German Sport University Cologne

Institute of Exercise Training and Sport Informatics

Head of Institute: Univ.-Prof. Dr. Daniel Memmert

The effect of semantic value on inattentional blindness

Doctoral thesis accepted for the degree

Doktor der Sportwissenschaft

by

Dennis Redlich

from

Bielefeld

Cologne, 2022

First reviewer: Univ.-Prof. Dr. Daniel Memmert

Second reviewer: Asst. Prof. Dr. Mauro Murgia

Chair of the doctoral committee: Univ.-Prof. Dr. Mario Thevis

Thesis defended on: 05.04.2022

Affidavits following §7 section 2 No. 4 and 5 of the doctoral regulations from the German Sport University Cologne, February 20th 2013:

Hereby I declare:

The work presented in this thesis is the original work of the author except where acknowledged in the text. This material has not been submitted either in whole or in part for a degree at this or any other institution. Those parts or single sentences, which have been taken verbatim from other sources, are identified as citations.

I further declare that I complied with the actual “guidelines of qualified scientific work” of the German Sport University Cologne.

…………………………………………..

Dennis Redlich, Cologne

Abstract

We often fail to consciously perceive a stimulus that appeared unexpectedly in our field of vision if our attention is focussed elsewhere. This failure of conscious perception has been termed inattentional blindness and can lead to major consequences for our daily life as well as sports performance. Various determinants have been identified that influence the likelihood of inattentional blindness. However, it is not clear whether the semantic value of a stimulus can affect whether or not this stimulus is consciously perceived under conditions of inattention. Therefore, this thesis includes six experiments with a total of 1226 participants to shed light on a stimulus´s semantic value as a determinant of inattentional blindness. Thereupon, this thesis provides a theoretical overview on the variety of methodological approaches used to investigate inattentional blindness and its prevailing definition.

My findings indicate that neither a stimulus´ semantic value based on personal meaning and created through monetary short-term reinforcement-based learning, nor a stimulus´ semantic value based on evolutionary meaning and modulated through the induction of perceived hunger on inattentional blindness influences the probability to consciously perceive an unexpected stimulus containing the respective semantic value. In contrast, my findings showed that a stimulus´s semantic value solely based on evolutionary meaning, namely the semantic value of primary reinforcers as facial expressions, seemed to partly influence its likelihood to be consciously perceived under conditions of inattention. Embedded in previous research, my own findings cannot confirm nor confute a general effect of a stimulus´ semantic value on inattentional blindness. These mixed findings rather demonstrate that a stimulus´ semantic value should be seen as an important but complex determinant of inattentional blindness. Also, in response to these mixed findings, the theoretical overview on the variety of methodological approaches used to investigate inattentional blindness provides the opportunity redefine, rethink and categorize potential subtypes of inattentional blindness as a

failure of awareness based on their underlying mechanism and its determinants. Theoretical and sports-related implications of the findings and the resulting conclusions are discussed.

Based on my findings presented in this thesis, I recommend future research on inattentional blindness to (a) take the different types of semantic value, their sources as well as their interactions into account, and (b) keep in mind that different paradigms with different operationalizations might have different underlying mechanisms.

Oft nehmen wir einen Reiz, der unerwartet in unserem Blickfeld auftaucht, nicht bewusst wahr, wenn unsere Aufmerksamkeit auf etwas anderes gerichtet ist. Dieses Versagen der bewussten Wahrnehmung wird als Unaufmerksamkeitsblindheit bezeichnet und kann erhebliche Folgen für unser tägliches Leben und unsere sportlichen Leistungen haben. Es wurden verschiedene Faktoren ermittelt, die die Wahrscheinlichkeit von Unaufmerksamkeitsblindheit beeinflussen. Es ist jedoch nicht klar, ob der semantische Wert eines Reizes einen Einfluss darauf hat, ob dieser Reiz unter Bedingungen der Unaufmerksamkeit bewusst wahrgenommen wird oder nicht. Daher werden in dieser Arbeit sechs Experimente mit insgesamt 1226 Teilnehmern durchgeführt, um den semantischen Wert eines Reizes als Einflussfaktor der Unaufmerksamkeitsblindheit zu beleuchten. Darüber hinaus gibt diese Arbeit einen theoretischen Überblick über die Vielfalt der methodischen Ansätze zur Untersuchung von Unaufmerksamkeitsblindheit und deren vorherrschende Definition.

Meine Ergebnisse zeigen, dass weder der semantische Wert eines Reizes, der auf persönlicher Bedeutung basiert und durch monetäres, kurzfristiges, verstärkungsbasiertes Lernen erzeugt wird, noch der semantische Wert eines Reizes, der auf evolutionärer Bedeutung basiert und durch die Induktion von wahrgenommenem Hunger auf Unaufmerksamkeitsblindheit moduliert wird, die Wahrscheinlichkeit beeinflusst, einen unerwarteten Reiz, der den entsprechenden semantischen Wert enthält, bewusst wahrzunehmen. Im Gegensatz dazu zeigten meine Ergebnisse, dass der semantische Wert eines Reizes, der ausschließlich auf der evolutionären Bedeutung beruht, nämlich der semantische Wert von primären Verstärkern wie Gesichtsausdrücken, die Wahrscheinlichkeit, dass er unter Bedingungen der Unaufmerksamkeit bewusst wahrgenommen wird, teilweise zu beeinflussen scheint. Eingebettet in die aktuelle Literatur können meine eigenen Ergebnisse eine allgemeine Wirkung des semantischen Werts eines Reizes auf die Unaufmerksamkeitsblindheit weder bestätigen noch widerlegen. Diese gemischten Befunde zeigen vielmehr, dass der semantische

Wert eines Reizes als ein wichtiger, aber komplexer Einflussfaktor der Unaufmerksamkeitsblindheit angesehen werden sollte. Als Reaktion auf diese gemischten Ergebnisse bietet der theoretische Überblick über die verschiedenen methodischen Ansätze zur Untersuchung der Unaufmerksamkeitsblindheit die Möglichkeit, potentielle Untertypen der Unaufmerksamkeitsblindheit basierend auf den zugrunde liegenden Mechanismen und dessen Einflussfaktoren neu zu definieren, zu überdenken und zu kategorisieren. Theoretische und sportbezogene Implikationen der Ergebnisse und die daraus resultierenden Schlussfolgerungen werden diskutiert.

Auf der Grundlage der in dieser Arbeit präsentierten Ergebnisse empfehle ich zukünftigen Forschungen zur Unaufmerksamkeitsblindheit, (a) die verschiedenen Arten von semantischer Wertigkeit, ihre Ursprünge sowie die Interaktion verschiedener semantischer Wertigkeiten zu berücksichtigen und (b) zu bedenken, dass verschiedenen Paradigmen mit unterschiedlichen Operationalisierungen unterschiedliche Mechanismen zugrunde liegen können.

Table of Content

List of Tables

List of Figures

Acknowledgements

This PhD journey at the DSHS has been challenging, stimulating and enriching. In finishing this thesis, this journey comes to an end and I would like to express my profound and sincere gratitude to those who have contributed to this successful journey.

First of all, I am sincerely and heartily grateful to my advisor, Prof. Dr. Daniel Memmert for the opportunity to start my PhD at this amazing institution and providing me with a framework of trust, freedom, support and guidance throughout my dissertation.

A special thanks goes to my mentor Dr. Carina Kreitz. Your detailed critique and encouraging feedback made me grow as a researcher. Your balanced way to challenge and support me, made grow as a person. Through all those years, you have been an inspiring mentor, role model, colleague and friend. Thank you.

Dr. Frowin Fasold and Prof. Antonis Hatzigeorgiadis, thank you for encouraging me to pursue a career in academia. Giulia, thanks for being the bundle of energy with the ability to recharge my motivation, discipline and good mood. Anne, thank you for the valuable complaining-sessions and encouragement-meetings at mountaintops, table-tennis courts and afternoon runs. Niels, thanks for enriching my office and life with fun, bread and happiness.

I also want to thank my actual and former colleagues Fabian, Ben, Robert, Michel, Max, Marius, Philip, Sebastian, Alexandra, Timo, Heinz, Ulrike, Marc, Raphael, Ann-Kathrin, and Doro for sharing knowledge, experiences and ideas. Thanks to Svenja and Thierry for proofreading and language editing. Furthermore, I want to thank all interns and students who contributed to my studies with their expertise, commitment, and reliability.

