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Arthur M. Jacobs / Raoul Schrott

CAPTIVATED BY THE CINEMA OF THE MIND

ON TOGGLE SWITCHES, MADELEINE EFFECTS, AND DON
QUIXOTE SYNDROME DURING IMMERSION IN TEXTUAL
WORLDS

It starts spontaneously, and it keeps on as long as I keep reading. ... I have to concentrate and get involved. ... I immediately immerse myself in the reading, and the problems I usually worry about disappear. ... It starts as soon as something attracts my attention particularly, something that interests me. ... It can start wherever there is a chance to read undisturbed. ... One feels well, quiet, peaceful. ... I feel as if I belonged completely in the situation described in the book. ... I identify with the characters, and take part in what I am reading. ... I feel like I have the book stored in my mind.

Fausto Massimini, Mihaly Csikszentmihalyi, and Antonella delle Fave, "Flow and Biocultural Evolution," in Mihaly Csikszentmihalyi and Isabella Selega Csikszentmihalyi, eds, *Optimal Experience: Psychological Studies of Flow in Consciousness*. Cambridge: Cambridge University Press, 1988

So it was that as I read my point of view was transformed by the book, and the book was transformed by my point of view. My dazzled eyes could no longer distinguish the world that existed within the book

from the book that existed within the world. It was as if a singular world, a complete creation with all its colors and objects, were contained in the words that existed in the book; thus I could read into it with joy and wonder all the possibilities in my own mind.

Orhan Pamuk, *The New Life*, translated from the Turkish by Güneli Gün. New York: Farrar, Strauss and Giroux, 1997

Sitting at my desk, elbows on the page, chin on my hands, abstracted for a moment from the changing light outside and the sounds that rise from the street, I am seeing, listening to, following (but these words don't do justice to what is taking place within me) a story, a description, an argument. Nothing moves except my eyes and my hand occasionally turning a page, and yet something not exactly defined by the word 'text' unfurls, progresses, grows and takes root as I read. But how does this process take place?

Alberto Manguel, *A History of Reading*. London: HarperCollins, 1996

INTRODUCTION

These "readers' testimonies" tell of a world of images and feelings, of figures and objects, that appear to be as real as the world around us; they tell of the magic of a story that so captivates and draws us in that we forget everything around us. When people are asked about how reading (fictional) narrative texts affects them, they speak of experiences of "diving in," "immersing oneself," and "losing oneself" in a textual world. What becomes clear from the quotes above is that concentrated attention and emotional involvement play just as important a part in this process as interest, the desire to forget oneself, escapism, identification, empathy, and happiness. On the other hand, they raise of

the question of the how of the process, and the fact is that empirical science knows very little about this utterly ordinary and universal phenomenon.

In his 1988 work *Lost in a Book*, Victor Nell gave this phenomenon the name absorption (in the sense of absorbing attentiveness, demanding complete concentration), and associated it both with enjoyment in reading, which he calls ludic reading (see Anz 1998), and—like Freud—with fiction as a form of play. Other literary scholars, sociologists, and reading researchers such as Hakemulder, Green, and Gerrig speak of transportation (into textual worlds). In our book *Gehirn und Gedicht* (*Brain and Poetry*, Schrott & Jacobs 2011), we called this capacity of a particular type of reading to hold our attention immersion. The term is borrowed from Bela Balazs's film theory, as our eyes move in a similar manner to a movie camera while reading. According to Balazs, the camera "takes my eye along with it. Into the very heart of the image. I see the world from within the filmic space. I am surrounded by the figures within the film and involved in the action, which I see from all sides. ... What does it matter that I remain seated for a two-hour period in exactly the same way as in the theatre? ... My gaze, and with it my consciousness, identifies with the characters in the film. I see what they see from their standpoint. ... I travel with the crowd, I fly up, I dive down, I join the ride."

Similarly, the literary scholar Wolfgang Iser describes the act of reading as a *Mittendrin-Sein*, a state of being in the midst of things. In contrast to the normal process of perception, where we relate to an object by standing in front it, the reader occupies a vantage point as he moves through the realm of objects presented to him (Iser 1978). It is this, according to Iser, that constitutes what is specific to understanding the nature of aesthetic objects in fictional texts. The fact that a text, in

contrast to many other objects of visual perception, can never be grasped as a whole but always only as a series of distinct moments of reading—as a wandering point of view—has cognitive consequences. What has already been read fades from memory; only what has just been read is present to the mind, while what has not yet been read is anticipated in terms of what is remembered and currently being experienced. In Iser's words: "every moment of reading is a dialectic of protension and retention, conveying a future horizon yet to be occupied, along with a past (and continually fading) horizon already filled; the wandering viewing point carves its passage through both at the same time and leaves them to merge together in its wake."

TYPES OF IMMERSION

Transportation, absorption, presentness, and flow are terms used to describe immersive phenomena that have been barely examined by experimental science, and which have yet to be properly understood. Despite this, a wide variety of disciplines offer a whole series of theories that can be used to provide a hypothetical explanation. In the humanities, for example, popular theories include Lipps's classic theory of empathy (1903–1906), Ryan's virtual reality theory (2001), or Iser's triadic model of real, fictive, and imaginary fictional reception (1993) (cf. Voss 2008).

