Thomas Weitin

Understanding Reading

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DIGITAL
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COOPERATION

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Abstract

Reading is one of the most complex cognitive processes of the human brain. Reading follows a domain-independent rhythm of attention but is also constrained by embodied cultural patterns that influence cognition and can be decisive for success or failure at school. Against this background, Pamphlet #11 discusses recent reading research of the Darmstadt LitLab[1]. Five vignettes show how extreme cultural attitudes influence the brain when reading, how literature lessons strengthen empathy, and how individual reading diversifies comprehension. Furthermore, awareness of historical contexts leads to more confident judgment, while shared semantic arousal patterns emerge when a reading experiment mimics the essence of a literary work.

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Understanding Reading

1 Introduction

Reading is one of the most complex cognitive processes of the human brain. When we move our eyes to scan a page or screen, we perform the fastest movement of the human body. However, reading is just one of many everyday activities in which the neuronal attention network performs rhythmically coordinated alternations between information intake and eye movements. Orienting in an untidy children's room, driving a car, or picking raspberries all follow the same cognitive pattern (Fabian n.d.). As the basic structures of attention are domain-independent, it appears appropriate to expand the reception-aesthetic concept of the implicit reader (Iser 1994) to include the idea of the explicit reader (Weitin 2024). Iser described the act of comprehension as a one-sided effect of text structures on readers' mental models. By now, we know that the cognitive task of reading also follows mechanisms not implied by the text. Therefore, the inherent principles of these fundamental mechanisms must be made explicit.

Above all, these mechanisms include the space-time coordination between the sensory system and the eye's motor system. While our eyes move, we are blind and cannot take in any information. This is why our brain permanently ensures the temporal separation of sensory processing and eye movements via a central neuronal clock frequency. About four times per second, there is an alternation between shifting, which suppresses information processing, and sampling, which releases resources for processing with suppressed motor activity (Fiebelkorn and Kastner 2019; Helfrich et al. 2018).

The neuronal rhythm of reading is too fine and rapid to cross the threshold of self-perception. It belongs to the unconscious side of understanding. Even empirically established models, such as linguistic eye-tracking pioneer Keith Rayner's, have long assumed that reading behavior can be predicted from text features alone (Helfrich et al. 2018). In literary studies, the assumption that the act of reading is part of the comprehension process has been accepted beyond reception research. However, cognitive science findings are mainly taken into account in terminological and conceptual considerations (Ajouri, Mellmann, and Rauen 2013; Caracciolo and Kukkonen 2021) and are not included in the modeling of concrete reading comprehension (Schneider 2000; Jannidis 2008; Jannidis 2009).

Comprehensive models may not even be necessary. It may suffice to develop a framework based

on the various data collected in the respective studies of empirical reading research. A distinction can be made between two types of data according to the collection method: those that come from questionnaires and those that measure physiological reactions, e.g., eye-tracking, magnetic resonance imaging (MRI), or electroencephalography (EEG). Analyses often combine both data types, as almost all physiological experiments record at least the participants' demographic data. In addition to demographic data, many reading studies specifically inquire about everyday reading behavior. It is precisely because of the data types' frequent intersection that it is particularly informative to differentiate systematically between the two. Although a good questionnaire does not necessarily reveal its target variables in its questions, the answers, e.g., on a text's complexity or aesthetic quality, are still conscious assessments of participants. Eye movements, heartbeat, skin reactions, or the activation of brain areas - all things that experiments can measure - remain beyond the reader's control. These data make the literally unconscious side of reading visible.

In the following, I present five small vignettes of my experimental reading research over the last few years to highlight the most crucial result of each experiment from a humanities perspective. The cited publications contain detailed descriptions of all methods and results, as well as a detailed discussion. The data are available on request.

2 Extreme cultural attitudes influence the brain when reading

On the one hand, my group and I have attempted to visualize the attention economy in social networks of literature through network analyses of large fanfiction corpora (Weitin, Bühler, et al. 2023). On the other hand, we are interested in the actual effect on readers of what is by far the fastest-growing part of contemporary literature. When fans expand on the works they adore, and others comment on this, positive emotions take center stage. And not only that. Negative criticism is habitually scorned in the fanfiction community, with some forums explicitly declaring it unwelcome. This has given rise to a new genre known as 'badfiction', in which people deliberately write bad texts to criticize, similar to a parody.