Last but not least, I would like to express my heartfelt appreciation to my family. Miriam, I am very grateful for your loyalty and unflinching support during the past years. Luisa, Tobias und Alexander, danke, dass ihr mein Leben mit Liebe und Lachen bereichert.

Mama und Papa, danke für eure bedingungslose Unterstützung und aufopfernde Liebe.
Nichts davon selbstverständlich.

1. Introduction

In invasion sports one might repeatedly wonder why a player in ball possession does not pass to a better positioned teammate or why a referee does not notice an obvious foul, although such situations happen in front of the players' or referees' field of vision. When the players and referees are asked about these situations after the game, they usually reply that they simply had not seen the seemingly obvious. Such an experience was also described by Vswanathan Anand, after missing a game winning move during the chess-world championship in 2014, who said "The thing is, when you're not expecting a gift, sometimes you just don't take it" (Dogers, 2014). These examples give reason to suspect that the understanding of attentional processes and conscious perception in different kinds of sports are essential to better understand performance in sports. Overlooking open teammates, fouls and game-winning moves seem to be reasonable as our perceptual and cognitive resources are strictly limited (Fecteau & Munoz, 2006), so that only a small part of the available sensory input is analyzed at any given time (Bundesen, 1990; Desimone & Duncan, 1995). Therefore, our limited resources need to be used effectively by prioritizing certain small parts of sensory information for analysis (Driver, 2001; Theeuwes, 1993). This process has been termed selective attention and is critical to the successful performance of any cognitive task, as it determines which aspects of sensory information are relevant for one´s goal of successful performance and thus, selected for cognitive processing, representation, and conscious awareness (Driver, 2001). However, one should be aware that selective attention is also accompanied by the exclusion of stimuli that are not goal relevant or critical to the successful performance as, for example, spectators in sports.

Although human perception has developed into a potent and efficient system, the exclusion of stimuli can cause astonishing failures of awareness: people tend to miss the second of two targets in a visual stream if both targets appear within 100-600 ms (attentional blink; Raymond et al., 1992; Shapiro et al., 1997), changes in a scene or a picture (change blindness; Rensink et al., 1997; Simons & Levin, 1997), or stimuli that are subsequent followed by a mask stimulus (visual masking; see Enns & Di Lollo, 2000; Kahneman, 1968). This thesis focuses on a unique failure of awareness in which people tend to miss an unexpected stimulus in our line of sight while being engaged in another task; a real-life example from soccer might be to miss a pass towards as a better positioned teammate in our direct view when dribbling the ball. This failure of awareness is a well-established phenomenon in the scientific literature termed as inattentional blindness (Mack & Rock, 1998). The unique characteristic of inattentional blindness is that the unexpected stimulus appears completely unexpected (Jensen et al., 2011).

Besides sports, investigating the perception of a truly unexpected object is of major relevance for our daily life as some unexpected stimuli can be life-threatening (Drew et al., 2013; Pammer & Blink, 2013). Furthermore, inattentional blindness rises the opportunity to investigate the framework of consciousness as the paradigm allows us to examine the conscious perception of a stimulus with minimized top-down guidance. This is due to the unexpected nature of the additional stimuli which precludes goal-driven allocation of attentional resources towards the unexpected stimulus.

The determinants of the probability that an unexpected object is noticed have been investigated extensively during the past two decades. Whereas some determinants of inattentional blindness (as personality and cognitive capacity) seem to have limited influence on the noticing rate of unexpected objects when attention is engaged elsewhere (e.g. Bredemeier et al., 2014; Kreitz et al., 2015a, Kreitz, Schnuerch, Gibbons, & Memmert, 2015), others seem to strongly determine the likelihood that an unexpected stimulus gets noticed. These determinants include the unexpected stimulus´s size (Mack & Rock, 1998), the period of the unexpected stimulus´s occurrence (Kreitz, Furley, & Memmert, 2016), or feature similarities of the unexpected stimulus with currently attended stimuli (Most, Simons, Scholl, Jimenez, et al., 2001). However, another determinant is assumed to especially impact the likelihood of noticing an unexpected object under conditions of inattention, namely a stimulus´s semantic value (Mach & Rock, 1998, p x). Although some studies have found an influence of different types of semantic value on the susceptibility to inattentional blindness as animacy (Calvillo & Jackson, 2014) or one´s name (Mack & Rock, 1998), others did not. Inconsistent evidence has been found for threat (New & German, 2015; Zhang, Wang et al., 2021) and no evidence was found for stimuli characteristics related to gains or losses in custom video games (Stothart, Wright et al., 2017), so that a general effect of semantic value on inattentional blindness remains unclear. To provide a better understanding throughout this thesis, the most important and frequently used terms and concepts will be defined and clarified in the following:

Inattentional blindness: Inattentional blindness is defined as the phenomenon that we often miss unexpected objects in our direct view when our attention is engaged elsewhere (Mack & Rock, 1998; Simons & Chabris, 1999). A variety of definitions have been put forward over the years, all sharing four core aspects: (1) inattention of the person experiencing inattentional blindness is created by a demanding primary task (Simons & Chabris, 1999; Mack & Rock, 1998), (2) the additional object is unexpected and occurs while the observer carries out the primary task (Jensen et al., 2011; Simons & Charbis, 1999), (3) the unexpected object occurs at or near fixation within the visual field (Newby & Rock, 1998), and (4) the unexpected object is identifiable as something new, distinctive, or unusual when one´s attention is not engaged in the primary task (Jensen et al., 2011). The measure of inattentional blindness is defined as “noticing rate” or “detection rate” of an unexpected stimulus when our attention is engaged elsewhere. For simplicity, in this thesis, I will consistently use the term *noticing rate*.

Semantic Value: In the context of this thesis, semantic value, also known as the stimulus´s meaning or importance, is understood as an umbrella-term encapsulating the strength of primary reinforcers and secondary reinforcers (adapted from Skinner, 1935). Such semantic value is assumed to lead to an attentional bias that involuntary drives attentional selection in favor of the meaningful stimuli (Maunsell, 2004). The semantic value of a stimulus will be established as our brain is optimized to learn about perceptual stimuli with a potential for procuring reward (Shuler, 2006; Seitz et al., 2009). A distinction might be made between different types of semantic value: semantic value of primary reinforcers and semantic value of secondary reinforcers. Primary reinforcers include stimuli that contain semantic value without any learning having taken place. Such stimuli can be seen as something that one will act to obtain (if positive) or avoid (if negative). One example might be spider stimuli (e.g., pictures) which might be something that one will try to avoid. Although no specific learning has taken place, the avoidance of spiders might evolutionary be related to physical health. Consequently, spiders might contain semantic value based on evolutionary developed primary reinforcers. In contrast, secondary reinforcers summarize stimuli that contain semantic value learned through a reinforcement-based learning process between the semantic value of a primary reinforcer and the respective stimulus. One example might be money, a secondary reinforcer that acquires semantic value of other primary reinforcers as food, sex or sleep through the social reinforcement-based learning process of social communication and interaction. Although these different types of semantic value could be considered independently, in practice they might always interact.

Consciousness and *awareness:* The term "consciousness" is widely used in a variety of scientific fields and is associated with different concepts. In the present thesis, consciousness will be referred to as the global availability of a stimulus to the organism for further cognitive processing, including verbal and nonverbal report (Dehaene, et al., 2017). More specifically, the focus in this thesis is on access consciousness as the ability to report what one is conscious of, in contrast to phenomenal consciousness as the subjective perceptual experience or feeling (Block, 1995). This distinction is important as our rich subjective experience (phenomenal consciousness) seems much larger than our ability to describe, report, or act on what we are conscious of (access consciousness; Bronfman et al., 2014; Phillips, 2018; Sperling, 1960). Since there is evidence that the subjective experience of rich content may be an illusion based on the inflation of visual experience to fill the whole picture (Odegaard et al., 2018; Ward, 2018), I refer to access consciousness in the context of inattentional blindness. Similarly, perceptual awareness is also seen as the subjective perceptual experiences that are accessible for report (Dehaene & Changeux, 2004; Lavie et al., 2014). For the sake of simplicity, I will use the terms consciousness and awareness interchangeably and refer to the definition of perceptual awareness and access consciousness. Since the report of subjective perceptual experiences can be considered as fundamental for awareness, participants of inattentional blindness studies will be considered as aware of an unexpected object if they have noticed the unexpected object and are able to report some of its defining characteristics (e.g., color, shape, location or direction of movement; Koivisto & Revonsuo, 2007; Kreitz, Pugnaghi, & Memmert, 2020; Most, Simons, Scholl, Jimenez, et al., 2001).

