
FINAL REPORT

Förderlinie 4: Forschungsförderung von PostDocs

Granting: 2017 (24 month starting Okt 2017)

Project Title:

Unconscious guidance: Behavioral and neural effects of unnoticed information in inattentional blindness

Applicant:

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Summary and research question

We often fail to detect clearly visible, yet unexpected objects when our attention is otherwise engaged, a phenomenon that has been termed inattentional blindness (Mack & Rock, 1998). Much is known about the factors that determine whether or not inattentional blindness occurs (see e.g., Kreitz, Furley, & Memmert, 2015; Kreitz, Schnuerch, Gibbons, & Memmert, 2015; Mack & Rock, 1998; Most et al., 2001; Newby & Rock, 1998). Surprisingly, though, hardly anything is known about whether and how we process objects that go unnoticed during inattentional blindness. Previous research suggests that stimuli that are not consciously noticed due to inattentional blindness are nevertheless processed on a perceptual level (Lathrop, Bridgeman, & Tseng, 2011; Mack & Rock, 1998; Pitts, Martínez, & Hillyard, 2012). What remained controversial until recently was whether these stimuli are also processed at higher levels, for example, semantically (Lathrop et al., 2011; Mack & Rock, 1998). In a recent publication we provided the first direct and reliable evidence for semantic processing of stimuli that are not consciously represented due to inattentional blindness (Schnuerch, Kreitz, Gibbons, & Memmert, 2016). Following up on these intriguing findings, the overarching goal of the proposed research project was to shed further light on the potential of unseen stimuli in inattentional blindness to shape behavior and neural processes. Specifically, we aimed to explore whether information of which we remain unaware due to inattention (1) elicits preparatory perceptual and/or motor activity in the human brain; and (2) shapes behavior and decisions in applied settings, such as in the context of sport performance and subjective preferences. Moreover (3), we sought to identify potential moderators of higher-level processing of undetected stimuli. In order to achieve these goals, we wanted to collect both behavioral and electrophysiological data.

Course of the project

A master student (Michel Brinkschulte) and a doctoral student (Giulia Pugnaghi) have been involved in the project.

In the first year of the project we started with Study 3 (affective judgement) and Study 4 (perceptual load) of the research proposal. For each study, we initially tested 80 participants as planned. Both projects yielded null results which made it necessary to collect additional data to substantiate the null results and to investigate potential influencing factors of this finding in the second year. Both lines of research are described below in more detail.

Study 3: Exploring potential moderating factors (affective judgements)

In this study we investigated whether unexpected stimuli (non-words) that are never consciously noticed (i.e., participants remain inattentionally blind) can impact following evaluations, that is, conscious affective judgments of subsequently presented stimuli.

We did an extensive literature research on the topic, designed the details of the study, and programmed the experiment with the NBS Presentation software. We then did a pilot-testing with 66 participants to get a valid rating of 15 non-words, which we then used as unexpected objects in the experiment. We then tested 80 participants in the laboratory and analyzed the data. As hypothesized, the unexpected objects remained unconscious in almost all participants but against our expectations there was no effect on affective judgements. As it is almost impossible to publish null findings based on a single experiment, we then designed and coded two follow-up studies for which we each tested 80 additional participants. The second experiment replicated our initial finding and generalized it to altered task settings (increase of unconscious processing of the non-words by a longer presentation time, larger fonts, and less distractors). In a third experiment we generalized our findings to a different stimulus category: We used symbols instead of non-words as unexpected objects because it has been questioned whether word binding can take place when stimuli are processed unconsciously.

The studies (N = 240) have already been published in the peer-reviewed Journal Consciousness and Cognition (IF = 1.9). I attached the paper for you.

Pugnaghi, G., Memmert, D., & Kreitz, C. (2019). Examining effects of preconscious mere exposure: An inattentional blindness approach. *Consciousness and Cognition*, 75, 102825.

Study 4: Exploring potential moderating factors (perceptual load; load theory)

In this study we explored whether different levels of perceptual load of the primary task influence the processing of unexpected and not consciously perceived stimuli. For this purpose, we adapted a paradigm established by Schnuerch, Kreitz, Gibbons & Memmert (2016) and implemented two load conditions. We hypothesized that the effect of interference between the unexpected numeral and the target number word will be continuously diminished with higher perceptual load of the primary task.

We did a literature research on the topic, designed the details of the study, and programmed the experiment with the NBS Presentation software. We then tested 80 participants in the laboratory and analyzed the data. We found a significant interference effect between the congruent and incongruent condition and therefore replicated the findings of Schnuerch et al. (2016). We also found a significant main effect of load (manipulation check). However, against our expectations, no significant interaction effect of load and condition was found. To substantiate this unexpected null finding and

generalize it to a slightly different method, we prepared a second experiment ($N = 114$) in which we tested even more participants and adapted the design closer to the original paradigm by Schnuerch and colleagues (2016). We replicated the findings of Experiment 1. Our results suggest that task-irrelevant stimuli might be allocated more attentional resources than originally assumed by the Perceptual Load Model, if they belong to the attentional set of the primary task. Therefore, preconscious processing of such unexpected stimuli might not primarily depend on perceptual load but dominantly on their relevance for the task at hand.

I attached the original version of the manuscript submitted to *Attention, Perception, & Psychophysics* (IF = 1.8) and the acceptance note from the editor for you.

Additional Study: Meta-analytic approach to preconscious processing despite inattention blindness

We additionally utilized a meta-analytic approach to explore the fate of those stimuli that are not consciously noticed due to inattention blindness. Findings concerning this research question have been scarce so far; while much research has been conducted on the determinants of inattention blindness far less research has been concerned with the fate of those objects that go unnoticed in such a setting. Few previous studies support the notion that objects that are not consciously noticed due to inattention blindness are still processed to a certain degree. Our meta-analytic study substantiated and generalized this limited evidence by reanalyzing 16 datasets in regard to participants' guessing accuracy in multiple-choice questions concerning the unexpected object: Participants who did not notice the critical object showed guessing accuracy that lay significantly above chance. Thus, stimuli that are not consciously noticed (i.e., cannot be reported) can nevertheless exert an influence on seemingly random choices. Modality of the primary task as well as performance in the primary task and in a divided-attention trial were evaluated as potential moderators. Methodological limitations as the design and implementation of the multiple-choice questions and the generalizability of our findings are discussed and promises of the present approach for future studies are presented.

The study has been accepted for publication in *The Quarterly Journal of Experimental Psychology* (IF = 2.5). I attached the manuscript and the acceptance note of the editor for you.

Comments on changes of the work program

Unfortunately, we were unable to collect the EEG data of Study 1 as planned in cooperation with the University of Bonn as the main collaborator left the university. Instead, we used the time and resources to design and code several follow-up studies on two promising lines of research and collected additional data: We performed two follow-up studies on Study 3 ($N = 160$ additional participants) and one follow-up study on Study 4 ($N = 114$ additional participants). Additionally, we conducted and published a meta-analysis in *The Quarterly Journal of Experimental Psychology*. Overall, the project produced three papers in reputable psychological journals.