This development is a gift for reception analyses since we can find texts under the label 'badfiction' that are considered 'bad' in a social network of writers and readers. We can, therefore, examine bad literature without any external academic evaluation bias. We conducted an EEG experiment in which we measured the brain activity of participants who read badfiction about *Harry Potter*, original excerpts from the novels, and conventional, affirmative *Harry Potter* fanfiction (Weitin, Fabian, et al. 2023). In order to isolate the possible effect of the bad texts, four original passages were alternated with one conventional fanfiction and again four originals with one badfiction for each participant in each trial. Forty participants completed 15 trials each, so each participant read 150 stimuli, consisting of 120 originals, 15 fanfiction, and 15 badfiction passages each.

The results of our study show two things. Firstly, the three types of text studied can be distinguished by brain activity during reading, with badfiction eliciting the least activity. This did not necessarily correspond to my expectations, as I had believed in a strong effect of the irritation potential of badfiction. Badfiction texts deliberately subvert reader expectations regarding literariness, good writing, and conventions. Plots take unexplained turns, characters are shallow, and the language is awkwardly simple. Against this background, the lower level of brain activity can be explained by the effort saved in following the plot and character development. However, and this is the second result of our study, badfiction does not affect all reader groups in the same way. We reveal the influence of everyday reading habits by examining the different frequency bands of brain waves relative to each other. *Harry Potter* fans, fantasy-attuned readers, and those who generally read a lot are significantly more attentive when reading. Those who read less and are unfamiliar with fantasy and the Potter universe need more mental effort because they must constantly process new information.

I was amazed by how much the attitude towards the pop-cultural subject of badfiction influenced

the individual's perception and the statistical result for the readership as a whole. After the experiment, we presented the participants with two of the previously shown badfiction texts and asked them to describe their impressions using keywords. When I first reviewed the results, I was struck by the strongly polarized responses. The evaluation differentiated this impression as most readers do not have a clear stance on badfiction. However, there are minorities with a strong affinity or aversion to badfiction, which turned out to be small subgroups of fans or non-fans, respectively. These minorities dominated the results with their extreme cultural attitudes in such a way that we were able to separate being a fan or not from this other, stronger influence on reading behavior. In our survey, being a fan or not corresponds to familiarity with the content, i.e., the world of *Harry Potter*. Most fans (like non-fans) remain ambivalent towards the controversial phenomenon of deliberately poorly written *Harry Potter* fanfiction. Their cognitive reading behavior differs from readers who hold strongly positive or negative attitudes toward badfiction, revealing a cultural attitude that fanhood alone does not explain. In other words, being a fan is only a decisive factor in reading behavior for those who remain ambiguous about the controversial artifact of badfiction.

3 How can literature lessons enhance empathy

Since reading is a prerequisite for social participation, developing this skill is crucial in elementary school. In later educational phases, reading and understanding literature becomes the focus of literature lessons, with curricula relying on competence-oriented learning. German curricula assume that literature lessons, besides imparting literary knowledge, also strengthen key secondary skills via the guided understanding of literary works. The main focus here is on empathy and judgment. Literary scholars like to believe in the higher purpose of *poetic justice* (Nussbaum 2007), according to which literature sensitizes people to its topics, makes them empathic, and thus also impacts their lives. Therefore, the humanities have hardly ever demanded empirical evidence for such strong assumptions. However, there is evidence that reading literary texts improves the theory of mind, i.e., the ability to comprehend the mental states of others (Kidd and Castano 2013). Moreover, it has become clear that we cannot assume a simple transmission of emotions through literary texts (Mellmann 2010) and that empathy must be viewed conceptually nuanced. The downsides of excessive empathy emerging in the age of social networks make moderation and regulation appear as sensible pedagogical goals (Breithaupt 2017; Errasti, Amigo, and Villadangos 2017).

Based on these considerations, we conducted reading experiments with two high schools to investigate how students (N = 97) react to texts with difficult topics and correspondingly negative emotions. As the respective curricula limited the choice of texts, we used Juli Zeh's *Corpus Delicti* for one experiment and Stefan Zweig's *Chess Story* for the other. When selecting the passages for each of the ten stimuli, we aimed to mimic the complete works as closely as possible regarding the main characters, plot, and message. Given their specific characteristics, both works led to two differently structured sequences of stimuli, which enabled us to examine 'sequence' as a variable systematically. In *Corpus Delicti*, the protagonist is repeatedly confronted with extreme violence (Weitin 2012). In line with the plot, we alternated the depictions of strong negative emotion with neutral passages. While negative emotions were read in an interrupted sequence here, it made sense to work with a continuous sequence in the *Chess Story*. The participants first read a series of very negative characterizations of the antagonist Czentovic, starting with his ethnic name, contrasting unfavorably with the protagonist Dr. B's characterization as an academic. In comparison, the second part consisted of neutral passages from the opponents' chess game. For both the interrupted and the continuous sequence of negative texts, we tested a control group that only read neutral to positive passages from *Corpus Delicti* and the *Chess Story*.

