such a line of research by investigating perspective in simulation in situated contexts.

In the light of the results presented here, it is clear that there is no default perspective in simulating language. Rather, 1st and 3rd person perspective seem to be equivalent modes in constructing situation models, which potentially support working memory and prediction by guiding attention. It is an open question whether preferences for one perspective over the over are stable individual traits or situation and task dependent.

A new framing of simulation

Almost two decades after 'Perceptual symbol systems' (Barsalou, 1999a) was published, there is still little consent on what simulation actually is and which role it plays in cognition. It seems to be clear that simulation is not an automatic or necessary process for comprehension at the level of individual concepts (e.g. word comprehension). Some accounts even argue that there are no stable 'core' concepts at all and that every instantiation of meaning is ad hoc (e.g. Casasanto & Lupyan, 2015; van Gelder, 1995).

Simulation cannot be reduced to modality specific concept processing. Rather simulation seems to produce multimodal and contextual dependent models which are semantically rich and flexible. It has been argued before that simulation is not equal to word level comprehension, but potentially functions as a support mechanism at the interface of concept representations from different levels and modalities (Mahon & Caramazza, 2008; Papeo et al., 2011). Instead of being restricted to modality (and effector) specific activations, simulation seems to take information from different modalities and unify them into coherent multimodal representations.

I propose that simulation functions as a semantic unification mechanism at the level of situation models. Its function is to continuously integrate information from different cognitive levels and modalities in order to maintain flexible and coherent mental models of events in real time (see Figure 18). This way, information from lower levels is restructured and reshaped into suitable chunks for episodic memory. This idea has parallels with the consecutive 'now-or-never' bottleneck model of language processing by Christiansen & Chater (2015) (see also Barsalou, n.d.). Christiansen and Chater (2015) argue that in order to deal with the 'continual deluge of linguistic input', the brain must compress and recode linguistic information on multiple levels as rapidly as possible. In order to do so, it uses recurring bottlenecks at each new representational level. These 'now-or-never' bottlenecks force the language system to compress input into increasingly abstract chunks that cover progressively longer temporal intervals and facilitate prediction to support processing (Christiansen & Chater, 2015). Discourse is the highest level of language processing, so a narrative consisting of multiple events, is the biggest possible chunk. I suggest that simulation is that bottleneck at the level of situation models, which predicts, integrates, and unifies information into one coherent chunk or rather a situation model. Only information which is relevant and consistent with the current situation model passes the bottleneck and can in this form be encoded into episodic memory.

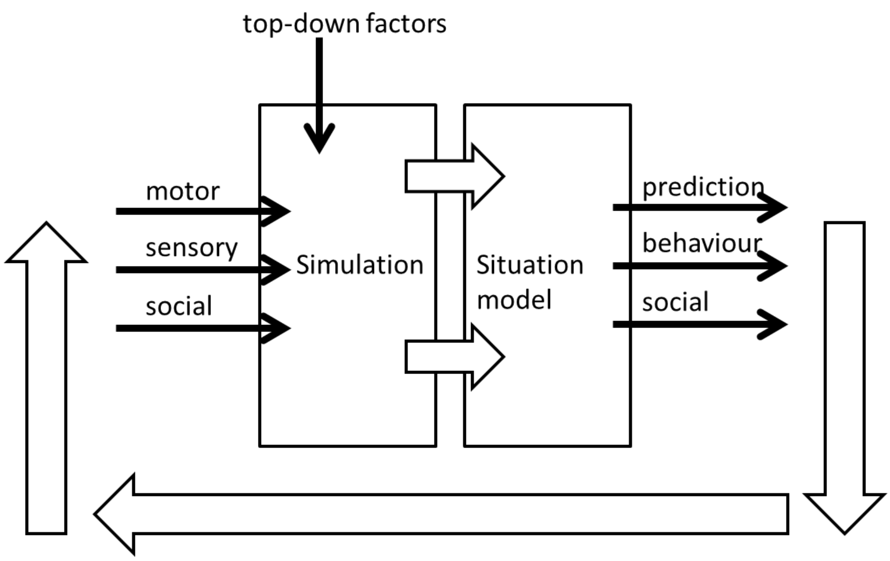

Figure 18: Simulation as a semantic unification mechanism supporting situation models. Simulations integrate information from different modalities in order to maintain flexible and coherent mental models of events in real time order to facilitate prediction and appropriate output. This way, information from lower levels is restructured and reshaped into suitable chunks for episodic memory.

Framing simulation as a mechanism which mainly supports situation models implies that simulation must be multimodal, flexible, and context sensitive. In addition, simulation must be a continuous process in which information is constantly updated with incoming input. At the level of situation models, simulation can support prediction by providing an anticipation frame (next moment will be within the scope of the current model). Following this argumentation, investigating simulation only makes sense at the level of situation models. At this level, simulation indeed seems to fulfil a more important if not necessary role for comprehension (Barsalou, 2012; Kurby & Zacks, 2013). This framing has multiple links to the situated conceptualizations model, which also highlights the relevance of simulation for other areas of cognition like social cognition, affective processes, appetitive processes, and episodic memory (Barsalou, 2015). A related idea has also been raised by Clark (2006) who proposes that language evolved as a cognitive tool which enhances cognition by creating mental models and substituting or improving perceptual input where appropriate (Dehaene, 1997; see Dehaene, Spelke, Pinel, Stanescu, & Tsivkin, 1999; Feigenson, Dehaene, & Spelke, 2004 for a similar case for numbers). Whether simulation is automatic and necessary on the level of situation models is still an open question.

While simulation can be enactive, it is not necessarily so. We have seen that comprehension can follow an enactive or observant manner and while the resulting representations of events might be different, there is no evidence that there is a difference in performance. Given the findings presented in this dissertation, simulation cannot be reduced to a subconscious and automatic form of mental imagery (Chapter 4). Instead, it seems to be an independent process, which is highly flexible in terms of perspective (and potentially modality) and there is no strong tendency towards either perspective. Yet, once a comprehension mode is selected, it seems to be applied consistently in the present situation (e.g. within a story).

It is beyond the scope of this dissertation to answer the question whether simulations are actually based on embodiment and previous interaction with the world. But maybe, research on simulation has spent too much time already trying to establish where simulations come from and if embodiment theory is wrong or right instead of exploring what simulations can do and in how far simulation is a helpful tool in cognition.

Outlook

Engaging in stories is special to humans and language. Through stories, we communicate, we transmit and preserve knowledge, and we create culture. However, the majority of experimental research on language barely looks beyond the sentence level. The two main reasons for this are: a) the common belief that effects from the laboratory easily scale up to natural situations, and b) researchers are afraid to compromise experimental control when choosing for a more natural experimental setting. Effects like that regions from the motor cortex become active when someone reads an action verb, or that we encode actions from an actor's perspective when being presented with *I am cutting tomatoes*, but from an observers perspective when being presented with *He is slicing tomatoes* are well-established experimental effects in language research. Yet, we have seen that this is not necessarily the case when these verbs and sentences are embedded in context. Language is not about cutting tomatoes or deciding whether a verb is part of the lexicon or not. Language is about people, their stories, and sharing culture. Research on language has to acknowledge that language is more than words and sentences and should continue to support the growing body of systematic research on natural language. I hope that I showed that using naturalistic and complex stimuli for linguistic experiments is viable and has relevant insights into cognitive processes which otherwise remain unexplored.