1.1 Aims of the thesis

The aim of this thesis is to extend the knowledge of a stimulus's semantic value as a potentially important determinant of inattentional blindness (Mack & Rock, 1998). Researchers have previously investigated the effect of semantic value on inattentional blindness (Lee & Telch, 2008; Mack & Rock 1998; New & German, 2015), but have yet to differentiate between several subtypes of semantic value and their underlying mechanisms. Consequently, many questions regarding a comprehensive view on semantic value as a major determinant of inattentional blindness and the integration of the hitherto gained knowledge remain open. I will review different types of semantic value with regards to their commonalities and differences on their effect on inattentional blindness. Hereby, my own experimental data will fill the gaps which have appeared in the literature.

The investigation of semantic value as one potential major determinant of inattentional blindness provides an extensive benefit for basic research in two ways. First, it adds to our knowledge on the principles of failure of awareness and, more in general, on the relationship between attention and awareness. A deep understanding of the factors driving inattentional blindness may help to enhance and develop theories on attention, perception, and consciousness (Jensen et al., 2011; Most, Scholl, et al., 2005; Simons & Chabris, 1999). The unique nature of inattentional-blindness paradigms also raises the opportunity to gain knowledge about the conditions that determine the preconscious distribution of attention as the occurrence of an additional stimulus is truly unexpected and therefore no attention can be distributed towards this stimulus in advance. Secondly, and besides the importance for basic research, inattentional blindness is not only useful to deconstruct the mechanisms of awareness (see, e.g., Pitts, Martínez, & Hillyard, 2012), but is rather highly relevant in our daily life. The semantic value of unexpected stimuli might play a special role as every aspect of our environment contains a certain amount of semantic value. This influences our preconscious distribution of attention with significant match-losing or life-threatening consequences in case of a disadvantageous distribution of attention (e.g., in sport, air and road traffic, surveillance, or medical diagnostics). Gained knowledge about the relationship between semantic value, attention, and awareness investigated with the phenomenon of inattentional blindness might, thus, have important practical applications and might provide a path to prevent such negative consequences. The use of traffic signs displaying wild animals (e.g., deer) is a good example for the practical application of our knowledge about the relationship between semantic value, attention, and awareness. Seeing such signs associates the deer with a high semantic value based on the reward to stay healthy and alive in case of avoiding a collision with a deer. Consequently, one will explicitly adapt one´s attentional distribution and increase the expectations towards deer on or close to the road. A better understanding of the relationship between semantic value, attention, and awareness might provide even more devices and mechanism in different fields, as traffic, medical diagnostics, or sports, to face the negative consequences of missing unexpected but valuable objects or events.

My research focuses on the question: If and to what extend does the semantic value of an event or object influence the likelihood of the respective event or object to cross the threshold of awareness? To answer this question, this thesis pursues three objectives:

The first objective of my thesis is to replicate and extend previous effects of semantic value on inattentional blindness. This is important as publications within the field of psychology are strongly biased toward reporting positive effects (Fanelli, 2010; Jasny et al., 2011; Makel et al., 2012). Therefore, the replication of previous studies is important as it contributes to a more balanced view on the state of art regarding the effect of semantic value on inattentional blindness and provides a strong foundation for further investigations on different types of semantic value. I will address this objective by answering Research Question I (Table 1).

The second objective of this thesis is to take a closer look on the different approaches to create or modulate the semantic value of a specific stimulus. This objective will be addressed by answering Research Question II (Table 1). To answer Research Question II, I will focus on general semantic value based on primary reinforcer (i.e., evolutionary relevance of faces), modulated semantic value based on primary reinforcer (i.e., stronger relevance of food after fasting), and semantic value based on secondary reinforcer created through a reinforcement-based learning process (i.e., monetary reward). Of course, my line of research will provide a useful insight but at the same time cannot enlighten and explain all aspects of the mechanisms underlying the effect of semantic value on inattentional blindness. Therefore, I will discuss and contrast my line of research within the existing literature, establish a more comprehensive view on the effect of semantic value on inattentional blindness, and provide a fruitful contribution to theories of inattentional blindness, conscious perception, and semantic value.

The third objective of this thesis is to review and discuss the used methodological approaches employed in inattentional blindness research. A better understanding and overview of the different methodological approaches could, on one hand, help to improve the comprehension of ambiguous findings and, on the other hand, might identify additional determinants of inattentional blindness which have been neglected so far. This objective will be addressed by answering Research Question III (Table 1). As an overview, the three research questions addressed in this thesis along with the publications that contribute to answering these are outlined in Table 1.

Table 1

Research questions addressed in the thesis and relevant publications

	Research Questions		Relevant Publications
I.	Does the semantic value of a stimulus influence the threshold of awareness towards the respective stimulus and, thus, the susceptibility to inattentional blindness?		Publication I, II, and IV
II.	Can the semantic value of a stimulus be modulated or established and thus, influence the threshold of awareness towards the respective stimulus?		Publication I, II, and IV
III.	Which methodological aspects should be considered when investigating inattentional blindness?		
	a.	Which paradigms are used to investigate inattentional blindness?	Publication III
	b.	Which paradigms are easily transferable and benefit to the real world?	Publication III

c.	Do different subtypes of inattentional blindness exist and are they covered by the prevailing and predefined core aspects of inattentional blindness?	Publication III

1.2 Approach and outline of the synopsis

The synopsis of this cumulative dissertation is based on four manuscripts reporting data from six experiments with a total of 1226 participants. Three manuscripts are published in international peer-reviewed journals and one manuscript is accepted as a preregistration in an international peer-reviewed journal (see Table 2).

Table 1

Publications Included in the Thesis

I.	**Redlich, D**., Schnuerch, R., Memmert, D., & Kreitz, C. (2019). Dollars do not determine detection: Monetary value associated with unexpected objects does not affect the likelihood of inattentional blindness. *Quarterly Journal of Experimental Psychology*, 72(9), 2141-2154.
II.	**Redlich, D**., Memmert, D., & Kreitz, C. (2021). Does hunger promote the detection of foods? The effect of value on inattentional blindness. *Psychological Research*, 1-12.
III.	**Redlich, D**., Memmert, D., & Kreitz, C. (2021). A systematic overview of methods, their limitations, and their opportunities to investigate inattentional blindness. *Applied Cognitive Psychology*, 35(1), 136-147.
IV.	**Redlich, D**., Memmert, D., & Kreitz, C. (2021). Clarifying the effect of facial emotional expression on inattentional blindness. *Consciousness and Cognition*, 87, 103050.

Chapter 2 offers a detailed overview on semantic value. In this overview, I will cover the underlying mechanism of semantic value, different types of semantic value, and its role in attentional prioritization.

Chapter 3 is devoted to the phenomenon of inattentional blindness. In the first part of this chapter, I will retrace the origin and development of inattentional blindness and refer to the widely used core aspects and definitions of inattentional blindness. To gain a better understanding of the phenomenon itself, I devote the second part of this chapter to consciousness theories and their role as underlying mechanism for inattentional blindness. The third part of this chapter reviews the determinants that might influence the probability of missing an unexpected stimulus when one´s attention is engaged elsewhere and aims to focus on physical as well as individual ones.

Chapter 4 addresses a stimulus' semantic value as a potential determinant of inattentional blindness. In the first part of this chapter, I will review different types of semantic value (primary or secondary reinforcers) and its influence on inattentional blindness, as well as integrate my own research findings into the existing inattentional blindness literature. In *Publication I,* I investigated the effect of semantic value based on monetary reward as a secondary reinforcer on the probability to notice an unexpected stimulus possessing characteristics associated with this specific semantic value. In *Publication II,* I investigated the effect of semantic value based on food pictures modulated by the circumstance of hunger as a probably more flexible primary reinforcer on inattentional blindness. In *Publication IV,* I investigated the effect of semantic value based on emotional facial expressions as more stable primary reinforcers on inattentional blindness whereby different emotional valences were considered. Based on the research findings, I will end this chapter by discussing the creation of semantic value based on reinforcement-based learning processes as well as methodological aspects.

Chapter 5 sheds light on the variety of methodological approaches used to investigate inattentional blindness and its prevailing definition. In *Publication III*, I systematically investigated the methodological approaches and paradigms used to investigate inattentional blindness and classified them based on their "representativeness" and "functionality".