In this experiment, we used a complex experimental setup. In addition to eye movements, we measured the electrodermal activity of the skin (EDA) as well as the activity in the smile muscle (*zygomaticus major*) and the frown muscle (*corrugator supercilii*) using facial electromyography (fEMG). While the EDA value indicates arousal, the measurable currents in the two facial muscles indicate valence, i.e., positive and negative emotions. Via the facial muscles, we can measure not only conscious reactions but also subconscious micro-expressions. This means that the participants do not have to smile or frown visibly. To make empathy accessible as a variable, all participants completed an established empathy test before the experiment. Based on the results of this test, we used a threshold value to divide the participants into two groups with high and low empathy.

In the statistically significant, generalizable part of our results (Fabian et al. n.d.), we can show that the negative passages of the texts alone have no direct influence on the emotional reaction of the readers. There is no difference between the test and control groups (with or without negative passages). This argues against the idea that we simply mirror the emotional content of texts. However, we find a difference if we consider all passages read in succession and the different interrupted and continuous sequences. In particular, the corrugator activity indicating negative emotion can then be interpreted in terms of empathy. Empathic readers display weaker negative reactions than readers with low empathy when texts depict violence or describe characters negatively. Although this result may seem counterintuitive at first glance, it can be explained if empathy is conceptualized not as affective compassion but in terms of cognitive empathy (Decety and Ickes 2011) as a form of compassion that is subject to emotional self-control (Mellmann 2010). Our data further support this view as the values for neutral passages are reversed. Here, empathic readers show significantly stronger negative emotions than less empathic readers. Given that all participants were required to read the complete works before the experiment, we can assume that higher empathy enables readers to consider better the context of literary events. In our case, this means anticipating negative events without actually reading them. Less empathic readers, on the other hand, seem to be more emotionally exposed to the individual negative literary event. Therefore, it makes sense to specifically train cognitive empathy in literature lessons, for which texts with negative emotions are particularly suitable.

We also showed that the interrupted sequence (Zeh) triggers more negative emotions in less empathic readers than the continuous sequence (Zweig). If we assume the established mechanism of fear extinction (Milad and Quirk 2012), according to which negative emotions subconsciously motivate people to self-regulate their emotions and take into account that the higher empathy was the only disparity between the differently reacting groups, we can make a clear recommendation for literature

lessons. Reading literary texts with interrupted negative emotions helps pupils regulate their emotional reactions through increased empathy.

4 Reading diversifies, literature lessons intensify

German teachers are very open to empirical research and are particularly keen to know what specific effect their teaching has. We were able to determine this because only one of the two classes dealing with the *Chess Story* had already discussed the book in class before the experiment. Therefore, the evaluations in this and the following chapter only refer to the experiment with the *Chess Story*.

After the experiment, we surveyed the reading level. All participants were instructed to read the entire text independently in the weeks before the study. After the experiment, we asked for honest answers about the reading level to examine this as a variable. Four different levels of text engagement emerged: no text knowledge, private (partial), private (complete), and in class (complete). Another group of those who had covered the *Chess Story* in class but only partially read the text was so small that we neglected it.