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Supplementary Material

Stories

Officina Asmara (used in Chapter 2)

It is almost dark above the Ijsseldijk near Deventer. Heavy clouds press the light of the day from the world. 'I should have taken an umbrella with me after all', ***my/his*** father said. A jogger is catching up with ***us/them*** from behind on the bike path. ***I/He am/is*** always nervous when a jogger is running behind ***me/him***. It seems to ***me/him*** that they are plotting to steal something. In the distance along the dike are the silhouettes of cattle; Galloways imported from Scotland. Some of them calved in January already. (Once, on a winter's night, ***I/he*** was walking there with a loved one about the same dike, back then white with snow. ***We/They*** passed a herd of cattle who were breathing heavily. They lay close to each other, like dark hills. Streams of breath came out of their nostrils; a train was crossing the railroad bridge towards the west behind ***us/them***. ***We/they*** were deeply moved by the gentle beasts in the snow. The spring back then brought not only flowers and fresh grass, but also foot-and-mouth disease, so that the entire group had to be culled. Now there are new ones.)

I/He offer/offers my/his father ***my/his*** cap to protect him against the first showers of rain brewing above ***us/them***, but he declines. ***We/they*** talk about news about the family of which he is the patriarch. 'Actually I think it's a mess,' he says into the wind. 'Friends of mine have large family reunions several times a year, and more grandchildren than they can remember. And what do I have; two angry daughters, and a grandson who cannot listen. Not to mention you.' He hunches down in his collar. 'A serious relationship doesn't work for you, does it?'

I/He remain***(s)*** silent. ***We/They*** turn back. As ***we/they*** arrive at ***my/his father's*** house he wants to show ***me/him*** something in the barn: an antique model of the Cutty Sark, the famous tea-clipper. The rigging is red, the wood is as decayed as a ship's at the bottom of the sea. He says: 'Don't touch, I need to refurbish it first.'

Against the wall stands a table with a chair and piles of paper around it. ***I/He ask/asks*** what he is doing with all the piles of advertisements. 'An Eritrean asylum seeker does the sorting for his paper route here,' he says. Officina Asmara. When the Dutch team is playing, he always wears his orange cap'.

'So now you're a criminal?'

Who gives a damn about the law?
Later that evening ***we/they*** sit at the kitchen table in the gray light. ***My/His*** father's face is full of shadows. ***I/He*** examine***(s)*** this dubious man, who refurbishes old ship models in his barn between piles of paper, and resolve***(s)*** to take a closer look as long as time still allows.

River (used in Chapter 2)

Two people/We walk down the flood bank to the river***, a man and a woman/my wife and I***. ***They/We*** walk through the floodplains of the Lower Rhine, which drags itself reluctantly through its bed. The grass is flattened by the rain, tufts of sheep's wool hang on the barbed wire.
After a while, ***they/we*** take a break. ***The man/I*** support(s) **my/his** hands on **my/his** knees and rest(s) in that bent position. Later ***they/we*** slowly proceed through the grass and the clay, which sticks on the soles of ***their/our*** shoe soles.
One of ***them/us*** is going to die soon. This is what the doctor told ***them/us***. ***They/We*** have been so aghast since that notice that ***they/we*** can only talk about trifles of a practical nature. Sometimes, ***he/I*** tries (try) something like: "We got pretty far, the two of us."
She would prefer it if ***he/I*** did not say such things, she thinks that it trivializes the seriousness of the matter. But she doesn't say it out loud. She nods and smiles.
Now that it has come to this, ***the man and the woman/my wife and I*** are suddenly separated from each other by different forms of loneliness; hers caused by the days she has left without **him/me**, ***his/mine*** caused by the days ***he/I*** will no longer have. In front of ***him/me*** waits an eternity that ***he/I*** will have to enter discarnate. ***He/I*** look(s) at the river, the clouds, ***his/my*** wife, and fear(s) the abyss in which philosophy and jazz no longer help. A literature quote crosses ***his/my*** mind; a line by Elias Canetti: "You're afraid of everything that does not come after death."
She thinks about the seven thousand hours in a day, the forty nine thousand days in a week, not to mention the light years of a month... She is so astonished by the time ***they/we*** spent together, just as if there would never be an end to that. So frivolous, so thoughtless. And in the back of her mind, she resents ***him/me***, and that ***he/I*** will leave her behind, alone. "The dying one takes the world along. Where to?" (Canetti, again).
In that way, ***the man and woman /my wife and I*** are walking to the river in different kinds of perpetuity.

De Mexicaanse hond (used in Chapter 2, 3, and 4)

Mr. Kuisters from the fish shop, where ***I/he*** occasionally had to pick up sliced salmon for ***my/his*** mom on Friday afternoons after school, was a tall, bony man whose face consisted mainly of wrinkles. His head with its sheer ginger quiff was jutting out over his hunched shoulders. He cut the salmon with a thin knife that was worn in the middle. He took the slices between his thumb and index finger and carefully placed them side by side. His hands were purplish red and fish scales clung to them. He always asked ***me/him*** if **I/he** wanted to play with Tonia. ***I/He*** said ***I/he*** could not, because they were sitting at home waiting for the salmon.

But one day ***I/he*** could not escape. It was busy in the shop. As soon as Mr. Kuisters saw ***me/him*** come in he opened the sliding door between the shop and the apartment a bit and said that ***I/he*** should go inside because it would take quite a while. "Tonia is home." He pushed ***my/his*** shoulder and closed the door behind ***me/him***. The room was dark and small. Tonia sat at the table staring at her hands lying in front of her on the plush tablecloth; a pale child with light, watery eyes and hair like flax. She was in ***my/his*** class and because everyone thought she not only resembled a fish, but also reeked of fish, no one wanted to play with her.

"What are you doing?" she asked. She put her hands in her lap and looked at ***me/him*** suspiciously. Her mouth was half open; her white face gleamed like it was smeared with grease.

"I have to wait here for your father."/He said that he has to wait for her father.

The furniture in the room was placed so close together that you could hardly walk without touching something. ***I/He*** shoved the chair on which ***I/he*** leaned ***my/his*** forearms as far as possible under the table, but when ***I/he*** leaned back a bit ***I/he*** felt the key of the dresser in ***my/his*** back. The space was further cramped by a huge tasseled lamp that hung like a parasol over ***our/their*** heads. On the edge of the chimney stood a black metal pendulum clock with a little naked man on top of the pendulum. He held a kind of club in one hand and with the other he pointed down to the dial. The clock ticked loudly. And ***we/they*** didn't say a word to each other. About twenty minutes later her father came in.

"Well," he said. He locked the door with a hook and changed his white coat for a brown jacket that hung on a hanger in the closet. "Now we can go peacefully about our business." He pushed a couple of chairs aside, which was the only way to get to the small table in the corner of the room. On top of the table stood an apparatus with a front plate made of black ebonite. Coils emerged out of it and it had two buttons at the bottom with a white scale.

Mr. Kuisters pressed down a lever on the side of the device, turned the knobs, put the coils in a particular position, and asked his daughter if there was a new fuse in the control box. She nodded.

"Wonderful," he said, "then we can start." He looked at his watch. "It is just the right time. Come over here." He beckoned to ***me/him***, pulled a chair closer to the table and motioned to ***me/him*** that ***I/he*** should sit there. "Move your head slightly forward." He stood behind ***me/him*** and pushed gently against ***my/his*** crown, his hands went through ***my/his*** hair. A shiver crept down ***my/his*** spine up to ***my/his*** bottom. ***I/He*** smelled a sharp fishy smell that made ***me/him*** sick. The man put a double metal strap over ***my/his*** head and pressed two black discs with holes in them over ***my/his*** ears.

"Now listen," he cried, "here it comes." He leaned forward so that his big, saggy face hung in front of ***mine/him***. I/He saw the red veins in his watery eyes and how his pupils darted back and forth - he wanted to see what ***I/he*** was hearing. An immense noise filled ***my/his*** ears, cracking, wheezing, tearing screams, long whistles, all of which suddenly merged into a furious roar that echoed through ***my/his*** whole body. Mr. Kuisters laughed. Now, that is him," he shouted, "that's the Mexican dog."