Finally, in Chapter 6, I will summarize the key findings of my studies and integrate them into a general framework of determinants and mechanisms of inattentional blindness.

Furthermore, I will (1) discuss the prevailing definition of inattentional blindness, (2) suggest to redefine the core concepts defining/characterizing inattentional blindness, (3) propose three subtypes of inattentional blindness based on their underlying mechanism, (4) discuss the impact of my findings on theories of consciousness and semantic value, (5) consider the limitations of my studies and inattentional blindness research in general, and (6) conclude directions for further research.

2. Semantic value – Definition and theoretical foundation

As described in Chapter 1 the semantic value of a stimulus is understood as umbrella-term, which encapsulates the strength of primary and secondary reinforcers (adapted from Skinner, 1935). While primary reinforcers include stimuli that contain semantic value without any learning having taken place, secondary reinforcers include stimuli that contain semantic value which is acquired through, i.e., the repetitive association of a particular stimulus with reward (Anderson et al., 2011a, 2011b) or with punishment/loss (Kennedy & Most, 2012; Most, Chun et al., 2005; Most & Wang, 2011), and is termed reinforcement-based learning.

Several aspects seem to influence the reinforcement-based learning process and consequently the strength of the learned semantic value. For example, Wimmer and colleagues (2018) found that the periods of rest and time distribution in which the reinforcement-based learning process takes place have an impact on the strength of the learned semantic value. Similarly, the magnitude of the reward or loss during reinforcement-based learning seems to have an influence on the strength of the stimulus´ semantic value as targets previously associated with reward capture attention and depend on the magnitude of the prior reward (Anderson et al., 2011a, 2011b, 2012; Anderson & Yantis, 2013). This thesis will cover different types of semantic value which are associated to primary reinforcers or secondary reinforcers. These different types of semantic value can be considered individually as well as in combination. Raymond and O´Brian (2009) showed that faces (primary reinforcer) previously associated with monetary reward or punishment (secondary reinforcers) attract more attentional resources in an attentional blink paradigm than faces not associated with monetary reward or punishment. Such accumulations of reward or punishment associations do not only occur for different types of semantic value but also in combination with physical salience: Anderson and colleagues (2011a) demonstrated that stimuli that were already physically salient and previously associated with high reward were more distracting than stimuli that were physically salient stimuli and previously associated with low reward.

The accumulation of semantic value and its influence on attentional prioritization fits well into the framework of the Attentional Control Theory (Eysenck et al., 2007), a general model of information processing and attentional control. The Attentional Control Theory assumes that information processing and attentional prioritization act as a combined process through the interaction of two systems. The “stimulus-driven” attentional system reacts automatically to relevant information such as a stimulus´s semantic value (bottom up), whereas the “goal-directed” attentional system acts as executive control of information processing (top down). The distribution of attention starts with rapid and automatic processing of potentially relevant stimuli (bottom up) and is followed by schema-related processing in later phases of the information processing act (top down) which depends on individual strategies and abilities. Integrating our knowledge from the above reviewed literature, the “stimulus-driven” attentional system might react to stimuli containing high semantic value and distribute attentional resources to them. If a stimulus contains accumulated semantic values, it might even attract more attentional resources and, thus, attentional prioritization. As our attentional resources are limited it might occur that the amount of attention distributed by the “stimulus-driven” attentional system is very high (e.g., stimuli related to a phobia as spiders; Münsterkötter et al., 2015). Consequently, the attentional resources distributed through the schema-related processing of the “goal-directed” attentional system are not sufficient to follow executive goals and strategies so that the phobia related stimuli might be seen as distraction.

3. Inattentional Blindness

This thesis deals with the effects of semantic value on the phenomenon of inattentional blindness. Thus, this section is intended to provide a general understanding of this phenomenon and illustrate its roots and history, as well as introduce the most common paradigms used to investigate this phenomenon and review potential underlying mechanism.

3.1 Origins and commonly used paradigms

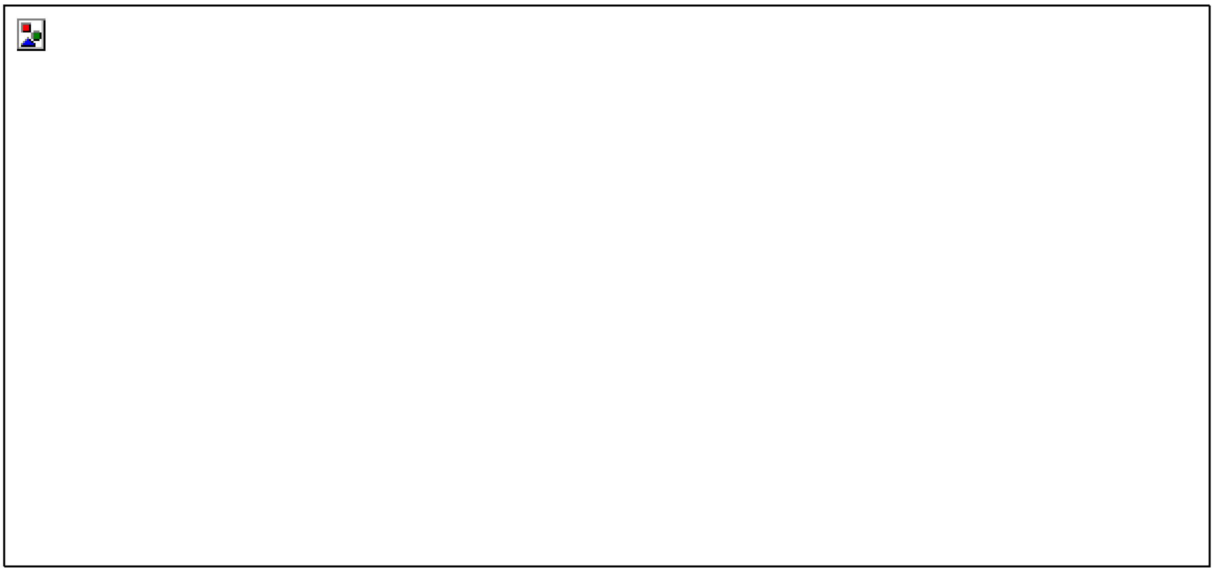
The roots of the phenomenon termed inattentional blindness lie in the work of selective attention (Cherry, 1953; Moray, 1959; Treisman, 1960) which was mainly based on auditory perception and utilized a dichotic listening paradigm (Cherry, 1953; Treisman, 1964; Treisman & Riley, 1969; Wood & Cowan, 1995). Neisser and his colleagues aimed to investigate the selective-attention effect in another modality and designed a visual analog of the auditory dichotic listening paradigm - the selective-looking paradigm (Neisser, 1979, Neisser & Becklen, 1975). This first selective-looking paradigm contained a superimposed video of three basketball players in black and three basketball players in white shirts passing a basketball within each group. Participants were asked to attend to one team and count their number of passes, while ignoring the other one. As the players pass the ball to each other an unexpected woman with an umbrella walks through the scene. In a subsequent interview, participants were asked about the woman with the umbrella. Only 21% of the participants indicated that they had seen her. In contrast, all participants reported the presence of the woman with the umbrella when no selective attention was instructed, i.e., when participants only watched the video and did not perform the counting task. Despite such surprising findings the scientific community neglected this type of research for the next years.

It took almost 10 years, until this phenomenon of failure of awareness was revisited by Arien Mack and Irvin Rock between 1988 and 1998. Similar to the findings by Neisser (1979), Mack and Rock (1998) found that unexpected objects are sometimes not consciously noticed when attention is engaged elsewhere. Since then, one cannot ignore the increasing research effort on this phenomenon (for an overview see *Publication III*). To be able to examine inattentional blindness as a specific failure of awareness, however, it must first be made tangible by an applicable definition. A first definition of inattentional blindness described the phenomenon as “the failure to see a highly suprathreshold stimulus at or near fixation owing to inattention” (Newby & Rock, 1998, p.1026). Simons and Chabris (1999) pursued this approach and defined inattentional blindness as the phenomenon “when attention is diverted to another object or task, observers often fail to perceive an unexpected object, even if it appears at fixation” (Simons & Chabris, 1999, p. 1060). Based on this, various authors have constantly developed and modified the definition of inattentional blindness, however, all inattentional-blindness paradigms share the characteristics outlined in Chapter 1. The probably most important and distinctive characteristic of inattentional-blindness paradigms is that the additional object is completely unexpected to avoid top-down guidance and deliberate splitting of attentional resources between the primary task and the unexpected stimulus (Jensen et al., 2011). To guarantee the additional object´s complete unexpectedness inattentional-blindness paradigms contain just one critical trial in which the unexpected stimulus occurs. If asked once about the unexpected object, one will subsequently potentially look for additional critical objects so that multiple critical trials are usually not valid to study unattended objects or events. When incorporating the outlined characteristics, inattentional-blindness paradigms constitute the best method to investigate conscious perception and its failures with minimized top-down guidance under conditions of inattention.