Lipps's aesthetic theory in particular has given rise to the hypothesis that reader and text "qualitatively merge into each other." The reader's empathetic investment in the text thus creates the impression that the latter is alive and has strength and energy flowing through it, so that the self, as it were, "empties itself out into a fiction" (Voss 2008). For the film and theater scholar Robin Curtis, immersion is also an aesthetic

effect, which can lead, through the animating impulse of Lipps's concept of empathy, to various possibilities of involvement, including those that lie beyond a strategy of naturalist representation. For her, it makes sense to see immersion and empathy as synonyms.

By contrast, the Dutch reading researcher Rolf Zwaan describes the processes that take place during immersive reading as extending well beyond straightforward empathy (for example, processes of inference, or of forming mental models of situations): "When readers read stories, they construct a rich mental image of the story-world. They have an idea of how it looks to the protagonist, and can move with him through this world (assuming he is familiar with this environment). In addition, the reader imagines what the protagonist's aims are, and keeps a mental account of his successful and unsuccessful attempts at achieving them. The reader often also makes causal inferences about physical events, for example when he mobilizes his knowledge about fire and water to conclude that the fire went out because someone poured water over it. Moreover, the reader draws on his rich emotional knowledge to infer that the protagonist is frustrated when he does not achieve his aim. The reader is caught in a temporal series of events in such a way that events that are nearer to us in the story-world are also easier to remember than those that happened further back in the past. Nevertheless, the phenomenological experience of immersion in a story-world extends well beyond this. When reading a story, we can 'experience' a cold wind blowing in our face, the smell of stale beer, a kiss on our lips or a hot slice of pizza in our mouth."

Ryan's book *Narrative as Virtual Reality* defines immersion as an imagined relationship with a meaning-universe in a textual world, a window onto something that exists beyond language and that extends both spatially and temporally far beyond the frame of this window.

According to her, a text must be familiar and “mimetic” to have an immersive effect, that is, it must create a virtual space with individual characters, objects, or events that a reader can relate to and participate in. This imagined world must contain temporal and spatial contours that also enable these imagined objects to be concretely visualized. Such “mimetic texts” can involve readers being “taken prisoner,” being plunged into artificial worlds (immersion), traveling in foreign lands (transportation), or losing contact with all other realities. Drawing on Gerrig’s book *Experiencing Narrative Worlds* (1993), Ryan’s analysis distinguishes between two forms of transportation: one minimal and weak, the other rich and strong. The former merely involves representing an object located concretely in space and time (for example, if you read the word “Texas,” you cannot, according to Gerrig, help but be mentally transported to Texas), while the latter involves not only thoughts about a concrete object but also about its environment, the world that surrounds it—including the idea of being inside that world oneself, in the presence of the object. Like Iser, Ryan also characterizes the strong form of transportation as “aesthetic immersion,” because it is dependent upon features of the text such as plot, narrative presentation, quality of the imagery, and style.

According to Iser, in a perspectively constructed text the reader’s wandering point of view is located in one of four perspectives: narrator, character, plot, or a fictionalized version of the reader himself (an ancillary perspective, which reflects the reader’s own frame of reference and largely serves to delineate his attitude to the narrated events). The quality of these features and (shifting) perspectives makes a crucial contribution to the enjoyment of reading, and with it to the aesthetic aspect of immersion. According to Iser, changes of perspective can follow the Gestalt psychology concept of the law of good continuation

if the “felt and expected relationship” between successive sentence correlates is a given. However, they can also interrupt fluent reading’s “effortless stream of sentence thinking” if an unexpected twist in the plot upsets the immersion of the moment.

Moreover, Ryan distinguishes between four different degrees in intensity of transportation during reading: i) concentration, that is, the type of attention given to nonimmersive texts, which is still highly vulnerable to the distracting stimuli of external reality; ii) imaginative involvement, a form of “split subject” attentiveness which transports the reader into the textual world while still allowing a detached contemplation of it from an aesthetic or epistemological point of view; iii) entrancement, a nonreflexive enjoyment of reading which completely absorbs the reader, causing him to forget the aesthetic qualities of the author’s work as well as the (logical) truth-value of its statements; it allows him to forget he is reading a text, without forgetting that the world of the text is not reality; and iv) addiction, a kind of compulsive reading aimed at escaping reality, which can also lead one to lose touch with reality itself, something Ryan calls the “Don Quixote Syndrome.”

In the triadic model of fictional reception outlined in Iser’s 1993 book, he gives special emphasis to the imaginary, which he sees as a capacity to make manifest the latent structures of meaning available in the text, and central to which is an active process of filling out the imagined meaning gestalt (by including what is systematically left out). In this process, the reader uses imaginative divergences from the original text’s material constellation to transform his experiential knowledge of reality into an imaginary form representing his own reality and intentionality (Voss 2008).