I/He tried to pull the discs from ***my/his*** ears, but he held them tight. He pressed his hand firmly on ***my/his*** head and turned one of the buttons.

"Here's HDO, the Hilversum Radio Broadcasting," someone shouted, and after a few unintelligible phrases some deafening music hit against ***my/his*** eardrums, as if ***my/his*** head was jammed in the horn of ***my/his*** father's gramophone.

After a while, Mr. Kuisters abruptly let go of the headphones. He didn't seem pleased with the outcome. Dazed, ***I/he*** remained seated in the chair.

"Move." Tonia pulled ***my/his*** arm. "It is my turn now."

With ringing ears and throbbing temples ***I/he*** got up and walked to the door. With some difficulty, ***I/he*** loosened the hook. The door rumbled back on its tracks. The fishy smell in the shop was stronger than ever. ***I/He*** only dared to breathe again once I was outside, and ***I/he*** was already half a block away before ***I/he*** noticed that ***I/he*** had forgotten the salmon.

One afternoon ***I/he*** came home from school, and while ***I/he*** hung ***my/his*** coat on the rack in the hallway, ***I/he*** heard someone talking very loudly. The sound came from the living room. There were no other voices talking. It remained a grim monologue. Presuming that there was a visitor with a very unfriendly manner of conversation, or one of ***my/his*** relatives revealing the truth about what they think of ***my/his*** family, I***/he*** gently opened the door and peeked inside.

Inside the room, ***my/his*** father and brother were standing on either side of the chimney. They had their heads slightly tilted and stared silently at the radio's speakers.
"Who is shouting?" ***I/he*** asked.
"That's Hitler," ***my/his*** father said. He gave ***me/him*** a sign to be quiet.
I/He remained there listening. It was only the first year that ***I/he*** had learned German at school, and ***I/he*** understood very little of it. ***I/He*** only understood the word "Juden", which the man uttered more and more often, in an increasingly contemptuous tone, as if he was kicking it. Even upstairs in ***my/his*** room ***I/he*** could hear his voice. His voice penetrated into every corner of the house. It even drowned out the sound of the rumbling sink faucet that ***I/he*** had opened to see whether ***I/he*** could still hear it against the running water.
I/He arranged ***my/his*** books and notebooks, but before ***I/he*** started my homework, ***I/he*** climbed up the attic stairs. ***I/He*** closed the attic door behind ***me/him***. Without switching on the light ***I/he*** walked to the middle of the room and stood still. The sound of the voice was quieter here, but still very audible, and ***I/he*** went back to ***my/his*** room and started doing ***my/his*** homework. With ***my/his*** hands over ***my/his*** ears, ***I/he*** was trying to study ***my/his*** history lesson about the Holy Alliance. ***I/He*** felt the same sensation as years before at Mr. Kuisters' when ***I/he*** had the hard discs of the headset over ***my/his*** ears and heard the sound of radio for the very first time. The Mexican dog. ***I/He*** pressed ***my/his*** hands firmly against **my/his** ears, as if ***I/he*** subconsciously felt what that voice would bring.

De muur (used in Chapter 3 and 4)

With **my/her** index finger **I/she** carefully **scratch/es** the leftover from the can. **My/her** ears register familiar sounds. The fizzing of the water in the toilets. The children's shrieks from the apartment above **my/her** head. The outside door three floors down that locks into place.
My/her old woman hands scrabble above the sink. The empty can falls on the ground and rolls with a bang against the metal trash can. My/her arm movement freezes. The man of the apartment next door must have heard the bang. The agonizing scratching will start again. Oh God, will this ever come to an end?
I lift/she lifts up **my/her** skirt, **lower/s myself/herself** to **my/her** hands and knees and **drag/s my/her** old body to the living room. **I/she need/s** to go there. Today, **I/she** will not let **myself/herself** be overtaken by fear.
For several days, the man from the apartment next door scratches on the wall. The scratching is destined for **me/her**. First and foremost, the man wants to frighten **me/her**.

He then wants to break break down the door. But this is **my/her** apartment. **I/she** won't let anybody in.
Every time the man hears **me/her** in the living room, the scratching starts. 'Do not make any more noise', is the message.
The scratching on the wall becomes more violent. The man acts as if he were a predator. He knows he can just scratch that wall without restraint, for **I/she** cannot ask a living soul for help.
I/she have/has to lure that man away from the wall. Now is the time to do so. Without any sound **I/she creep/s** towards the front door and **press/es my**/**her** eye against the round peephole. The elevator in the hallway produces a zooming sound. A woman gets out of the elevator and disappears into het apartment. A few minutes passed when **I/she** inaudibly **open/s** the door. **I/she** carefully **shuffle/s** across the hallway towards the next door. A single press on the bell. **I/she** then **run/s** back and **lock/s** the door.
The scratching stopped. The wall keeps silent. His doorbell must have caused some confusion. **I/she** did it. The trick is to distract a predator from its prey, you need to attract his attention to another part of his auditory field. A predator can only focus his hearing on one point only, it is his only weakness.
Don't make any more mistakes, do not direct his attention to the wall, be quiet as a mous. Breathe out in six counts. Without a sound **I/she shift/s my/her** body weight backwards, only thereafter **I/she move/s**. This is the secret of cats.
Until recently **I/she** lived in the house **I/she** was born on the other side of the city. Sixty years **I/she** waited there for a man. While **I/she** waited, **I/she** read the announcements in the parish magazine and watched the lottery draw on television. **I/she** read the horoscopes in the women's magazines. But no man ever appeared.
After the death of **my/her** parents **I/she** sold the house. With the money **I/she** bought this comfortable three room apartment and a Siamese cat. "The perfect companion", according to the shop assistant.
On hands and feet **I/she creep/s** to the kitchen, **grab/s** the pillcase and **fill/s** a glass of water. In the living room, **I/she crawl/s** upon the pillow. For a while **I/she lie/s** there motionless. **I/she** then **lick/s** the sleeping pill from her opened hand.

* * *

The scratching just woke **me/her** up. It's two o' clock. Never before had **I/she** heard the scratching noise during the night. **My/her** throat tightens. Rolled up **I/she lie/lies** on the pillow. **My/her** arms come into motion.

Tonight it will happen, this is the night the man has been waiting for. The neighbours have withdrawn themselves into the cocoon of sleep. **I/she** is all by **my/herself**. It's now solely between the man and **me/her**.

Away from the pillow, **(she)** mustn't remain lying on **my/her** back. He who lies on his back surrenders, even cats know that. **I/she** slowly **rise(s).**

Three minutes past two. Don't move. Count the minutes until the day breaks.

Three o' clock.

The scratching proceeded into clawing. What should **I/she** do? Cramps in **my/her** legs. Are there neighbours awake yet, or do they still wander in the soundless world of sleep. From which hour onwards will it no longer be night?

Four o'clock.

Cramped right leg. **I/she try/tries** to rely on **my/her** left leg. Not a single sound on the street. One more hour before the day breaks. Why did the scratching stop? Perhaps the man waited until fatigue numed **me/her**. Stay awake. He will not come in here.

Five o'clock.

The night is now really over. The neighbours awaken. They will hear **me/her** if **I/she cry/cries** for help. The man will take a risk if he chooses to invade **my/her** apartment at this time. Why does the morning light not penetrate through the curtains yet, what is the morning light waiting for? Most crimes are committed at five o' clock, so **I/she** read in the newspaper.

Six o' clock.