Mack and Rock (1998) were the first to investigate this phenomenon in a structured manner and coined it “inattentional blindness” in their book entitled with the same name. Their comprehensive work led to a multitude of experimental findings on inattentional blindness and was highly feasible as they used a simple static paradigm that was both flexible enough to easily change different parameters of the original paradigm to investigate several aspects of inattentional blindness and structured enough to ensure a high degree of experimental control. An exemplary visualization of this static paradigm is depicted in Figure 1. This static paradigm is widely known as “the cross task” and was already used in at least 35 inattentional blindness experiments (*Publication III*).

Figure 1

Schematic illustration of trials in the inattentional blindness cross-task (adapted from Mack and Rock, 1998).



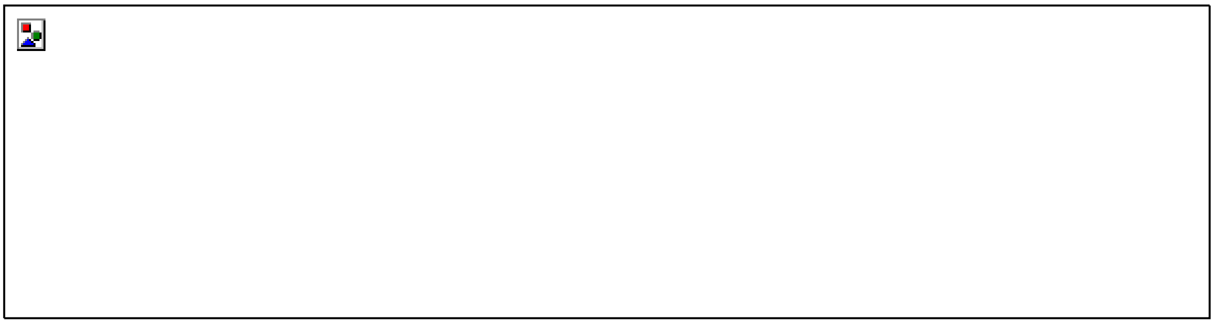
Note. (a) Standard trials during this phase, in which participants looked for the longer arm of the cross. (b) Critical trial, in which an unexpected object (colored shape) appeared next to the to-be-attended cross (from *Publication I*).

Due to its large contribution to the field of inattentional-blindness research, I will briefly outline the cross task: Participants are asked to focus on a fixation point for 1000 ms followed by a 200 ms presentation of two lines that bisect each other to form a cross. Afterwards they are instructed to judge the relative lengths of the two bisecting lines and identify the longer one. After several judgements were made an additional stimulus appears unexpectedly next to the cross for the whole duration of its presentation in a so-called critical trial and participants are asked about the appearance of the unexpected stimulus after solving the line-judgement task. Consistently, a substantial proportion of participants missed the unexpected stimulus. Besides all its above-mentioned benefits, the cross task also has drawbacks: The short presentation time of the critical stimulus and the sparse display make the task less realistic so that findings might not easily be generalizable and transferable to our daily life.

A more realistic and dynamic inattentional-blindness paradigm emerged in the late 1990s and has drawn much public interest in the following years: the gorilla video by Simons and Chabris (1999) whose chronical illustration is depicted in Figure 2. This paradigm was intended as a replication and extension of the selective-looking task by Neisser (1979): Participants watched a video for 75 seconds of three players dressed in white and three players dressed in black moving around in a random fashion and passing a basketball within their team. Participants were instructed to count the total number of passes made by one of the two teams. Forty-five seconds into the video, a woman with an umbrella unexpectedly passed through the scene for approximately five seconds. When asked about the unexpected woman afterwards, in line with Neisser (1979), only 42% of the participants reported seeing her. Similarly, many participants failed to notice a woman wearing a gorilla costume unexpectedly walking through the scene (*Experiment 2*; Simons & Chabris, 1999). The paper of Simons and Chabris (1999) is the most cited paper on inattentional blindness so far; the gorilla task has not only been replicated (Hüttermann & Memmert, 2012) but also adapted to the respective research aim by creating new video material (Wayand et al., 2005), using different video lengths (e.g., 30 seconds, Memmert, 2014; 45 seconds, Wayand et al., 2005), using different instructions (Grossman et al., 2015), and using additional unexpected events (Simons, 2010).

Figure 2

Chronical illustration (from left to right) of the inattentional blindness gorilla video task.

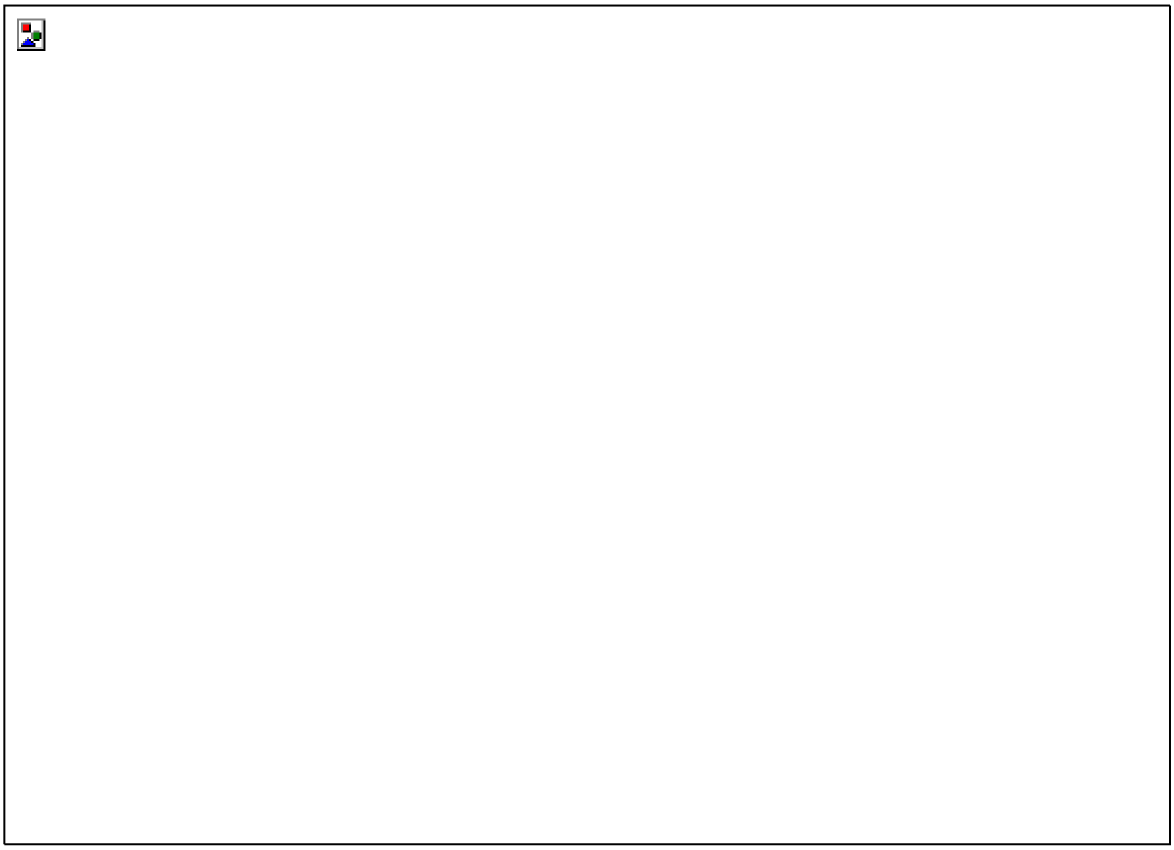


Note. Participants counted in a 75 second video the passes made by one of two teams (black or white). 45 seconds into the video, a woman wearing a gorilla costume unexpectedly walks through the scene. Figure provided by Daniel Simons.