In short, we can say that there is no shortage of definitions and

theoretical approaches to immersive phenomena. Nevertheless, for an experimental scientist this still begs the question of the how of immersion. How does immersive reading function, not only on the verbally communicable level of subjective experience, but also on the levels of cognitive and affective processes and their neuronal bases, which cannot be directly observed? The processes of reading that can be consciously communicated, which are those that most literary critics and psychologists refer to, and which are generally measured using questionnaires and psychometric scales (for example, Appel et al.'s transportation scales 2002; Busselle & Bilandzic 2009; Green & Brock 2000), only amount to the tip of the iceberg. The iceberg itself consists of many unconscious and affective processes which reading researchers aim to illuminate using methods such as measuring eye movement and brain activity (Jacobs 2006a). In *Gehirn und Gedicht* (Schrott & Jacobs 2011), we postulated two neuronal bases for the phenomenon of immersion, components of a general model of neurocognitive poetics that involves further neuronal bases (Jacobs 2011; 2014a,b; 2015a,b; Jacobs et al. 2013; Lüdtke et al. 2014): “symbol grounding” on the one hand, and “neuronal recycling” on the other. In what follows, we will attempt to outline both of them.

NEUROCOGNITIVE BASES OF IMMERSION

What is the origin of reading's astounding capacity to hold our attention? How can it be that such supposedly abstract symbols as words—cultural objects that in evolutionary terms are extremely recent—should be able to induce “sensory delusions” and “quasi-real feelings” in us, captivating us in the “cinema of the mind”?

A glance back to the early years of psychology suggests several

possible answers. Thus Sigmund Freud, writing in 1891, claimed the brain treated words in much the same way as any other kind of object, and saw no reason for coding them in any other terms than their perceptual and motor features—that is, principally in terms of their vocalized form and articulatory operations. Karl Bühler’s studies of children led him to realize in 1934 that words have a “spheric fragrance”: if, for example, the word “radish” appears in a text, the reader is immediately transported to the dining table or the garden, that is, to an entirely different sphere than the one associated with a word such as “ocean.” If we generalize Bühler’s remarks about speech, a reader is “transported to the things that are spoken of, and lets his inner constructive or reconstructive ability be guided in great part by the object itself, which he either already knows or which the text has already arranged and constructed.” This is why a reader actually “hears” the crunching of the radish in her head, “sees” the red and white colors, and perhaps even “smells” the earthy smell when she reads the word “radish.” According to Bühler, words therefore have a “substance.” They are embodied cognitions, and the activities they are used for—speaking, reading, thinking, feeling—are themselves determined by their being as material substances (cf. Jacobs 2014b; Jacobs & Kinder 2015; Jacobs et al. 2015).

Imagine a child hearing the sentence: “Lisa bumped into the table and cried.” Could she understand this sentence if she couldn’t imagine bumping into a table herself or hadn’t seen someone else do it? Building on the ideas of Jean Piaget and Ludwig Wittgenstein, we can even surmise that the meaning of the word “table” consists of nothing other than a (neuronal) pattern of actions relating to this object. The embodied meaning—the motor-sensory concept “table”—is composed of the experiences of a table a person has already had and the judgments

they've been able to form as a result. Examples of the questions to be determined would be the following: how far is it from me; where is its edge; what do I need to do so as not to bump into it; what shape does it have; how big and heavy is it, and what kind of material is it made of; how much strength do I need to get round it; what is it like to touch? Empirical studies at the Dahlem Institute for Neuroimaging of Emotion (DINE) at the Freie Universität Berlin have established that, as well as being distinguishable by their linguistic and affective features, words can be differentiated by the attributes "body-object-interaction" and "sensory experience": words such as "sea" or "honey" exhibit a high "embodiment index," while "purpose" or "accident" have a low one (Jacobs et al. 2015). From time immemorial, poetry has used this knowledge of the motor-sensory and affective associative potential of words, skillfully linking these with their phonetic qualities (Jakobson 1960; Schrott & Jacobs 2011).

Put simply, the hypothesis of symbol grounding claims that the memory images evoked by words and sentences we hear or read are similar to those evoked by the objects they refer to. This phenomenon, described by Ryan as the "madeleine effect" in reference to Proust, points to the fact that, when reading or when listening to language, the processes involved are based on the same or similar neuronal mechanisms as those used in direct experience. This mental simulation of situations described verbally or in writing is therefore, under certain circumstances, capable of holding our attention with an intensity comparable to real perception, and sometimes even greater. This hypothesis hence contradicts the traditional understanding of these matters in cognitive psychology, which postulates a strict division between language on the one hand and perception or action on the other, because, unlike in cognitive psychology, language is here

considered to be based on the manipulation of abstract symbols. However, this does overlook the fact that the visual appearance of words and sentences constitutes the same kind of sensory stimuli as objects or faces. They are also automatically associated with their auditory form. Light and sound waves, transformed into neurochemical signals, affect our brains in a way that transforms these waves through complex intermediary stages into (multi-modal) “symbols”: into letters/graphemes on the one hand, and into their corresponding sounds/phonemes on the other. A word is therefore symbolically grounded by those learnt motor-sensory activities connecting its reception (seeing, hearing) with its production (speaking, writing). What at first sight appears as an abstract, amodal object composed of letters of the alphabet acquires its familiar, almost obvious meaning only after many laborious years of learning—and anyone who has watched children or adult patients with brain lesions learning to read and write will know how hard this process is. Today neuroscience is able to actually prove the existence of Bühler’s “spheric fragrance.” Reading the sequence of letters that makes up the word “radish” causes various sensory-response areas of the brain to become active, while “ball” also causes movement centers to be active, and “kiss” serves those that deal with emotions. The brain actually experiences events it is actually only reading about, and this power of simulation (mimesis, reliving) is an important basis of immersion, the neuronal substratum of the “cinema of the mind.”