A truck horns in the street, the city comes back to life. The neighbours come out of their bed. Why **do/does I/she** not hear anything? It's morning. It must be morning.

Seven o'clock.

The elevator comes into motion with a zooming sound. Somewhere above **my/her** head a child starts crying.

"Shut up!' someone shouts.

At last, the trusted sounds of the building. **I/she** survived the silence of the night. **I/she** drop/s my/herself to the pillow again, **pull/s my/her** legs up and **close/s my/her** eyes. The chains of sleep shan't disturb **me/her** no more.

Slowly **I/she open/s my/her** eyes. Sunbeams burn through the thin curtains. Someone flushes the toilet. A woman cries, a man laughs loud. The usual midday sounds. **I/she hoist/s** up **my/her body**, **stumble/s** to the kitchen and **open/s** a can.
The elevator in the hallway produces a zooming sound. Then it stops. Don't take any risk. **I/she have/has** to know what's going on there. Carefully creep towards the door. Voices in the hallway. **My/her** right eye peeks through the small round peephole. Two neighbours.
'Look, she's standing there again; says one woman, 'you can see the shadow of her feet under the door.'
My/her gaze slides to the bare strip between the bottom of the door and the doorstep.
'She's standing there quite frequently, says the other woman, often when I take the elevator.'
'That woman frightens me', says the first woman. 'I sometimes take the stairs because I am afraid to walk to the elevator'.
'It's a scary woman', says the first woman, 'she only leaves that apartment to go out for cat food. She talks to nobody.'
'She lives there all by herself with her Siamese cat', says the first voice.
Starteled **I/she move/s** away from the door. **My/her** sharp fingernails scratch **my/her** knees. On hands and feet **I/she** silently **creep/s** to the living room. By now **I /she know/s** how to do that.
I/she lay/s on the pillow and **roll/s my/herself** up. Why did this animal not want to share this pillow with **me/her**? Why did **I/she have/had** to throw out the cat just to keep this sleeping area in **my/her** own apartment?

Matroesjka (used in Chapter 5; only 'I'-version)

'She really looks like grandma,' they said at Easter, birthdays and Pentecost, when they saw you playing in the garden. You wore the old skirts and dresses from your cousins, who looked like grandma as well, but not as much as you did. There is a picture in a photo book in the filing cabinet upstairs, showing all cousins sitting around grandma in similar looking blue dresses. It was taken on her birthday. Every girl looks adorably into the camera as they should. *Cheese*.
Except you and grandma. You're both looking naughty, as if grandma had just told you she has discovered where grandpa keeps his candy jar. Two pairs of straight noses with a small valley close to the tip, four bright blue eyes, grandmother's white hair sticking out from under her headscarf, your mouth slightly open, no idea yet what posing means, two pairs of

apple cheeks, glowing like match heads. You don't remember it, you were only three when grandma died and I recently read that you don't remember anything before the age of four. But I just don't get it, when I look at that picture I just don't get it. Grandma so beautiful, you so beautiful - you were different, extraordinary.

Yet I'm proud of you, sis. You decided to do it and did it; you lost weight like a matryoshka. But it seems like every bit of fat that disappears takes some of what defines you with it. You change. When mom and dad were away for a weekend lately, you asked for a salad at the snack bar. In the evening, you watched a movie in your room with a friend. I could hear you and him laughing through the wall. Your voice is higher nowadays.

During the most recent Easter egg hunt in grandma's - now aunt Liesbeth's - garden, you gave all the eggs you found to me. Even your favorites, the white ones containing praline.

'You can handle it,' you said, when you put them in my hands.

Before I knew it, it had slipped out: 'You have become normal, sis.'

You walked towards me and put your arms around me.

I felt how you tried to hug me, like old times. But where you used to be soft, I now felt edges, bones: your shoulders, hips, collarbones; how your ribs floated rhythmically against my chest; your bra, and how it dented.

'Thank you, brother,' you said.

Meesterwerk (used in Chapter 5; only 'he'-version)

He opened the window in the conservatory of his spacious country house by touch, with his eyes closed. He's seeing everything in red due to the blood in his eyelids. Would there be clouds? Will he recognize his feelings in the clouds? A breeze is blowing inside next to him. He sniffs. Could you smell weather? And would this be the smell of cumulus clouds? He covers his eyes with his hands and puts his feet firmer on the ground. Now he's seeing everything in black. He relaxes his shoulders then. He notices that they were tense. He breaths in. Breaths out. And when he's breathing in again, he does it: he puts his hands down and opens his eyes wide as he can.

It burns, he's only seeing white, but he continues. Until he sees everything, and closes the window again.

The phone's ringing and he feels guilty. Not because he doesn't answer the phone, but because he has been disappointed. Maybe he shouldn't have been expecting so much. But should he just take everything as it is? May he not hope?! May he not try to make the best out of each new day? He's furious and slams the window, closed by the curtain again. It's

emitting a cloud of dust. He'll let Anastasia know next time. When would she come again?
What day is it today actually?
The phone's ringing again.

- Hello, he says.
- Where are you?
- Well, he says, just where I am.
- Are you at home?
- Behind my desk.
- We had ...
- My fancy desk, not that ugly thing.
- ... We were going to meet. You wanted to talk to me today.
- Suusje, I wanted so much more for you. How could I know thay you would suddenly listen to me now?
- Aw man, not that again.
- Father, Suus. I'm your father, not your husband.
- Father. They say they havent't seen you here in weeks. That Johannes is making the decisions now.
- Johannes, he's a wise man.
- You hate Johannes.
- He could have been my son in law, Suus. Remember?
- That's ... Dad. What do you want? ... Has something happened? Are you on holiday or what...
- Suus, I became a painter.

Decisively, he hangs up the phone, and walks away from the desk. Towards the corner with the best light, close to the window. From there he takes a look at his creation displayed on the easel. He knows that the people outside think he's crazy, but whatever, let them stay outside. Their letters and numbers on paper, their culture of dialogue, their tax strategies, that's not what it's all about. This, what he's creating, that's what matters, this. White on white, on blank canvas. About the relief. Differences in height. Paint on paint on paint.
He bends over, brings his face close to the canvas until he's only seeing white. He closes his eyes and he sniffs. It smells good.

Then he turns his head and he's getting closer. He rubs the canvas with his cheek, with his beard, and using these hairs that he has never allowed himself before, he feels that it's fine. He's getting ready to add a new coat of paint.

Koffiemolen (used in Chapter 5; only 'I'-version)

There are seven coffee machines in the kitchen of my dorm in Utrecht:

- Two filter coffee machines (old) (dirty) (sticky dust layer) (nobody ever uses it) (are they still working?)
- Three percolators (small ones) (for holidays, to put it on the camping stove?) (all three spotless) (never been used?)
- A Philips *Senseo II* Senseo machine (from those days where beautiful people were acting in coffee pad commercials) (I use it)
- A Krups *Fastspresso* Nespresso machine (*What else?*) (using those little cups) (the others use it)
- and a *real* espresso machine (with a seventies look) (and a little pointer indicating the pressure or something) (you have to put the coffee in a porta filter and press it with the perfect amount of force using some big, shiny chess pawn) (according to Naut, the only one who knows how to use it).

Naut tries it on once a month or so. We're all sitting at the kitchen table in the morning, and I'm reading the newspaper, and then I grab my cup without looking and I take a sip, and it suddenly turns out to be a different kind of coffee.

I drop my newspaper and there's Naut's face: 'Shocking difference, isn't it? That trash of yours compared to an *espressolungo* made from Guatemalan Arabica beans. You taste the difference, right?'

'Yes,' I'll say, 'I do taste the difference, I just don't taste *thirty cents* of difference.', and then he'll look at me with a pitying, sorrowful kind of expression. As if I just told him that I don't believe in God, and he's picturing me burning in everlasting fire.