The triumvirate of inattentional-blindness paradigms is completed by the object-tracking task (for a schematic illustration see Figure 3) of Most, Simons, Scholl, Jimenez, and colleagues (2001). The object-tracking task combines the benefits of a dynamic display (e.g., gorilla video; Simons & Chabris, 1999) with the controllability and flexibility of a laboratory task (e.g., cross tasks; Mack & Rock, 1998) and is the most frequently used paradigm in inattentional blindness research (*Publication III*). In this task, participants monitor two sets of simple shapes (e.g., letters) moving around a computer display for 15 seconds and bouncing of the edges of the display. Participants are asked to count to total number one set of shapes bounces off the edges of the display while ignoring the other set of shapes. On the critical trial, in addition to the main counting task, an unexpected stimulus moves horizontally across the display. Similar to the inattentional-blindness paradigms mentioned above, participants are asked about the number of bounces made by the shapes and if they noticed anything else on that trial. As in the other paradigms, a high number of participants usually fails to report the occurrence of the unexpected stimulus. As this paradigm is especially well suited to investigate determinants of inattentional blindness several studies adapted it for their respective scientific purposes by using target and distractor shapes with different luminance's (Most, Scholl et al., 2005), different unexpected objects (Guo et al., 2016), different trial durations (18 seconds, Zhang, Yan et al., 2017), different speeds of the unexpected objects (Kreitz, Furley, & Memmert, 2016), or different instructions (Wood & Simons, 2017).

Figure 3.

Schematic illustration of trials in the sustained inattentional-blindness task (from Publication I; adapted from Most, Simons, Scholl, Jimenez, et al., 2001).



Note. (a) Standard trial in which participants counted the total number of bounces off the edges display of the either black or white shapes. (b) Critical trial, in which an unexpected object (colored cross) moved through the display, while the primary task was performed.

Besides these most commonly used inattentional-blindness paradigms, several other paradigms have been designed to operationalize inattentional blindness and meet the specific needs of the respective research questions. Examples are picture-judging tasks (Pammer, Raineri et al., 2018; Pammer, Sabadas & Lentern, 2018), object-identification tasks (e.g., Calvillo & Hawkins, 2016; Gao & Jia, 2017; Koivisto & Revonsuo, 2007), tasks in real-world simulations (Murphy & Greene, 2016), or in the real world itself (Chabris et al., 2011; Simons & Schlosser, 2017), to name just a few. This diversity in paradigms and settings is a strong indicator for the robustness and external validity of the phenomenon; inattentional blindness can be found in all kinds of situations and with all kinds of settings, including a variety of primary tasks, stimulus durations, and stimulus characteristics.

3.2 Theories of inattentional blindness

In the following, I will review different theories which offer a starting point to shed light on the mechanism behind inattentional blindness and, more in general, on conscious perception. One common assumption of the following theories is that sensory, perceptual, and cognitive processes are reflected by neuronal activity expressed in event-related potentials (ERP). Studies investigating ERPs showed different stages of information processing often classified as primary (early) and secondary (late) processing of sensory input (Wang, et al., 2001). Specifically, it has been found that early processing of sensory information, represented by the ERP components P200 and N200, reflects basic sensory processing of stimuli, whereas late processing of sensory information, represented by the premotor potential (PMP) and the P300 waves, reflect higher level perceptual and cognitive processing of stimuli (Banaschewski & Brandeis, 2007).

Theories as the Global Neuronal Workspace Theory (e.g., Dehaene & Naccache, 2001) suggest that visual consciousness occurs during the late stages of signal processing, whereas other theories as the Recurrent Processing Model of Consciousness (Lamme, 2010) suggest that visual consciousness might already emerge during early stages of processing (for a review see Pitts, Lutsyshyna, & Hillyard, 2018). As inattentional blindness refers to the lack of visual consciousness towards an object in the central field of vision, I will briefly describe the main theories to which inattentional blindness might strongly contribute and which simultaneously might provide a deeper understanding of the phenomenon inattentional blindness.

The Global Neuronal Workspace Theory (Dehaene & Changeux, 2011; Baars et al., 2013) considers sensory visual information as conscious if it causes a non-linear amplification through widespread neural networks, including the fronto-parietal areas (Lau & Rosenthal, 2011), so that they are “globally accessible”. In this context attention acts as a “gate keeper” as it enhances the processing of attended sensory information within early visual areas (Reynolds & Chelazzi, 2004). Consequently, the neural representations of the attended sensory information are more likely to be consciously perceived compared to other sensory input. This approach illustrates why inattentional blindness is termed the way it is: Unexpected objects or events are not consciously perceived because one´s attention is engaged elsewhere. Due to the lack of attention, the processing of the unexpected stimulus is not enhanced by a global distribution of neuronal activity, thus, decreasing the likelihood of its conscious perception. As consciousness is based on the widespread distribution of neural information across the cortex in the global workspace theory, it implies that visual consciousness occurs at late stages of signal processing. Attention is regarded as prerequisite of consciousness (Cohen et al., 2012) and accordingly, top-down control (e.g., expectations) can drive attentional capture (Leber & Egeth, 2006).

Similarly, the model of Attentional Set by Most, Scholl and colleagues (2005), which is based on Neisser’s (1976) Perceptual Cycle Framework, aims to account for the occurrence of visual consciousness, especially in the context of inattentional blindness. Most, Scholl and colleagues (2005) argue that unexpected sensory information invokes a “transient, implicit shift of attention” (Most, Scholl et al., 2005, p 226). Based on the information’s consistency with one´s attentional set (defined as “tuning” of one´s attention for processing of specific types of stimuli) additional attentional resources are devoted to the information. In a series of experiments, Most, Scholl and colleagues (2005) manipulated the visual similarity of the unexpected stimulus to the target stimuli and showed that unexpected stimuli matching the current attentional set (i.e., features of the target stimuli) are more likely to cross the threshold of awareness. The attentional-set model, therefore, also highlights the importance of (late-) attentional processes in conscious perception.

In contrast, the Recurrent Processing Model of Consciousness by Lamme (2003, 2004, 2015) assumes that visual consciousness occurs at early stages of signal processing; sensory information can be recurrently processed within the areas of the visual cortical through feedback loops and horizontal connections and does not have to be distributed to other cortical areas to become conscious. Lamme (2010) suggests that any subsequent neuronal processing in higher cognitive subsystems could be seen as post perceptual and is, therefore, not directly associated with the generation of a conscious experience (Aru et al., 2012). The recurrent processing model of consciousness is also supported by studies on attentional processing by Theeuwes (2004) according to which low-level physical characteristics of stimuli are automatically processed with priority and capture attention in a bottom-up fashion.

In addition to the above-mentioned theories suggesting that observers fail to report an unexpected object because they never consciously perceived it, other theories argue that inattentional blindness may rather reflect the inability to access the information for report (e.g., Block, 2011; Vandenbroucke et al., 2014) or that inattentional blindness reflects a failure of memory, termed inattentional amnesia (Wolfe, 1999). Inattentional amnesia assumes that we may be aware of unexpected objects but fail to encode it into memory and, therefore, rapidly forget the information. Ward and Scholl (2015) specifically investigated this possibility by using an inattentional-blindness paradigm that left no time for memory decay. They concluded that inattentional blindness “reflects a genuine deficit in moment-by-moment conscious perception, rather than inattentional amnesia or inaccessibility" (Ward & Scholl, 2015, p727). Additionally, neurological investigations weaken the hypothesis of inattentional amnesia as a cause of inattentional blindness (for a review see Hutchinson, 2019).

3.3 Determinants of inattentional blindness

As this thesis is concerned with one specific determinant of inattentional blindness, I will start by reviewing determinants influencing the rate of noticing in general. These determinants can be grouped in physical, individual, and semantic ones. Physical as well as semantic determinants may be examined from two different perspectives as they can be assigned either as a characteristic of the context (context factors) or as a characteristic of the unexpected object/event. In this chapter, I will provide a comprehensive overview of physical and individual determinants of inattentional blindness and integrate my own research findings when appropriate. Due to their exceptional importance to this thesis, I will deal with semantic determinants separately in Chapter 4.