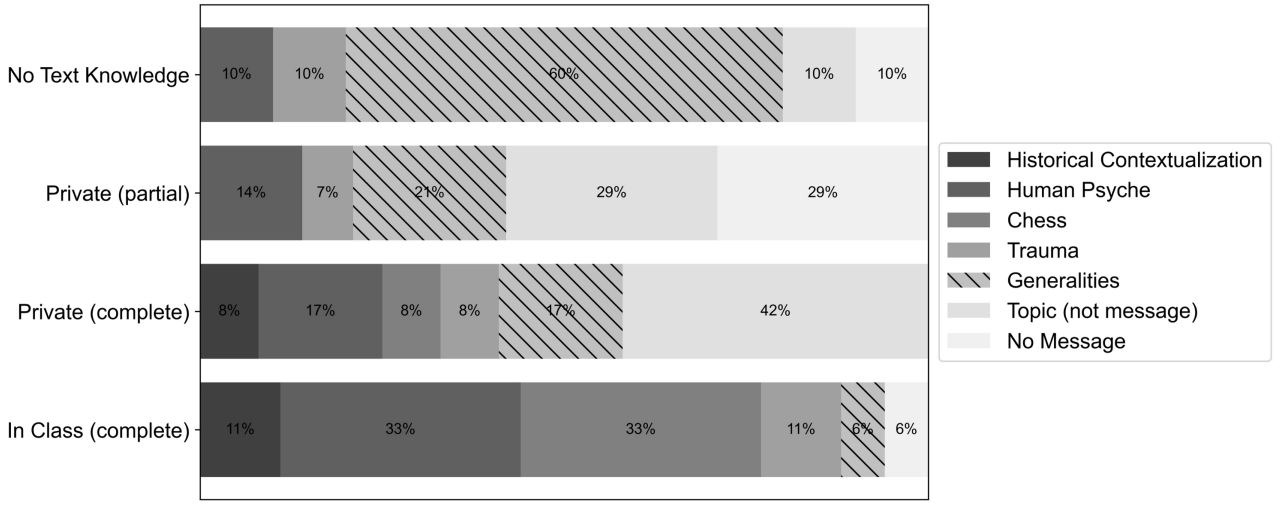

Figure 4.1: Recognized messages in the *Chess Story* according to the completeness of reading and classroom instruction

In the questionnaire after the experiment, the pupils were asked to summarize the text's message in a short sentence. Figure 4.1 shows how the answers vary in quality and content depending on the completeness of the reading. In order to work this out, we annotated the pupils' sentences according to seven categories. Some wrote nothing, others only named topics instead of the message ('It's about jealousy.'). Still others only gave generalities ('Practice makes perfect.'). In terms of content, we distinguish four semantic areas. In addition to the chess game exhibited in the story title, messages were formulated about the human psyche, trauma, and historical contextualization.

It is apparent how the generalities drop from 60% among those who have not read the text to only 6% after complete reading supported by classroom instruction. The portion of those who only indicate

topics but no message increases with the completeness of the individual reading. All those who have dealt with the text in class were able to specify a message. At first glance, the comparison between pupils with no text knowledge and those with partial text knowledge is surprising. While only 10% of those who entered the experiment unprepared did not answer the question about the text's message, the figure was 29% for those with incomplete knowledge of the text. Those who know at least a little about the text can be interpreted to have a sense of the variety of possible answers and are reluctant to give one themselves.

Our results allow us to systematically distinguish the effect of individual reading from literature lessons and explain the interaction of both factors. The completeness of the reading considerably increases the number of perceived messages. Only after complete reading is the text historically contextualized and trauma recognized as an interpretive context. Literature lessons do not add more semantic areas but strengthen the existing ones. In our case, the teacher had provided material on Freudian psychoanalysis as a context, which explains the strong increase in corresponding messages, which were also recognized by those who read intensively on their own. It is, therefore, the completeness of the reading that ensures the diversity of understanding. Reading for yourself diversifies, literature lessons intensify.

5 Judgment: Historical contextualization leads to more confident judgment

Before the participants in our study were asked to summarize the text's message, we wanted to know whether they believed the Chess Story even had a clear message. The answer options were scaled from "yes, absolutely" to "no, not at all" so that we could determine how certain the pupils were after reading the entire text and re-visiting key passages in the experiment. In this way, we wanted to approach the difficult measurement of judgment.

Following Kant, we have operationalized this central category in another way. For Kant, aesthetic judgment shows what constitutes judgment: art is judged subjectively but with certainty as if one could expect everyone to agree. In order to test the assumed generalizability of the judgment of taste, we asked the participants to make some aesthetic judgments in the follow-up questionnaire after the experiment. These included a contemporary painting, a contemporary poem, a current legal case, and an everyday ethical situation. In addition to the ratings, we also asked about the participants' confidence in making the judgments.