To make Naut happy, and to show him that I'm really not indifferent to his great love, I bought an antique-looking and loudly squeaking coffee grinder for seven euros at a flea market in Rotterdam a few weeks ago.

The salesman was asking ten euros for it, but when I told him I only had seven euros, he nodded and agreed.

It’s sometimes said that after proper negotiations both parties feel like they have swindled the other. That was definitely the case here, as he didn’t make any fuss about me paying with a twenty euro note. At home, a closer inspection of my purchase revealed that the loud squeaking and creaking was caused by a sticky layer of green mold on the mill's grinder. It would be almost impossible to remove that mold, because the only access route was the narrow slit in front of the drawer that collects the coffee.

That evening, my cousin Katinkel came round; wine, Japanese snacks, laughter, that kind of thing. When I returned to the kitchen after getting us a second bottle of Aldi-shiraz - we were going out later - I saw her staring at my failed purchase, mesmerized. She asked why I owned a coffee grinder. I briefly told her about the squeaking and creaking, and about the mold that caused it.

Katinkel listened and turned the grinder.

Sure enough, it squeaked and creaked.

Katinkel picked up a nut. ‘Can I grind a peanut?’

‘What?’ I asked.

She took the peanut out of its coating. ‘In your grinder? A peanut.’

‘Sure, whatever.’

Katinkel turned the grinder with much squeaking and creaking. After that she looked in the drawer: finely ground peanut crumbs mixed with green dots of mold. She peeled another peanut, and pulled this one through the grinder as well; then she did it again. And again, and then she used two peanuts at once. Then even three and four peanuts at the same time. And then I said I wanted to try it too.

I threw five peanuts at the same time into the grinder, without taking off their coating. It barely fit. The grinder squeaked and creaked horribly, much louder than before. Apparently, it was so loud that the sound reached Naut’s room through the kitchen ceiling, making him run down the stairs into the kitchen to see what on earth was going on. He saw me there, trying to grind Japanese rice snacks in a groaning antique coffee grinder.

‘Oh you dirty Senseo drinker,’ Naut said. You savage! You have no heart, you. I knew it.' He picked up the coffee grinder and ripped it from my hands with such force that the coffee-collecting drawer became detached from its slit and flew through the kitchen, the salty snacks crumbs mixed with mold were spread across our kitchen floor. ‘Never, I'm never making you real coffee again.’ He ran back up the stairs to his room and closed the door with a loud bang.

I tried to explain it to him - via text, Facebook, even voicemail. I told him about the mold, about the narrow slit and the conversation with the salesman. I even vacuumed all the peanut crumbs from the kitchen floor, but he still refuses to talk to me. He wrote on the bulletin board in the kitchen that he has taken the coffee grinder to keep it safe from me. Recently, when he went home for the weekend, I wanted to search his room, but it turned out that all of a sudden he was keeping his door locked. Of all the spare keys, only his was missing from the box in the closet.

I’ve hung the coffee-collecting drawer on his door handle.

Emotioneel (used in Chapter 5, ; only ‘he’-version)

His grandmother was dying, and because his mother had criticized him earlier in the evening that he wasn't in contact with his feelings, he instructed his music player to play sad music only. His music player had a special setting for that: *SensMe Emotional*; and therefore it was easy to do. He could just go on thinking, while he was waiting for the confirmatory call.

Twenty, he believed, is actually a good age to have your grandparents dying. As being fifty is the right age to have your parents dying.

During the first ten years of your life, you depend on them; they depend on you during their last ten years.

During the second ten years, you envy them (they are grown up and can do everything they like; you can't); between their last twenty and ten years (when their eyelids start sagging) they envy you.

But the ten years in between you live in harmony. They associate their happiness with your success; you give them granchildren in which they recognize their childhood photos.

Symmetry. Balance. Equality. His parents don't have to live past the age of seventy.

But what was he saying? He was in his room. He was lying on bed, looking at the moisture spots and cobwebs on the ceiling, while he was listening to the sad music as long as the wait lasted. That took longer than expected and when his mother called him it was already half past three in the morning. He was *Emotional* for at least 8 hours. He could even cry about it, and proudly weeping he thought: well done, you're in good contact with your feelings.

While the music player was still playing he fell asleep with his head on a wet pillow.

He can't tell you whether he was dreaming that night, and if so: what he was dreaming about. He doesn't remember.

But what he does know is that when he woke up the next morning, and the music player switched from *SensMe Emotional* to *SensMe Exuberant*, that his feelings didn't change back with it.

Questionnaires

Author Recognition Test (ART, Dutch version)

Instructions: Below you see a list of names, some of which are names or pseudonyms of fiction authors, some are made up. Indicate by underlining, which names are familiar to you. When you underline a wrong name, it will be substracted from your final score. Therefore, please do not guess, but only underline names, you know for sure. It is not necessary to have read works from the writers though. (Fictive names marked here in italics).

Jonathan Franzen	*Janet de Waal*
J.B. Guthrie	Dave Eggers
Marek van der Jagt	Herta Müller
Anna Blaman	*Robert Tierney*
Willem Kloos	John LeCarré
Albert Camus	W.G. Sebald
Mensje van Keulen	Herman Koch
Isabelle Liberman	*Diane Corter*
Robert Vuijsje	Esther Verhoef
Jennifer Egan	Italo Calvino
Gerald Duffy	Toni Morrison
Mark Sorenson	*Erik Bogaart*
Stephan Enter	Heleen van Royen
René Appel	Jenna Blum
Tatiana de Rosnay	Douglas Adams
William Faulkner	*Arnon Iffegem*
Saskia Noort	Isaac Asimov
Stephen King	Danielle Steel
Dimitri Verhulst	*Sophie Boomgaarden*
H.P. Vliegenthart	*Andries Blok*
Terry Pratchett	John Grisham

Immersion questionnaires

Chapter 2:

Instructions: To what degree do the following statements correspond to your feelings and experiences while reading the story? Indicate with a cross on the scale which number is representative of how well the statement describes your experience (1=not at all, 7= completely).

Attention

1. While reading the story, I lost track of time.
2. I found it difficult to stay focused.
3. My attention was so focused on the story that I forgot about the surroundings.
4. At times, I completely forgot that I was in the middle of an experiment.
5. I was so concentrated on the reading that I forgot the world around me.
6. I was immersed in the story during reading.
7. I wanted to find out how the story ended.

Mental Imagery

1. While reading, I had an image of the main character in my mind.
2. While reading, I could see images of the situations being described.
3. At times, I could see the settings/environment in which the story unfolds in my mind.
4. At times, I had the feeling that I could see right through the eyes of the main character.

Emotional Engagement

1. I felt the same as the main character.
2. I shared the emotions of the main character.
3. I knew exactly what the characters were going through emotionally.
4. I never really felt like the main character felt.
5. The story affected me emotionally.
6. I could empathize with the characters.
7. I was able to understand the events in the story in a way similar to the way the characters understood them.
8. I could easily imagine myself in the situation of some of the characters.

Transportation

1. I forgot my own problems and concerns during the story.
2. When I finished reading the story, it felt like I had travelled into the world in which the story was set.
3. While reading, it seemed as if I was inside the narrative world.

4. While reading, my body was in the room, but my mind was inside the world created by the story.
5. At times, the world of the story and reality seemed to overlap.

Narrative Understanding

1. I could easily follow the thread of the story.
2. I understood why the events unfolded the way they did.
3. At certain points, I had a hard time making sense of what was going on in the story.
4. The story flows very well.
5. I understood why the characters did what they did.
6. I could understand why the characters felt the way they felt.
7. It was difficult to understand why the characters reacted to situations as they did.