3.3.1 Physical determinants of inattentional blindness

Previous research strongly suggests a dominant role of physical attributes to the probability of inattentional blindness. In regard to the unexpected object's physical attributes, its size seems to influence noticing rates (Mack and Rock, 1998). Similarly, the pilot study in *Publication IV* showed that bigger face icons are more likely to be consciously perceived than their smaller counterparts. Additionally, colored stimuli have an increased likelihood to be detected under inattention compared to black and white stimuli (Koivisto et al., 2004) as well as moving stimuli compared to static ones (Memmert & Furley, 2007). In regard to location, it has been shown that unexpected stimuli located further away from the focus of attention (not fixation!) are less likely to be noticed than stimuli located near to the focus of attention (Kreitz et al., 2015b; Most, Simons, Scholl, & Chabris, 2000; Stothart et al., 2015). In dynamic paradigms it has been shown that the actual speed of a moving unexpected stimulus does not affect inattentional blindness, but the time a stimulus is visible on the screen does (Kreitz, Furley, & Memmert, 2016).

Besides physical characteristics of the unexpected stimulus itself, contextual characteristics influence the probability that an unexpected object is detected under conditions of inattention. One such context factor is the area within one´s attentional breadth, which one attends to, as a wide attentional breadth does not necessarily ensure the processing of stimuli within the attentional breath. In a recent study, Kreitz, Hüttermann and Memmert (2020) showed that individuals are more likely to miss an unexpected stimulus between two attended targets, and therefore within the attentional breadth, than outside of these bounds. The authors assume that an active inhibition of the area between two attended targets might explain these findings as it overlaps the attentional benefit to detect unexpected stimuli caused by a wider attentional breadth.

Besides the breadth of the attended area, the complexity (i.e., difficulty) of a primary task can modulate inattentional blindness rates by restricting the resources available in addition to the primary task (Simons & Chabris, 1999; Remington et al., 2014). Both, primary tasks with higher perceptual load (Calvillo & Jackson, 2014; Cartwright-Finch & Lavie, 2007) as well as a higher cognitive load (Fougnie & Marois, 2007; Todd et al., 2005) have been found to decrease the probability that an unexpected stimulus is detected. Furthermore, physical load in form of exercise performed during task completion seems to influence inattentional blindness (Hüttermann & Memmert, 2012).

3.3.2 Individual determinants of inattentional blindness

In addition to stimulus characteristics and context factors, individual differences have been investigated in the context of inattentional blindness. In this regard, some studies found older participants (de Liaño et al., 2020; Graham & Burke 2011) as well as young children

(Memmert, 2006a; Remington et al., 2014; Zhang, Yan et al., 2018) to be more susceptible to inattentional blindness.

In regard to cognitive conspicuities, gifted children seem to be less prone to inattentional blindness (Memmert, 2006b; Zhang, Zhang et al., 2016), similar to individuals with autism spectrum disorders (Swettenham et al., 2014), as well as individuals diagnosed with attentional deficit disorder (ADHD; Grossman et al., 2015). General fluid intelligence might be one cognitive mechanism that predicts inattentional blindness but should not be generalized to the cross-aging population; only older individuals who scored high in fluid intelligence were more likely to consciously process an unexpected stimulus (O'Shea & Fieo, 2015).

In contrast to intelligence, previous studies did not find any support for an influence of self-reported emotional characteristics such as levels of trait negative affect, hedonic depression, worry, or anxious arousal on the probability to miss an unexpected object under conditions of inattention (Bredemeier et al., 2014). Similarly, there was neither an effect for basic personality traits such as extraversion, neuroticism, agreeableness, conscientiousness, nor for personality-related dispositions such as behavioral inhibition, and behavioral activation, as well as achievement motivation, or schizotypy (Kreitz, Schnuerch, Gibbons, & Memmert, 2015). Only openness to new experiences (one of the Big Five basic personality traits; Benet-Martinez & John, 1998) explained a small fraction of variance in noticing rates; individuals that are more open to new interests, impressions, and ideas might, thus, also be more "open" to unexpected stimuli in an inattentional-blindness paradigm (Kreitz, Schnuerch, Gibbons, & Memmert., 2015). Ambiguous results have been found for other individual characteristics as the trait tendency to become absorbed in a momentary experience (i.e., absorption; Kreitz, Schnuerch, Gibbons & Memmert 2015; Memmert, Unkelbach, & Ganns, 2010).

Besides such rather stable group categorizations of individual characteristics, certain group categorizations might develop more flexible through one´s individual actions, as an expertise in a certain field. Across different domains, experts have been found to be less likely to miss an unexpected stimulus in their field of expertise, such as sports (Furley et al., 2010; Memmert, 2006a) or medical diagnostic (Drew et al., 2013). It seems that this expertise effect may be robust and valid within the respective domain of expertise, for example, experts in basketball were more likely to notice an unexpected stimulus in a computer task (Memmert, 2006a), as well as in a real-life basketball task (Furley et al., 2010). It is conceivable that experts (a) develop additional perceptual and cognitive skills (Drew et al., 2013) (b) learn to distribute their resources differently (Furley et al., 2010; Memmert, 2006a) or (c) already contain some type of pre-existent perceptual-cognitive skills to perform tasks in these fields more efficiently than novices and, thus, free up resources for processing additional critical stimuli. Besides one´s expertise, other more flexible individual characteristics have been found to influence inattentional blindness: Whereas the consumption of alcohol decreases the likelihood to detect an unexpected stimulus (Clifasefi et al., 2006), a crisis mindset (Shi & Li, 2020) increases the likelihood to detect an unexpected stimulus. Moreover, divergent thinking has been found to influence inattentional blindness (Memmert, 2009), a finding probably based on the relationship between creative thinking and a wider attentional focus (Hüttermann et al., 2019). Integrating all those findings, most effects can probably be attributed to a wider attentional distribution.

In addition to a wider distribution of attention, more cognitive resources per se might be beneficial when it comes to the detection of unexpected stimuli. One of the most frequently investigated cognitive mechanism in this regard is the individual working memory capacity. Findings are ambiguous, with some studies arguing for an effect of individual working memory capacity on inattentional blindness (Hannon & Richards, 2010; Richards, Hannon, & Derakshan, 2010; Richards, Hannon, & Vitkovitch, 2012; Richards, Hellgren, & French,

2014) while other studies found working memory capacity to affect inattentional blindness only under specific circumstances (Calvillo & Jackson, 2014; Kreitz et al., 2015a; Seegmiller et al., 2011), and some even found no effect at all (Beanland & Chan 2016; Bredemeier & Simons, 2012; Kreitz et al., 2015b, Kreitz, Furley, Memmert, & Simmons, 2016). Based on these mixed findings, I examined in the idea that working memory capacity might moderate the effect of monetary value on inattentional blindness (*Publication I)*. My findings do not support any significant interaction effects of working memory capacity and monetary value on the noticing rate of unexpected stimuli. Summing up, my findings as well as the previous literature cannot support a general and robust effect of individual working memory capacity on inattentional blindness.

Besides working memory capacity, a variety of individual cognitive mechanism have already been investigated in regard to their influence on inattentional blindness. One cognitive mechanism that is strongly linked to working memory capacity is one´s ability to spread attention spatially, namely the attentional breadth (Kreitz, Furley, Memmert, & Simons, 2015b). Kreitz, Furley, Memmert, and Simons (2015b) found neither an influence of the individual maximum breadth of attention nor of a global attention bias on the detection of an unexpected stimulus. These findings are in line with other studies showing no influence of the spatial breadth of attention on inattentional blindness (Memmert, Simons & Grimme, 2009; Richards, Hannon, & Derakshan, 2010; but see Memmert & Furley, 2007). Furthermore, other individual cognitive mechanism as short-term memory capacity (Hannon & Richards, 2010), the ability to suppress responses (Kreitz, et al., 2015a), inhibition (Richards, Hannon, & Derakshan, 2010), and processing speed (O'Shea & Fieo, 2015; Richards, Hannon, & Derakshan, 2010) have not been found to predict the probability of falling prey to inattentional blindness either.

4. Semantic value as a determinant of inattentional blindness

An interesting combination of stimulus characteristics and context factors constitutes the semantic value of critical stimuli, which might lead to an attentional bias in favor of the meaningful stimuli as described in Chapter 1. Right in the beginning of inattentional blindness research, Mack and Rock (1998) suggested that the semantic value of the unexpected stimulus significantly (or even dominantly) influences whether an unexpected stimulus succeeds in capturing attention and reaching consciousness under conditions of inattention. Therefore, following a comprehensive overview of already investigated semantic determinants of inattentional blindness, I will integrate and discuss my own research findings to answer the research questions addressed in this thesis.

4.1 Previous research

Inattentional blindness literature uses several labels (meaningfulness, importance, semantic salience, signal value) to describe the concept of semantic value. As mentioned in Chapter 1 and described in Chapter 2, a distinction might be made between different types of semantic value: semantic value of primary reinforcers and semantic value of secondary reinforcers.