The second hypothesis, that of neuronal recycling, postulates that structures in the brain eventually adapt so well to their environment that culturally determined processes such as reading end up operating through them, even though they had not evolved for this purpose. This means that cultural inventions such as writing have occupied brain

networks that are older in evolutionary terms by taking over, at least in part, their general structural framework, and forming a kind of “neuronal niche.” In the six thousand years since the development of writing, evolution hardly had time to develop completely new, reading-specific structures, capable of specializing in the construction of such amodal symbols. Since neuronal networks in all four lobes of the brain, as well as the cerebellum and other subcortical structures, play a part in recognizing just a single word, we may assume that structures are being used here that performed comparable functions among our ancestors (for example, recognizing patterns, objects, and faces).

The paleontologist Stephen Jay Gould proposed the term “exaptation” for such processes. It means a kind of creative evolutionary misappropriation: the utilization of a characteristic for a function it wasn’t originally intended for. In his analysis of one of the greatest achievements of human civilization and one of the most complex functions of the human brain—namely reading—the neuropsychologist Stanislaw Dehaene’s 2009 theory of neuronal recycling claims that a particular part of the left cerebral hemisphere’s fusiform gyrus—a structure in the lower temporal lobe—represents just such an exapted region of the brain. The process of learning to read, which often takes years, recycles the circuits of this region, reshaping structures that had initially served to recognize objects and faces: a classic example of how the actual form of the brain can react to new cultural inventions. This so-called visual word form area includes a series of neuronal circuits, which on the one hand are reasonably close to the original function of recognizing patterns, objects, and faces that the other parts of the fusiform gyrus specialize in, but on the other are also malleable enough to be able to muster considerable resources for tasks that are culturally determined, such as recognizing letters and words. We can therefore

claim, along with the reading researcher Maryanne Wolf (2007), that “The brain’s design made reading possible, and reading’s design changed the brain in multiple, critical, still evolving ways.”

A third approach, the so-called Panksepp–Jakobson hypothesis (Jacobs 2015b; Jacobs & Schrott 2013; Jacobs et al. 2015), is based on the notion that evolution did not have enough time to develop emotional circuits and “pleasure centers” for the specific enjoyment of art or even literature. Rather, as the neuroscientist Jaak Panksepp demonstrated in 1998, the evidence is that the feelings experienced during reading, whether “vicarious fear” (for the protagonists) or the aesthetic enjoyment of a beautiful metaphor (i.e., Jakobson’s famous poetic function of language) are based on the ancient circuits of affect that we share with all other mammals (e.g., the so-called limbic system).

If we try to describe these processes in terms of neuronal activity, the majority of studies shows that fluent reading primarily draws on the left brain hemisphere’s reading system, especially the “fast” lower (ventral) route. In normally developed, proficient readers this system covers large parts of the left hemisphere and can be roughly divided into three constituent parts: a posterior region in the brain’s parietal and temporal lobes, consisting of two networks, and an anterior region in the frontal lobe. The lower route, which runs from the visual areas through the inferior and middle temporal lobes to the frontal areas, contains the visual word form area, which is associated with fluent, highly automated reading. The anterior part includes the lower frontal gyrus, which appears to play a special role in recoding the phonology and articulation of words. The superior (dorsal) reading circuit, which runs from the visual areas in the visual cortex through the superior areas in the temporal lobes to the frontal area, is associated with the relatively slow, rule-based decoding of less familiar words that requires intensely

focused attention.

Complex processes of interpretation and comprehension, requiring a bilateral activation of the brain, depend on the ability of the left hemisphere's rapid reading system to efficiently decode written information. Maryanne Wolf puts it vividly and succinctly: "With its decoding processes almost automatic, the young fluent brain learns to integrate more metaphorical, inferential, analogical, affective background and experiential knowledge with every newly won millisecond. For the first time in reading development the brain becomes fast enough to think and feel differently. This gift of time is the physiological basis for our capacity to think 'endless thoughts most wonderful.' Nothing is more important in the act of reading."

An area in the anterior temporal lobe seems to be important for Iser's aforementioned theory of the completion and closing of meaning gestalts. Since this area contains multimodal associative areas, it is likely that it integrates semantic, syntactic, and episodic sources of information, transforming textual input into meaningful representations. The least complicated assumption is that the right anterior temporal lobe is responsible for propositionalization: it probably translates words into larger semantic units of content, which could correspond to Iser's "meaning gestalts."