Chapter 3 and 4:

Emotional engagement items:

1. I felt the same as the protagonist.
2. I shared the emotions of the protagonist.
3. I knew exactly what the characters were going through emotionally.
4. I could empathize with the protagonist.
5. I was able to understand the events in the story in a way similar to the way the protagonist understood them.
6. I could easily imagine myself in the situation of the protagonist.
7. The story affected me emotionally.
8. I understood the feelings of the protagonist.
9. I felt with the protagonist.

Imagery items (perspective specific items in bold):

1. While listening, I had an image of the protagonist in my mind.
2. While listening to the story, I saw the situations which were described in my head as if I was in the story myself.
3. Sometimes I could see the scenery in which the story unfolds in my mind.
4. Sometimes I had to feeling to be in the setting of the story.
5. **At times, I had the feeling of seeing right through the eyes of the protagonist.**
6. **While listening to the story, I saw the situations which were described in my head as if I was an uninvolved observer.**

Chapter 5:

Attention

1. While reading the story, I lost track of time.
2. During reading, I was focused on what happened in the story
3. I was immersed in the story during reading.

4. My attention was so focused on the story that I forgot about the surroundings.

Emotional Engagement

1. I was able to understand the events in the story in a way similar to the way the characters understood them.
2. I could empathize with the characters.
3. I felt connected with the protagonist of this story.
4. I shared the emotions of the protagonist.
5. The story affected me emotionally.

Transportation

1. I forgot my own problems and concerns during the story.
2. When I finished reading the story, it felt like I had travelled into the world in which the story was set.
3. While reading, it seemed as if I was inside the narrative world.
4. While reading, my body was in the room, but my mind was inside the world created by the story.
5. At times, the world of the story and reality seemed to overlap.

Mental Imagery

1. While reading, I had an image of the main character in my mind.
2. While reading, I could see images of the situations being described.
3. At times, I could see the settings/environment in which the story unfolds in my mind.
4. At times, I had the feeling that I could see right through the eyes of the main character.

Perspective:

1. At times, I had the feeling of seeing right through the eyes of the protagonist.
2. While listening to the story, I saw the situations which were described in my head as if I was an uninvolved observer.

Thesis summary

When we read a book, we often get immersed into the story and colorful adventures unfold from the pages in our minds. At times, this can feel as if we relive the adventures through the eyes of a character and sometimes we accompany the characters as silent witnesses of their stories. But how does black ink on white paper transform to lively images in the mind? And how much does the way a story is told, e.g. from the perspective of a character or an all knowing narrator, influence how we experience it? A popular theory in cognitive science proposes that our minds can simulate what is communicated in order to create a form of experience which is similar to real events. For example, when we read about actions, parts of the sensory (sensation) and motor (action) cortex which are also involved when actually experiencing these actions can become active. This so called simulation theory proposes that when reading about events, our brains create states which are similar to the brain states when we experience such events ourselves. The main question of this thesis was how narrative perspective influences the way we simulate during reading. This question was addressed in 4 separate experiments.

In Chapter 2, I report an experiment in which I tested in how far our reading experience is influenced by the perspective from which a story is narrated. Participants read short stories, which could be either told from a 1st person perspective or from a 3rd person perspective. While participants were reading, their levels of arousal were measured with skin conductance sensors. And after each story, participants answered questions regarding their engagement with the story and the main character. The results indicated that people get more immersed into stories which are told from a 1st person perspective, but show higher arousal for stories narrated from a 3rd person perspective. While it was not surprising that readers engage more with 1st person stories and their characters, it is unclear why readers are more aroused during 3rd person stories.

In order to get a better understanding of the underlying principles, I conducted an fMRI experiment in which participants listened to stories in 1st and 3rd person perspective. In addition to asking about their narrative engagement after each story, I also asked participants whether they pictured the story from the perspective of the main character or from the perspective of an eyewitness. The results show that readers have strong preferences for the perspective from which they picture a story. Independent from the perspective from which a story is told, some readers prefer to simulate the story from the perspective of the main character, while others simulate from an observer's perspective. Some readers even reported to picture the story from both perspectives simultaneously.

In Chapter 4, I tested in how far the brain processes which are involved when we simulate during reading resemble the brain states when we are consciously imagining something. Again, participants listened to short stories while their brain activity was measured with fMRI. After listening to the stories once, the stories were presented two more times, but now participants were instructed to actively imagine the stories from the perspective of the protagonist or the perspective from an uninvolved eyewitness. Comparing brain activations from just listening to the story with imagining being the protagonist or an eyewitness revealed that despite relying on similar resources, comprehension and imagery are qualitatively different cognitive processes.

It was an open question whether the effects of increased immersion with 1st person stories are specific to fiction reading. To answer this question, I conducted a final experiment reported in Chapter 5. In an online study with more than 2000 readers, I tested whether people engage differently with a story when it is presented as based on true events or as fictional. Before reading the story, participants saw a short introduction with information about the writer and his writing style. Half of the participants were told that the writer is a columnist who writes about everyday situations which are based on true events, whereas the other half of the participants were told that the writer is a fiction writer who writes stories inspired by his vivid fantasy. Like in the other experiments in this dissertation, the stories were presented in either 1st or 3rd person perspective. After reading participants answered questions regarding their narrative engagement like in the preceding experiments. The results confirm the results reported in Chapter 2 that narrative perspective can have an effect on narrative engagement. Whether the story was presented as factual or fictional however does not seem to affect how readers get immersed into fiction.

In the final chapter, I discuss that while all experiments suggest that narrative style can influence how we experience stories, individual differences seem to be an even more important factor in predicting engagement with fiction. In addition, I propose a new model of the function of simulation in language comprehension. In contrast with previous models, my model takes factors which are subject to individual and situational variation into account (see Figure 18, page 166). As such, the model offers an explanation for variation in experimental data which formerly led to controversies. Simulation is proposed to function as a semantic unification mechanism at the level of situation models. It is predicted to support working memory by continuously integrating incoming information from multiple modalities and cognitive levels in order to reduce cognitive load by unifying information into one coherent representation. These representations are situation specific and can be integrated into episodic memory.

In summary, we have learned that getting immersed into stories and simulating experiences during reading is a very unique cognitive process. So what makes us experience stories through the eyes of the characters or and as a silent companion? Readers seem to have a set of reading modes between which they select depending on their personal preference, mood, or reading goal. While how a story is told indeed can influence how we relate to fictional characters and how we get immersed into stories, our personal preferences seem to be more important. How and why we select one mode over the other in certain situations remains an open question for future research.

Nederlandse samenvatting

Als we een boek lezen, gaan we vaak helemaal op in het verhaal en zien we alles voor ons. Soms voelt het alsof we een verhaal door de ogen van de hoofdpersoon beleven, op andere momenten staan we eerder als een stille getuige aan de zijlijn. Maar hoe kan zwarte inkt op wit papier nu zulke levendige voorstellingen oproepen? En maakt het voor onze voorstelling nog uit hoe een verhaal wordt verteld: door een ik-figuur, of door een alwetende verteller? Een bekende theorie uit de cognitieve wetenschappen stelt dat onze hersenen datgene kunnen simuleren wat we lezen. Volgens deze simulatietheorie kan onze leesbeleving dus vergelijkbaar zijn met de ervaring van echte gebeurtenissen. Als we bijvoorbeeld lezen dat iemand een bepaalde handeling uitvoert, dan worden die delen van onze sensorische cortex en motorcortex geactiveerd die normaal gesproken ook actief zijn als we deze handeling zelf uitvoeren of iemand erbij zien. De centrale vraag in dit proefschrift was hoe het vertelperspectief de simulaties die we ervaren bij het lezen, beïnvloedt. Deze vraag heb ik in vier experimenten onderzocht.