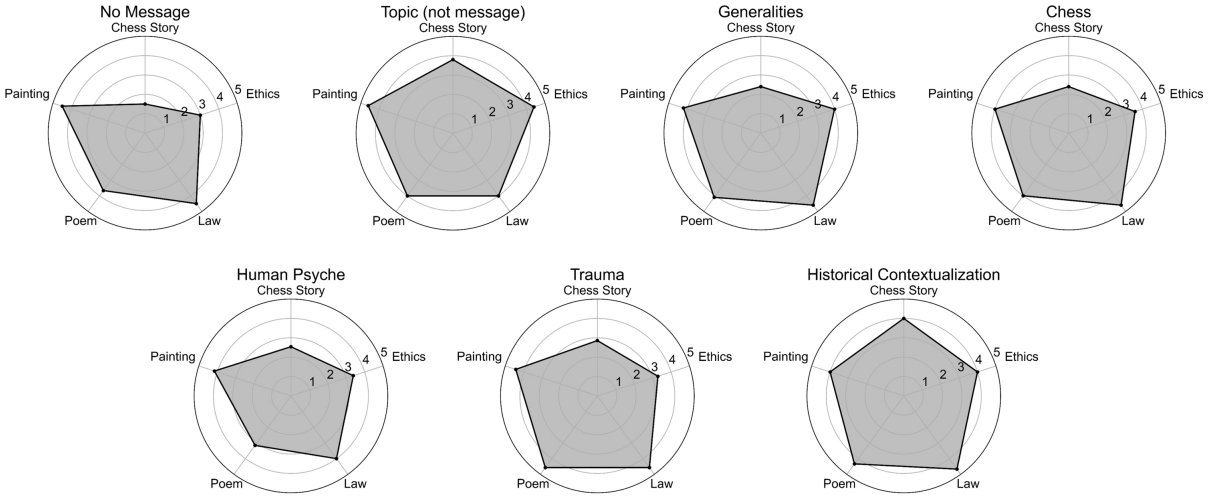

Figure 5.2: Confidence of judgments after reading the *Chess Story* categorized according to the perceived messages

Figure 5.2 shows the certainty of judgment in the five dimensions surveyed: the work covered in the experiment (*Chess Story*), an everyday ethical situation, a legal case, a poem, and a painting. The plots correspond to the seven categories of recognized text messages. When comparing the five dimensions in each plot, it is noticeable that in most cases, the certainty of judgment for the intensively read Chess Story is considerably lower than for the spontaneous judgment of art, law, and ethics. This is particularly striking for those who did not provide a text message for the *Chess Story*. Exceptions

are readers who only name topics instead of a message and those who determine the message of the literary work through historical contextualization. In a comparison of all semantic areas of recognized messages, the contextualization of the text in its time seems to support the impression that the work has a message and to enable us to articulate this message with certainty. While intensive reading makes so many possible meanings conceivable that a clear judgment is difficult, the historical context eases this difficulty. Historical contextualization leads to more confident judgment.

6 Meaning reinforces shared semantic arousal patterns

One established theory of eye movements during reading is that we absorb information during fixations (Holmqvist 2011, 22). Nevertheless, these milliseconds of lingering are not easy to interpret. Everyone knows from conscious reading experience that you can look at a word and still be elsewhere with your mind. All the more reason why mind wandering in the subconscious fixation rhythm is a topic for attention research. One way of clearly interpreting eye-tracking values, which can mean one thing or another, is to measure other physiological reactions simultaneously. Skin conductance, measured as electrodermal activity (EDA), is an established metric to measure arousal during reading (Brishtel et al. 2020).

In the coregistration of eye movements and skin conductance, we were particularly interested in the differences between the test and control groups for the two sequences. In the interrupted sequence from Zeh's *Corpus Delicti*, passages with strongly negative emotions appeared between the neutral passages at three points. In contrast, the continuous sequence from Zweig's *Chess Story* began with five negative stimuli, followed by five neutral stimuli. In both sequences, the control groups read neutral passages throughout.