Using the DINE's magnetic resonance tomograph (scanner), we looked at one-word metaphors, that is, composite terms that make a single word out of two nouns (noun-noun composites, or NNCs), to investigate how the brain works on simple meaning gestalts, and how the two dimensions of familiarity (known vs. unknown) and visualizability (literal vs. metaphorical) were manipulated in this process. Handschuh ("glove," literally "hand-shoe" in German) or Angsthase (scaredy-cat) are typical examples of familiar one-word

metaphors, which can be described as “dead” or “sleeping” metaphors to express the sense that as a rule these words cannot be understood and used “visually” but “literally.” The NNCs from our study were divided into four groups: conventional metaphors (CM) such as Flughafen (“airport,” literally “flight-harbor”) or Rampensau (literally “stage-sow,” one who hogs the limelight, though not always in a pejorative sense); conventional, “literal” NNCs (CL) such as Lehrjahr (“academic year,” literally “teaching year”) or Reisepass (“passport,” literally “travel-pass”); new metaphors (NM) such as Neidfieber (literally “envy fever”) or Mensakoma (literally “canteen coma,” in reference to students being tired after lunch); and finally new, “literal” NNCs (NL) such as Stahlhemd (“steel shirt”) or Sofaladen (“sofa store”). In so doing, the semantic relations between the two words of each NNC were kept at a constant by means of an algorithm that calculates the high-dimensional semantic distances (i.e., the dissimilarity of the semantic features of two words) using the latest computer-linguistic methods, thereby preventing any confusion of the possible effects of “metaphoricity” with those of semantic relatedness. In the left inferior frontal gyrus, a region of the brain that is systematically associated with language processing and meaning construction, clear differences emerged between the groups, showing a ranking order of graduated semantic processing and meaning gestalt construction: NMs > NL > CM > CLs. As the authors had suspected, the activity in the left inferior frontal gyrus reflects the relative “neuronal work” needed to work out what the NNCs mean; the newer, more unusual and more striking an NNC is, the greater the semantic effort required to construct a meaning gestalt. The brain evidently finds this process easier with words like Reisepass than with neologisms such as Mensakoma.

Moreover, the dorsolateral prefrontal cortex, the so-called posterior

cingulate cortex and the so-called temporoparietal junction or TPJ seem to be important in coherence formation and logical examination during reading, as well as in constructing more complex meaning gestalts, sometimes extending over several sentences or paragraphs. All these regions also play a part in empathy and theory of mind, the particular ability to guess what is going on in other people's minds, recognize similar events in one's own mind, and imagine the feelings, needs, ideas, intentions, expectations, and opinions of others.

Apart from symbol grounding, neuronal recycling, and the other neuronal processes mentioned here, a whole series of additional factors play a role in immersion, which is also a phenomenon determined by genre; these include interest, curiosity, surprise, suspense, enjoyment, and aesthetic processes (see Jacobs 2011; 2015b).

NEUROSCIENTIFIC STUDIES ON IMMERSION POTENTIAL

The immersion potential of an encounter between text and reader is determined both by the qualities of the text and the reader's own characteristics. Thus the term "immersion potential" denotes the encounter between a story's setting (spatial aspects), plot (temporal aspects), and its characters' emotions and the reader's personality traits. The latter determine whether one reader, thanks to a powerful visual imagination, can successfully imagine herself in the setting, whether another reader is more interested in the plot, that is, in the storylines and the question of what happens next, or whether someone successfully identifies with the protagonists, with their inner world (thoughts, feelings, aims), and can sympathize with their emotional conflicts (empathy). These three aspects of immersion, spatial, temporal, and emotional (see Ryan 2001), are also important

components of a mental situation model. Our thesis is that an immersive text is one that offers the reader a strong likelihood of encountering (familiar) situation models conforming to the cognitive and affective schemata he has acquired in the course of his life, and allowing him to read fluently within a “familiar textual world.” Such mental scripts are five-dimensional representations, formed dynamically in an automatic and implicit reading process, and consist of spatial, temporal, causal, motivational/intentional, and person- and object-related information. They deal with questions of the where, when, why/how, who, and what of individual events, and represent embodied cognitions based on psychosomatic experiences and motor-sensory, kinesthetic, and affective sensations which are automatically associated with words. Immersive reading therefore involves the construction of a series of situation models, which more closely interrelate the more strongly these five dimensions overlap with each other. Every time a rupture occurs in one of these dimensions—if, for example, the protagonist changes his location—then the situation model must be newly updated (Zwaan 1993).

Thus an immersive text must play with the reader’s situation models, arousing curiosity likely to induce immersion, springing surprises, and inducing suspense (Brewer & Lichtenstein 1982), such as by causing unexpected ruptures in one or another of the five dimensions. We studied this phenomenon at the DINE by examining people’s reading reactions to so-called black stories, a collection of macabre short stories whose protagonists find themselves in dangerous or distressing circumstances, and at the end of which they generally die, as in the following example:

“A farmer drove his combine harvester into a field of corn where his children were playing hide-and-seek. When the machine came to a

stop, he got out to see what was wrong. When he realized that he'd run over his children, he took his own life.”