In hoofdstuk 2 beschrijf ik een experiment waarin ik onderzocht in hoeverre het vertelperspectief onze leesbeleving beïnvloedt. Proefpersonen lazen korte verhalen, die ofwel geschreven waren in de ik-figuur, ofwel vanuit het perspectief van een alwetende verteller. Terwijl de proefpersonen aan het lezen waren, werd hun mate van opwinding gemeten aan de hand van huidgeleiding. Als we emoties ervaren, krijgen we namelijk een hogere bloeddruk en gaan we meer zweten, waardoor de huid een betere geleider van elektriciteit wordt. Na het lezen van elk verhaal beantwoordden de proefpersonen ook vragen over hun leesbeleving. De resultaten lieten zien dat mensen meer opgaan in verhalen die verteld worden in de eerste persoon (ik-figuur). Deze uitkomst is niet verrassend. Wél verrassend is dat er meer opwinding te zien was bij verhalen verteld vanuit de derde persoon (alwetende verteller). Waarom dit het geval was, is nog onduidelijk.

Om de onderliggende hersenprocessen beter te begrijpen, heb ik een fMRI-studie uitgevoerd waarin de proefpersonen luisterden naar verhalen geschreven in de eerste of derde persoon. Dit is beschreven in hoofdstuk 3. Naast de leesbeleving vroeg ik de proefpersonen ook of zij zich het verhaal voorstelden vanuit het perspectief van de hoofdpersoon, of van een getuige aan de zijlijn. Het bleek dat proefpersonen een sterke voorkeur hadden voor een van beide voorstellingen. Ongeacht het vertelperspectief, gaven sommige proefpersonen er de voorkeur aan om zich het verhaal voor te stellen vanuit het perspectief van de hoofdpersoon, terwijl andere proefpersonen de voorkeur gaven aan het perspectief van de getuige. Afhankelijk van het perspectief dat een proefpersoon gebruikte, waren verschillende neurale netwerken actief. Sommige proefpersonen gaven aan zich het verhaal vanuit beide perspectieven voor te stellen. Dit was ook terug te zien in hun neurale activatie.

In hoofdstuk 4 onderzocht ik of dezelfde processen zich afspelen in de hersenen als we ons tijdens het lezen een voorstelling maken, en als we bewust proberen ons iets voor te stellen. Proefpersonen luisterden weer naar korte verhalen terwijl hun hersenactiviteit werd gemeten met fMRI. Nadat ze de verhalen één keer hadden gehoord, werden de verhalen nog twee keer afgespeeld. Daarbij werd de proefpersonen gevraagd om zich het verhaal een keer actief voor te stellen vanuit het perspectief van de hoofdpersoon, en een keer van de getuige. Een vergelijking van de drie luisterrondes liet zien dat begrijpend luisteren en actief voorstellen weliswaar wat activatie in dezelfde hersengebieden oproepen, maar dat de onderliggende cognitieve processen kwalitatief anders zijn.

Het was nog een open vraag of de observatie dat mensen meer in een verhaal opgaan als ze een verhaal in de eerste persoon lezen, alleen van toepassing is op het lezen van fictie. Om deze vraag te beantwoorden, voerde ik een laatste experiment uit, dat wordt beschreven in hoofdstuk 5. In een online experiment met meer dan 2000 proefpersonen keek ik of mensen een verhaal anders ervaren als het wordt gepresenteerd als waargebeurd of als fictief. Voordat ze het verhaal lazen, zagen de proefpersonen een korte introductie met informatie over de schrijver en zijn schrijfstijl. De helft van de proefpersonen werd verteld dat de schrijver een columnist was die over alledaagse situaties schrijft die gebaseerd zijn op waargebeurde verhalen. De andere helft van de proefpersonen werd juist verteld dat de schrijver fictie schrijft, geïnspireerd door zijn levendige fantasie. Net zoals in de andere experimenten in dit proefschrift werden de verhalen gepresenteerd in de eerste of derde persoon, en beantwoordden de proefpersonen na afloop vragen over hun leesbeleving. De resultaten bevestigen de eerdere resultaten uit hoofdstuk 2: het vertelperspectief kan onze leesbeleving beïnvloeden. Echter, of het verhaal was gepresenteerd als waargebeurd of fictief leek niet uit te maken voor de leesbeleving.

In het laatste hoofdstuk bespreek ik dat hoewel alle experimenten erop wijzen dat het vertelperspectief van invloed is op onze leesbeleving van fictieve teksten, individuele verschillen een nóg grotere invloed lijken te hebben. Ik presenteer ook een voorstel voor een nieuw model over het functioneren van simulatie bij taalbegrip. In tegenstelling tot voorgaande modellen, neemt mijn model ook factoren mee die gevoelig zijn voor individuele en situationele variatie (zie Figuur 18, blz. 165). Het model biedt zo een verklaring voor variatie in experimentele data, die voorheen tot controverse leidde. In het model wordt aan simulatie de functie toegeschreven dat het informatie uit verschillende cognitieve domeinen omvormt tot betekenisvolle mentale beelden, aangepast aan de situatie. Zo kan het model verklaren hoe nieuwe informatie uit volgende zinnen in de al bekende informatie geïntegreerd kan worden. Het model neemt aan dat simulatie het werkgeheugen ondersteunt door verschillende soorten binnenkomende informatie (bijvoorbeeld actie, sensatie, of juist abstracte informatie) in al bestaande voorstellingen te integreren, waardoor de cognitieve druk op het werkgeheugen wordt verlicht. Ook ontstaat er op deze manier één representatie van het verhaal, die dan in het episodisch geheugen kan worden opgeslagen.

Samenvattend kunnen we zeggen dat het beleven van verhalen een uniek cognitief proces is. Maar wat bepaalt nu of we ons een verhaal voorstellen vanuit het perspectief van de hoofdpersoon of de getuige? Lezers lijken meerdere manieren van lezen te hebben, waaruit ze een keuze maken afhankelijk van hun persoonlijke voorkeur, stemming, en leesdoel. Hoewel de manier waarop een verhaal wordt verteld van invloed kan zijn op onze leesbeleving, lijken onze persoonlijke voorkeuren nog belangrijker te zijn. Hoe en waarom we kiezen voor een bepaalde manier van lezen gegeven de situatie, is nog een open vraag voor toekomstig onderzoek.

Deutsche Zusammenfassung

Wenn wir Bücher lesen, tauchen wir oft völlig ein in fantastische Welten und erleben Abenteuer die sich beinahe echt anfühlen. Manchmal kommt es einem fast so vor als ob man die Geschichte direkt durch die Augen des Protagonisten erlebt. Andere male wiederum, ist man eher ein stiller Augenzeuge zu den Geschehnissen der Geschichte. Aber wie kommt es, dass aus etwas so banalem wie schwarzer Tinte auf weißem Papier solch lebendige Vorstellungen in unserem Geist entstehen? Und inwiefern verändert sich dieses Erlebnis in Abhängigkeit davon wie eine Geschichte erzählt wird? Wird unsere Leseerfahrung davon beeinflusst ob die Geschichte durch einen der Charaktere oder einem allwissenden Erzähler präsentiert wird? Eine weitverbreitete Theorie in den Kognitionswissenschaften geht davon aus, dass unsere Gehirne den Bedeutungsinhalt von Sprache während des Verstehens nachsimulieren um Erfahrungen nachzuahmen, die dem echten Erleben ähnlich sind. Wenn wir beispielsweise über Handlungen lesen, werden Gehirnareale des Motorkortexes aktiv, die auch aktiviert werden, wenn wir dieselbe Handlung ausführen oder jemanden bei dieser Handlung beobachten. Diese sogenannte Simulationstheorie besagt, dass unsere Gehirne während des Lesens über bestimmte Ereignisse, tatsächlichen Erleben nachahmen. Die zentrale Frage in dieser Dissertation war inwiefern Erzählperspektive Simulation während des Sprachverstehens beeinflusst. Anhand von 4 verschiedenen Experiment habe ich diese Forschungsfrage untersucht.