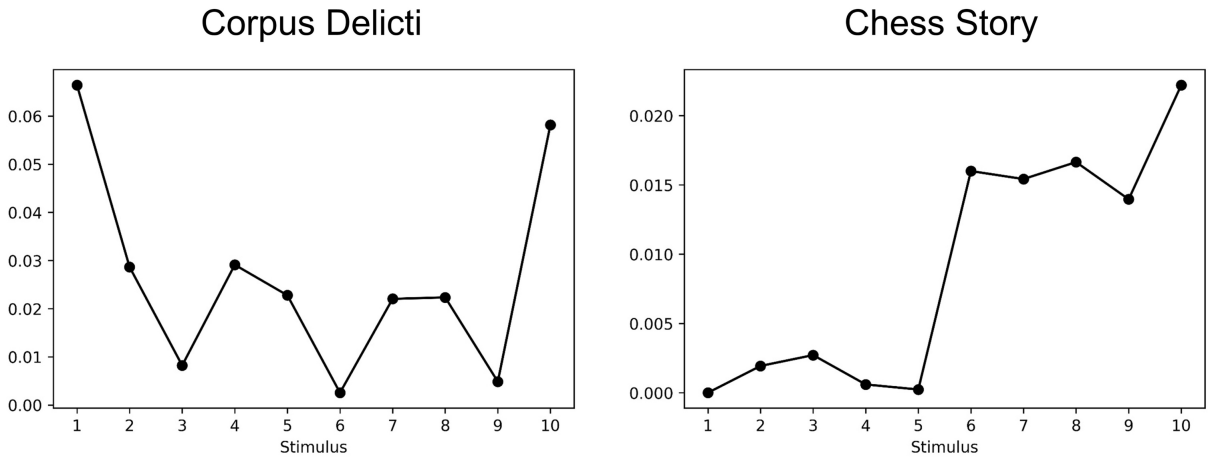

Figure 6.3: Similarity (Jaccard) of words fixated under high arousal (EDA phasic max) for groups with negative stimuli (A) and control groups without negative stimuli (B). Sequences from *Corpus Delicti* (left) and *Chess Story* (right)

Figure 6.3 shows the difference between the sequences. What we see here is the result of a strong pruning of the very extensive data. For this evaluation, we only considered the data points where the arousal peaked during reading (EDA phasic max). Based on these spikes in skin conductance, we examined which words were fixated at the respective points in time. This results in a word list for each reader for each stimulus, from which we obtain the individual semantic arousal pattern. In order

to compare experimental groups (A) and control groups (B) for a stimulus, we calculated the pairwise similarity of the word lists of all participants in one group with the word lists of the other group. These similarity values are then averaged for each stimulus.

At first glance, the two plots in Figure 3 merely reflect the two sequences. In the interrupted sequence from *Corpus Delicti* (left), the experimental group read texts different from the control group for the third, sixth, and ninth stimuli. In the continuous sequence from the *Chess Story* (right), both groups read the same text from stimulus six onwards. Naturally, the semantic arousal patterns of the groups differ where the texts differ.

Nevertheless, something else is visible. In both sequences, there is a rapid increase in the similarity of arousing words for the last stimulus. To illustrate the different characteristics of the two works in the experiment, we have included the contrasting ways they present their message. *Corpus Delicti* contains a rhetorically effective passage ("I withdraw my trust from a society that..."). The *Chess Story* uses the genre-typical reflection on the central theme of chess, which remains very abstract compared to Zeh's pedagogy ("... an art without a work ..."). These two passages each form the final stimulus.

In *Corpus Delicti*, the clear message homogenizes the semantic arousal patterns almost to the level of the introduction to the text read by everyone in the first stimulus. Despite its abstractness, the Chess Story's general reflection on the game of chess reverses the slight downward trend of the previous stimuli, which describe the game of the two opponents, and reaches the highest level of the entire experiment. When a text makes its readers feel that they have the meaning in front of them, commonalities in cognitive processing can be observed that defy even the otherwise very strong sequence signal (interrupted vs. continuous). Meaning, it seems, reinforces shared semantic arousal patterns.

Translated by Thomas Fabian

7 Bibliography

Ajouri, Philip, Katja Mellmann, and Christoph Rauen, eds. 2013. *Empirie in der Literaturwissenschaft*. Poetogenesis. Münster: mentis.

Breithaupt, Fritz. 2017. *Die dunklen Seiten der Empathie*. 2. Aufl. Suhrkamp Taschenbuch Wissenschaft 2196. Berlin: Suhrkamp.

Brishtel, Iuliia et al. 2020. "Mind Wandering in a Multimodal Reading Setting: Behavior Analysis & Automatic Detection Using Eye-Tracking and an EDA Sensor". In: *Sensors* 20.9. DOI: 10.3390/s20092546.

Caracciolo, Marco and Karin Kukkonen. 2021. *With Bodies: Narrative Theory and Embodied Cognition*. Columbus (OH): Ohio State University Press.