Our hypothesis was that empathy for the protagonists of a story, and the emotional immersion this is likely to cause (the so-called fiction feeling), would be greater for stories with strongly negative content than for control stories with neutral (unemotional) content. The findings support this thesis, and show that a whole network of brain regions is active (centered around the medial prefrontal cortex) when readers experience empathy and fiction feeling (Altmann et al. 2012). This particular brain activity was dependent on the test subjects' capacity for empathy, which was measured on a psychological scale. In order to test the toggle-switch theory of fictional reading, half the test subjects were told that the stories were pure fiction before reading them, the other half were made to believe that they were facts (newspaper reports). Gerrig's toggle-switch theory claims that Coleridge's reception-theory thesis of a “willing suspension of disbelief” is an illusion. This theory holds that the principle of toggling the switch that suspends disbelief when you're reading fiction and toggling it back when you're reading facts is not an option for our brains. Nevertheless, we did actually find clear differences in the brain activities of both groups: the brain activity patterns in the “fact group” indicated that the mind-brain attempts to reconstruct the events related in the stories, while in the “fiction group” it was primarily networks associated with fantasizing and the mental simulation of future events that were active. Since the subjects were neither aware of these activities nor claimed to have willingly caused them, and since, moreover, the fiction feelings were not different between the two groups, it is at least the case that the findings do not directly support Coleridge's thesis. They do, however, support Oatley's principle that “fiction could be

truer than fact,” because the mental simulation processes that fictional literature requires enable individuals to gain a deeper understanding of their own emotions (cf. Green et al. 2012).

At DINE we also studied the literary production of the fiction feeling by reading passages from the Harry Potter novels (Hsu et al. 2014). Test subjects reported the highest levels of subjective immersion in passages that induced fear through their descriptions of pain or emotional stress. On these occasions a brain region in the mid-cingulate cortex was particularly active, which is a region that plays a central role in physical and psychic feelings of pain, and is associated with the motor components of affective empathy (Craig 2009). A comparison of bilingual test subjects’ brain activity while reading passages from the novels in both German and the original English showed that fiction feelings were not only more intense in their mother tongue but also appeared to be more differentiated in neuronal terms (Hsu et al. 2015a). In the same study we also examined the role played by surprise and reading enjoyment in immersion, by using passages featuring magical content that contradicted our knowledge of the world. These descriptions of supra-natural events primarily activated parts of the brain’s amygdala, which are systematically related to the discovery of striking and emotionally important aspects of the world around us, and which here presumably correlated with the novelty, surprise, and reading enjoyment that these descriptions produced (Hsu et al. 2015b).

Empathy and emotional immersion are associated with another factor that facilitates immersion, namely suspense. We studied this in readers of E.T.A. Hoffmann’s short story “The Sandman.” Subjectively the feeling of immersion strongly correlates with that of suspense (a high statistical correlation coefficient), which in turn correlates with the

reader's degree of subjective excitement (Jacobs 2015). The heart rate increases in suspenseful and immersive passages (Auracher 2007), something that is attributable to plot, or more precisely the density of narrative developments per passage, measured by the number of verbs (Jacobs & Schrott 2013). In addition, neuronal activations in certain brain areas (medial-prefrontal, inferior-frontal, and posterior-temporal) suggest the influence of processes of empathy and the future event prediction during the reading of suspenseful passages (Lehne et al. 2015). At least one of the five key factors of current personality theories, namely conscientiousness, is also linked to suspense and immersion and probably has an indirect effect on the ability to concentrate (Jacobs & Schrott 2013).

In sum, it can be said that an increasing number of neuroscientific studies that have addressed the phenomenon of immersion have largely supported the three hypotheses we've outlined above (symbol grounding, neuronal recycling, Panskepp-Jakobson). In a manner entirely in line with the theories of Freud or Bühler, who sadly did not have access to DINE as part of their repertoire of methods, the neuroscientific evidence supports all three hypotheses. It makes it clear why literary reading is both a sensory and emotional experience, and why it is capable of becoming a kind of seventh sense, reliant on sensory experiences of sight and hearing, the limbic system's affective responses, and countless memory images.

GENRE EFFECTS AND SUBLEXICAL FACTORS

It is often argued that—in contrast to novels—poetry or other kinds of literature that encourage self-reflection do not produce any immersive phenomena, or at least very few (Ryan 2001). We tested this thesis

empirically using the so-called *Stimmungsgedichte* (mood poems) from Meyer-Sickendieck's anthology (2011), which includes poems by Eduard Mörike, August Stramm, and Jürgen Becker, as well as subjects such as "The City," "Space," "Morning," and "Silence" (Lüdtke 2013; Lüdtke et al. 2013). It turned out that test subjects not only experienced both mood empathy and emotional involvement—two important aspects of immersion—while reading "Romantic" poems, but also while reading "abstract" (post-)modern ones, as long as these poems described familiar phenomena, experiences, situations, moods, and atmospheres. This supports Max Kommerell's claim that "In it the poet was harmonized, the poem is harmonized and the reader is harmonized" (1985). We can therefore speculate that poems which—however subtly—address familiar situation models and enable the reader to mentally enter their poem-world and empathize with its mood/atmosphere do indeed exhibit an immersion potential. What may also be important is the initial mood that readers find themselves in, and how well this suits the mood of the poem or its basic affective tone (the hypothesis of mood management, on which more below.)