In Kapitel 2 stelle ich ein Experiment vor, indem ich getestet habe inwiefern Erzählperspektive die Leseerfahrung beeinflusst. Das Experiment bestand daraus, dass Versuchspersonen kurze literarische Geschichten lasen, die entweder aus der Perspektive des Protagonisten oder aus der Perspektive eines allwissenden Erzählers geschrieben waren. Nach jeder Geschichte wurden Fragen zur Leseerfahrung gestellt und während des Lesens wurde der Erregungszustand der Versuchsperson mittels Hautsensoren gemessen. Wenn wir zum Beispiel Emotionen erfahren, erhöhen sich Blutdruck und Schweißbildung, was als plötzlicher Kurvenanstieg sichtbar wird. Die Ergebnisse zeigen, dass Leser stärker mitfiebern bei Geschichten, die aus der ersten Person geschrieben sind, jedoch stärkere Erregbarkeit zeigen während sie Geschichten in der dritten Person lesen. Während es intuitiv scheint, dass Geschichten in der ersten Person stärker mitreißen, ist es unklar wieso Geschichten in der dritten Person zu erhöhter Erregbarkeit führen.

Um einen besseren Einblick in die zugrundeliegenden Prozesse zu bekommen, habe ich eine Studie mit funktionaler Magnetresonanztomographie (fMRT) durchgeführt, in der Versuchspersonen während der Messung literarische Geschichten aus der ersten und dritten Person gehört haben. Zusätzlich zu den Fragen nach der Leseerfahrung, wurde in diesem Experiment auch direkt danach gefragt, ob sich die Versuchsperson während des Hörens, Situationen in der Geschichte von der Perspektive des Protagonisten oder vom Standpunkt eines Augenzeugens vorgestellt hat. In den Ergebnissen wird deutlich, dass Leser starke Präferenzen für die Perspektive haben von der aus sie sich die Geschichte vorstellen. Diese ist weitestgehend unabhängig davon, von welcher Perspektive aus die Geschichte erzählt wird. Einige Leser gaben sogar an, sich die Geschichte gleichzeitig von der Perspektive des Protagonisten und der Perspektive eines Augenzeugen aus vorzustellen.

In Kapitel 4 stelle ich eine Studie von, in der ich untersucht habe inwiefern die Aktivierungsmuster während des Sprachverstehens tatsächlich den Aktivierungsmustern während sich Versuchspersonen bewusst vorstellen etwas zu erleben ähneln. Wie in der vorherigen Studie, haben Versuchspersonen Geschichten gehört, während ihre Gehirnaktivität mit fMRT gemessen wurde. Nach dem ersten hören, wurden dieselben Geschichten noch zwei weitere Male präsentiert. Hierbei wurde die Versuchsperson instruiert, sich aktiv vorzustellen die Geschichte so wie der Protagonist zu erleben oder sich genau vorzustellen wie es wäre den Protagonisten bei seinen Handlungen zu beobachten. Ein Vergleich der Aktivierungsmuster während der drei Hördurchgänge zeigt, dass außer wenigen Gemeinsamkeiten, Sprachverstehen und sich vorstellen etwas zu erleben qualitative unterschiedliche kognitive Prozesse zugrunde liegen.

Im letzten Experiment dieser Dissertation, habe ich mich der Frage gewidmet ob Effekte von Erzählperspektive und persönlicher Vorliebe für Perspektive spezifisch für das Lesen von Literatur sind. In einer Interstudie mit mehr als 2000 Teilnehmern habe ich getestet ob Geschichten anders erlebt werden, wenn der Leser glaubt die Geschichte ist frei erfunden oder beruht auf wahren Tatsachen. Bevor die Teilnehmer die Geschichte präsentiert bekamen, lasen sie einen kurzen Infotext über den vermeintlichen Autor der Geschichte und seinen Erzählstil. Die Hälfte der Teilnehmer bekam die Information, dass der Autor ein Kolumnist ist, der wahre Geschichten aus seinem Alltag erzählt, während die andere Hälfte der Teilnehmer die Information bekam, dass der Schreiber ein Literat ist, der gern fiktionale Charaktere und Situationen erfindet. Wie in den anderen Experimenten in dieser Dissertation, konnten die Geschichten entweder aus der ersten oder dritten Person erzählt sein. Nach dem Lesen, wurden Fragen nach der Leseerfahrung gestellt und ob sich der Leser die Geschichte aus der Perspektive des Protagonisten oder eines Augenzeugens vorgestellt hat. Die Ergebnisse bestätigen die Resultate der vorherigen Studien, dass

Erzählperspektive die Leseerfahrung beeinflussen kann. Ob der Leser glaubt die Geschichte sei wahr oder erfunden macht jedoch absolut keinen Unterschied für die Leseerfahrung.

Im letzten Kapitel fasse ich zusammen, dass die Resultate aus den 4 Experimenten bestätigen, dass die Art und Weise wie eine Geschichte erzählt wird, die Leseerfahrung beeinflussen kann. Jedoch wurde deutlich, dass persönliche Vorlieben ein wichtiger Faktor für das Erleben von Geschichten sind. Außerdem stelle ich ein neues Modell für die Funktion von Simulation während des Sprachverstehens vor. Anders als bei Vorgängermodellen, nimmt das neue Modell Faktoren wie Unterschiede zwischen Personen sowie jeweiligen Situationen mit in Bezug (siehe Abbildung 18 auf Seite 165) und kann dadurch ein wesentlich größeres Spektrum von natürlicher Varianz erklären was bisher zu Kontroversen geführt hat. Das Modell nimmt an, dass die Funktion von Simulation im Sprachverstehen daraus besteht, Information aus verschieden kognitiven Bereichen zu bedeutungsvollem mentalen Wissen oder Bildern zu formen, die der jeweiligen Situation angepasst sind. Damit kann es die Eigenschaften des Sprachverstehen über die Einheit des einzelnen Satzes hinaus erklären. Es wird angenommen, dass Simulation ein Mechanismus des Arbeitsgedächtnisses ist, dessen Aufgabe es ist, kontinuierlich neue Information aus verschieden Bereichen in bereits bestehende Vorstellungen zu integrieren um benötigten Arbeitsspeicher zu reduzieren und zusammengehörige Information als Gesamtheit weiterzuverarbeiten. In dieser Form kann Information dann im episodischen Gedächtnis abgelegt werden.

Zusammenfassend lässt sich sagen, dass Geschichten erleben und das nachahmen von Erfahrung ein einzigartiges kognitives Phänomen ist. Aber was genau entscheidet darüber ob wir eine Geschichte durch die Augen des Protagonisten oder als stiller Augenzeuge erleben? Es scheint als hätten Leser eine Reihe von Verschieden Lesemethoden zur Verfügung zwischen denen sie sich nach Lust und Laune oder auch Ziel des Lesens entscheiden könnten. Während die Erzählweise für das Erleben von Geschichten nicht völlig unwichtig erscheint, ist es wahrscheinlich, dass persönliche Vorlieben eine wesentlich größere Rolle spielen. Warum sich Leser eine bestimmte Lesemethode für die gegebene Situation wählen bleibt eine Frage, der sich weiter Forschung widmen sollte.

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