Decety, Jean and William Ickes. Jan. 21, 2011. *The Social Neuroscience of Empathy*. MIT Press.

Errasti, Jose, Isaac Amigo, and Manuel Villadangos. June 12, 2017. "Emotional Uses of Facebook and Twitter: Its Relation With Empathy, Narcissism, and Self-Esteem in Adolescence". In: *Psychological Reports* 120.6, pp. 997–1018. DOI: 10.1177/0033294117713496.

Fabian, Thomas. N.d. *Exploring Power-law Behavior in Human Gaze Shifts Across Tasks and Populations*. Forthcoming.

Fabian, Thomas et al. N.d. *Teaching Empathy in the Classroom by Alternating Texts with Negative and Neutral Sentiment*. Forthcoming.

Fiebelkorn, Ian C. and Sabine Kastner. Feb. 2019. "A Rhythmic Theory of Attention". In: *Trends in Cognitive Sciences* 23.2, pp. 87–101. DOI: 10.1016/j.tics.2018.11.009.

Helfrich, Randolph F. et al. Aug. 2018. "Neural Mechanisms of Sustained Attention Are Rhythmic". In: *Neuron* 99.4, pp. 854–865. DOI: 10.1016/j.neuron.2018.07.032.

Holmqvist, Kenneth, ed. 2011. *Eye tracking: a comprehensive guide to methods and measures*. Oxford; New York: Oxford University Press.

Iser, Wolfgang. 1994. *Der Akt des Lesens: Theorie ästhetischer Wirkung*. 4. Aufl. UTB für Wissenschaft Uni-Taschenbücher Literaturwissenschaft 636. München: Fink.

Jannidis, Fotis. 2008. *Figur Person*. Walter de Gruyter GmbH & Co.KG. DOI: 10.1515/9783110201697.

– 2009. "Verstehen erklären". In: *Literatur und Kognition : Bestandsaufnahmen und Perspektiven eines Arbeitsfeldes*. Ed. by Simone Huber Martin und Winko. Paderborn: mentis, pp. 45–62.

Kidd, David Comer and Emanuele Castano. Oct. 18, 2013. "Reading Literary Fiction Improves Theory of Mind". In: *Science* 342.6156, pp. 377–380. DOI: 10.1126/science.1239918.

Mellmann, Katja. 2010. "Gefühlsübertragung? : Zur Psychologie emotionaler Textwirkungen". In: *Machtvolle Gefühle*. Ed. by Ingrid Kasten. Trends in medieval philology v. 24. Berlin ; New York: De Gruyter, pp. 107–119.

Milad, Mohammed R. and Gregory J. Quirk. 2012. "Fear Extinction as a Model for Translational Neuroscience: Ten Years of Progress". In: *Annual Review of Psychology* 63, pp. 129–151. DOI: https://doi.org/10.1146/annurev.psych.121208.131631.

Nussbaum, Martha Craven. 2007. *Poetic justice: the literary imagination and public life*. Boston, Mass: Beacon Press.

Schneider, Ralf. 2000. *Grundriß zur kognitiven Theorie der Figurenrezeption am Beispiel des viktorianischen Romans*. 9. Tübingen: Stauffenburg-Verl.

Weitin, Thomas. 2012. "Ermittlung der Gegenwart: Theorie und Praxis unsouveränen Erzählens bei Juli Zeh". In: *Zeitschrift für Literaturwissenschaft und Linguistik* 42, pp. 67–86.

Weitin, Thomas. 2024. "Der explizite Leser. Kognitionswissenschaftliche Herausforderungen für die Literatur wissenschaft zwischen Korpus- und Rezeptionsanalyse". In: *Zeitschrift für Literaturwissenschaft und Linguistik* 54, pp. 285–299. DOI: https://doi.org/10.1007/s41244-024-00332-7.

Weitin, Thomas, Jill Bühler, et al. 2023. "Autorschaft und Literarische Kommunikation in Fanfiction-Portalen. Harry Potter auf Fanfiktion.de". In: *Zeitschrift für Literaturwissenschaft und Linguistik* 53, pp. 595–622. DOI: https://doi.org/10.1007/s41244-023-00306-1.

Weitin, Thomas, Thomas Fabian, et al. 2023. "Is Badfiction Processed Differently by the Human Brain? An Electrophysical Study on Reading Experience". In: *Frontiers in Human Neuroscience* 17. DOI: https://doi.org/10.3389/fnhum.2023.1333965.