The reception of poetry can of course be a playful, pleasant, and concentrated process, related to the reception of music or painting, which transports readers into an artificial world and thus enables them to partly or completely forget the world around them by their partial or total absorption in the text. The poet can facilitate this immersion by poetically imitating endogenous brain rhythms in his verses, which we have elsewhere described as follows:

"By using its three-second intervals to occupy the timeframe in which we experience our audio-temporal present, the typical line of poetry creates an artificial psychic space in which—divorced from everything around us—we can concentrate exclusively on the poem.

And this in turn leads to the pleasant and utterly harmless side-effects produced by reading and listening to poems: poets such as Emily Dickinson and Robert Frost have spoken of how, when reading poetry, they have had goose bumps or hot and cold shivers running up and down their spine; the muscles relax, while the mind can focus and concentrate; one finds one can laugh or cry more easily, draws deeper breaths, and is pervaded by a slight feeling of intoxication—Raymond Roussel compared it with a sober high, and Coleridge with the effect of drinking a couple of glasses of spirits during a conversation...” (Schrott & Jacobs 2011).

Thus poetry doesn't only operate on the lexical and supralexic level of words and verses, but also leads to subtle sublexical effects that depend on meter, rhyme, and rhythm, on the one hand, and affective phonological iconicity, on the other.

We can, dear reader, only guess what effect the following couplet by Wilhelm Busch has on you:

“Oft ist das Denken schwer, indes
Das Schreiben geht auch ohne es.”

“Take heart if thinking leaves you chary,
For writing it's not necessary.”

At any rate, an empirical study by Menninghaus et al. (2014) claims that the typical reader should find these two lines funny; a humorous effect that isn't produced by semantic incongruities but effected by rhyme and meter. This becomes clear when we defamiliarize the couplet's form while leaving it semantically unaltered, either by destroying its rhyme (“Oft ist das Denken schwer, jedoch / das Schreiben geht auch

ohne es”) or its meter (“Oft ist das Denken schwierig, indes / das Schreiben geht auch ohne es”). Notably, the test subjects in the study by Menninghaus et al. (2014) found the defamiliarized versions not nearly as funny as the original ones. The “pleasure” is lost. We explain this pleasure by the fact that when we read a line of poetry, each word activates a neuronal stimulus pattern that resonates as a sound gestalt, and this is still reverberating mentally, albeit subliminally, when the next word triggers its own neuronal pattern. Even when the first word has already been conceptualized—and the reader has already begun reading the third word in the series—the first word’s stimulus pattern remains present. Poets make use of these sliding transitions by constructing lines of poetry whose letter sequences repeat themselves, making them easier to memorize and recite with the help of meter and rhyme. Using the available residual stimulus patterns makes memorizing them less work. This is true not only of assonances within a verse, but also of alliteration at the beginning of words. It is precisely the ease with which rhyming lines can be recited that constitutes their pleasure—they trip as easily off the tongue as they impress themselves upon the memory (Schrott & Jacobs 2011).

Along with meter, rhyme, and rhythm, poets also make use of onomatopoeia, which to a greater or lesser extent plays with the phonological iconicity of words, something that influences the affective basic tone and determines the overall emotional mood of how a poem is received. We have studied this phenomenon by means of both textual analysis, using the so-called EMOPHON program (Aryani et al. 2013), and psychometrics, using a ratings scale for readings of Hans Magnus Enzensberger’s 1957 collection *Verteidigung der Wölfe*. The idea for this arose because Enzensberger himself had already attempted an intuitive classification of his fifty-seven poems into friendly, sad, and

nasty ones. Using EMOPHON, which quantifies phonological salience (the significant incidence of particular phonemes in any text), and a standardized database of words—which among other things makes it possible to quantify the affective features of phonemes, syllables, and words (Jacobs et al. 2015; Või et al. 2006; 2009)—we discovered that up to twenty per cent of the variation in text subjects' emotional assessments of the poems could be explained by basic affective tones, as calculated by EMOPHON (Aryani et al. 2015). These pre-attentive, and probably unconscious, effects serve to support others produced at the level of words and individual lines, leaving it an open question whether they were deliberately intended by the poet.

RESEARCH QUESTIONS

In conclusion, we would like to elaborate some of the exciting research questions and methodological challenges that research into textual immersion raises. These largely concern the necessary and sufficient conditions for immersive experiences and how these are to be measured. Given the digitization of the world of reading and the enormous importance of immersion, the question urgently arises of whether immersive phenomena depend on the reading medium (and if so, how), as well as whether, for example, the use of Fiktion's own Reader inhibits or encourages immersion in texts (a private study carried out together with Ingo Niermann and Mathias Gatz). As part of the European Union's E-READ research program (COST action IS1404 Evolution of reading in the age of digitization), the first author of this paper is investigating this issue with a large international group. Moreover, it is also interesting to ask where and when immersion is at its strongest, and to what extent audio books, song lyrics or spoken

poetry, analog and digital books, quiet reading vs. reading aloud are inherently different from film, music, painting, or sculpture, or only by degree. Initial data from this survey indicates that books are considered to be by far the most immersive medium, followed by film and music (Hakemulder 2013). Hakemulder's study also showed that respondents believed that this was primarily because of literature's successful and empathetic depiction of its protagonists' inner worlds, and only secondarily to plot-related effects such as curiosity, surprise, and suspense.

The question of whether immersion in works of fiction operates as powerfully as in works of fact is also still largely an open one (Altmann et al. 2012; Green et al. 2012), as is the question of the role of genre (for example, novel vs. poem). According to a pioneering study by Zeman et al. (2013), the first to use a scanner to compare the reception of prose and poetry, prose and poetry activate more common neuronal networks than separate ones. Chief among the latter in the reception of poetry are regions that are associated with theory of mind and the mental simulation of the future, such as the right temporal lobe and the anterior right temporal lobe, which is associated with propositionalization. Interestingly enough, a study at the University of Greifswald also found the right temporal lobe to be a possible neuronal correlative of creative writing (Shah et al. 2012).

It is well known that poets like Brecht opposed the effects of empathy and immersion by alienating their readers in order to enhance their capacity for critical thinking. Despite the "mood empathy" referred to above, there is little doubt that lines such as "Schwarze Milch der Frühe wir trinken sie abends" ("Black milk of daybreak, we drink it at sundown"; the first line of Celan's *Todesfuge* [Death Fugue], here in Michael Hamburger's translation) have an alienating effect on the

reader, forcing him to adapt (among other things) his thought schemata and mental affect scripts, as well as his (self-)reflexive processes, which in theory can only attain the weakest of Ryan's four degrees of immersive intensity (concentration). In *Gehirn und Gedicht* (Schrott & Jacobs 2011), we discuss alienation effects in reading as an instance of foregrounding (van Peer 1986)—that is, the deliberate use of rhetorical and poetic stylistic means, such as the oxymoron in the opening line of Celan's poem. We consider the question of whether immersion and alienation effects mutually exclude or interact with one another to be primarily an empirical one, which, despite the methodological problems we outline below, is likely to be resolved in the future using methods of empirical literary criticism, experimental psychology, and cognitive neuroscience.

Finally, it is an open question to what extent immersion itself is a uniform phenomenon, even within a medium such as the analog book. The three-way division into spatial, temporal, and emotional immersion is a purely theoretical one, which has yet to be experimentally researched (Ryan 2001). It is also an open question whether all three components are equally necessary or sufficient for immersion, whether they interact, and in what regards they depend on the reader's personality traits, such as their empathy or conscientiousness score, their curiosity, or their spatial imagination.

A general methodological problem in measuring immersion lies in the fact that test subjects cannot provide any data on their experiences during the act of reading itself without interrupting or rendering impossible the immersive process. Immersion can be pre-attentive—so much so that, in cases of complete absorption, readers are not even aware of being in this state. As soon as test subjects notice or report that they are immersed, it is clear that they can no longer be so

(Hakemulder 2013). An assessment of the “immersivity” of entire texts or passages made subsequent to the act of reading and based on a scale of immersion does not, however, constitute a neutral measure. Nevertheless, by simultaneously collecting data on personality, subjectively felt suspense, familiarity, valence, degree of excitement, and concentration of action in the content—that is, on constructs theoretically linked to immersion—this “non-neutral” measure can be “cross-validated.”

Furthermore, people can give false answers to questions about the possible causes of immersive states on the grounds of what they personally think its causes may be. That is why the subjective methods of empirical literary criticism need to be broadened with the more objective methods of measurement that we use at the DINE (for example, oculo- and pupillometry, peripheral physiological measures of heart rate, skin-conductance level or corrugator muscle activity, electroencephalography, or functional magnetic resonance tomography). These methods are not only expensive, however, and supply—despite some opinions to the contrary—only correlative and not causal information (Jacobs 2006b), but they also fail to clearly link certain measurement parameters to immersive states. In other words, there are no biomarkers for immersion, even though initial findings from the DINE have discovered certain regions of the brain to be possible neuronal correlates of particular immersive processes; one of these is the mid-cingulate cortex, mentioned above (Hsu et al. 2014). On the other hand, neuronal correlates for attention processes (frontoparietal network), spatial imagination (the so-called parahippocampal gyrus), theory of mind (TPJ), emotional involvement (so-called limbic system), surprise (amygdala), suspense (dorsolateral PFC), all of which are important components of immersion, are

relatively well known, and can serve as “objective” evidence for immersive processes. An example of this would be to first have the test subjects read a text in the scanner and then ask them to mark those parts that they considered particularly immersive, suspenseful, poetic, etc. (Speer et al. 2007). If the brain activity coinciding with those parts of the text corresponds to one or more of the “correlates” mentioned above, then this would be evidence for immersive processes.

In the future, these processes, both analog and digital, will—irrespective of whether or not they use mental toggle switches—undoubtedly continue to captivate people in reading’s cinema of the mind, offering them a broad spectrum of possibilities for enjoyment that neither film nor music can provide, from madeleine effects to Don Quixote syndromes.

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