4.1.1 Semantic value of primary reinforcers

Primary reinforcers contain semantic value without any learning having taken place; rather evolutionary processes predefined the respective meaning of a stimulus (see Chapter 1). The semantic value of primary reinforcers is assumed to be a stable predictor of inattentional blindness (Mack et al., 2002). Indeed, the semantic value of primary reinforcers based on predetermined evolutionary meaning, such as threats, affected the susceptibility to inattentional blindness (New & German, 2015). Other primary reinforcers, such as the emotional expressions of faces, are also associated with evolutionary predetermined semantic value; fittingly, cartoon-like happy faces were more likely to be noticed within an inattentional-blindness paradigm compared to other stimuli such as circles (Lee & Telch, 2008; Mack & Rock, 1998). Similarly, upright pictures of faces were detected with a higher probability than objects or inverted pictures of faces (Devue et al., 2009). Due to the same low-level physical characteristics of both, upright and inverted, pictures of faces the difference in noticing rates might be solely caused by the stimulus' semantic value as primary reinforcers.

However, findings on semantic value of primary reinforcers based on evolutionary meaning are ambiguous: For example, the presence of faces in a party scene alone did not result in higher noticing rate of this scene (Mack & Clarke, 2012). Indeed, Mack and Rock (1998) already highlight the complexity of semantic value even when associated with primary reinforcers. In contrast to cartoon-like happy faces, they found that cartoon-like sad faces were not more likely to be consciously detected than circles. Also, one might argue that these differences between circles and cartoons or pictures of faces are driven by low-level physical differences rather than differences in their semantic value (Devue et al., 2009, Lee & Telch, 2008). For instance, Mack and Rock (1998) did not find any differences in noticing rates when they compared scrambled faces and happy faces as well as scrambled faces and sad faces that shared the same physical properties (Mack & Rock, 1998). This finding was also supported by Lee and Telch (2008) who did not find significant differences between frowning cartoon faces and scrambled cartoon faces.

Besides faces with emotional expressions, also stick men (Mack & Rock, 1998) and human silhouettes (Downing et al., 2004) have been found to possess semantic value as primary reinforcers based on predetermined evolutionary meaning and influence the susceptibility to inattentional blindness. Accordingly, their noticing rates were higher than for figures as a Christmas trees (Mack & Rock, 1998) or object silhouettes (Downing et al., 2004). Integrating the findings of faces, stick figures, and human silhouettes, Calvillo and

Jackson (2014) postulated that, in general, animate (in contrast to inanimate) unexpected stimuli can be seen as primary reinforcers, thus, possess semantic value and are more likely to be detected under conditions of inattention. They applied and extended the animate-monitoring hypothesis (New et al., 2007) to the phenomenon of inattentional blindness and assumed that animated stimuli capture attention even without expectations or intentions. The strong evolutionary meaning of animate stimuli subsumes two types of stimuli: human animals and non-human animals (New et al., 2007). Humans can be seen as primary reinforcers possessing strong semantic value as they could be seen as family, friends, potential mates, and adversaries and, thus, bring social opportunities or dangers. Other animals can be seen as primary reinforcers possessing strong semantic value based on evolutionary meaning as they were of vital importance for our foraging ancestors; they could be predators, food, or a threat. Despite the catchy and simple distinction between animate and inanimate, there seem to be further differentiations within the animate category based on different evolutionary meanings for our foraging ancestors, thus, spider icons were more likely detected than a housefly icon (New & German, 2015). However, these findings need further replications and should be treated with caution, as Wiemer and colleagues (2013) showed that spiders do affect one´s skin conductance, but not one´s likelihood to consciously perceive them.

4.1.2 Semantic value of secondary reinforcers

In contrast to primary reinforcers, the semantic value of secondary reinforcers is learned through a reinforcement-based learning process between the semantic value of a primary reinforcer (reward or loss) and the respective stimulus as the secondary reinforcer (see Chapter 1). The reinforcement-based learning process can further take place in two different ways: a) an individual reinforcement-based learning process in which one interacts with the stimuli and events of one´s environment which establishes semantic value of secondary reinforcers based on personal meaning, and b) a social reinforcement-based learning process in which one interacts and communicates with society, which establishes semantic value of secondary reinforcers based on social meaning.

The semantic value of secondary reinforcers based on personal meaning can also be ascribed to task-relevant stimulus characteristics in a currently executed task, especially if the successful completion of the respective task is of one´s personal interest. A fitting example is the study by Pammer, Sabadas and Lentern (2018) in which participants had to judge driving situations in a picture taken from the driver’s perspective on its risk for a collision. Participants were more likely to miss motorcycles that faced away from an upcoming intersection (62%) than motorcycles that faced toward an upcoming intersection (33%). This is because motorcycles facing toward an upcoming intersection could be seen as a risk for a collision and are, thus, task relevant.

This type of value based on task relevance of secondary reinforcers is very similar to the concept of attentional set. One´s attentional set, can be defined as the cluster of stimuli characteristics that one attends to and prepares to respond to as part of the primary task. According to the contingent-capture hypothesis (Folk et al., 1992) only those characteristics of stimuli capture attention that are part of one´s attentional set. Indeed, previous studies found that an unexpected stimulus is more likely to be detected if one of its characteristics, such as its luminance, is identical or similar to the luminance of the attended stimuli of the primary task. For example, a black unexpected stimulus is more likely to be detected than a white or even a completely distinct (e.g., red) unexpected stimulus when black stimuli of a primary task are selectively attended while white stimuli of the primary task are selectively ignored (Most, Simons, Scholl, Jimenez, et al., 2001; Simons & Chabris, 1999). Furthermore, capturing attention of characteristics which are part of the attentional set may not be a binary but rather continuous selection process, as indicated in a study by Most, Scholl et al. (2005). The authors showed that an unexpected black stimulus was detected by 94% of participants, whereas gray (44%), light gray (12%) and white stimuli (0%) were detected to a lesser extent by participants when they had to attend to black stimuli in the primary task. Besides luminance, effects of the attentional set also apply to other characteristics, such as shape (Most, Scholl, et al., 2005) or color (Most & Astur, 2007). Uncovering the underlying reinforcement-based learning process, Koivisto and Revonsuo (2008) found that it is the selective attention to target items of a primary task, rather than the selective ignoring of distractor items of the primary task, that associates the target items with semantic value.

In contrast, other types of semantic value based on personal meaning, such as stimulus characteristics related to gains or losses in custom video games, have not been found to affect the probability of this failure of awareness (Stothart, Wright et al., 2017). Based on these contradictory findings one might suggest that the semantic value of secondary reinforcers based on a stimulus´ personal meaning is quite complex and might change over time with individual circumstances and needs. One example for such complex and specific semantic value based on personal meaning is the finding by Li et al. (2015), showing that the personal meaning, and thus semantic value, of ice-cream is only strong enough to influence conscious detection for female participants who experienced strong ice-cream cravings (which might be based on a personal reinforcement-based learning process).

Another example for the influence of semantic value based on personal meaning is one´s own name. Mack and Rock (1998) showed that the semantic value of one´s name influenced the noticing rate of an unexpected stimulus; whereas 50% of the participants felt prey to inattentional blindness when the unexpected stimulus was a common noun, only 12.7% did so when the unexpected stimulus was their own name (Mack & Rock, 1998). Thus, one´s own name seems to possess a strong semantic value based on personal meaning, even more than the value of names in general (35% of the participants failed to detect other names when they appeared unexpectedly). Confounding variables can be discarded as neither the change of one letter in the participant’s name, nor the use of other daily used words seem to increase noticing rates (Mack & Rock, 1998; see also Mack et al., 2002). Therefore, the increased semantic value of one´s own name might be unique for each individual as the respective reinforcement-based learning process applies especially to one´s individual name. These findings are supported by a similar effect in the auditory domain (Moray, 1959) and its transfer into daily life (“Cocktail party effect”; Cherry, 1953).

Building up on their findings concerning personally relevant words, Mack and Rock (1998) also found that words associated with a more general semantic value, as the word “STOP”, are more likely to be consciously detected than other words. The word “STOP” usually gains semantic value through a social reinforcement-based learning process in order to maintain physical and emotional wellbeing of oneself and one’s environment. Social reinforcement-based learning does not take place in a single individual but rather in a social group of individuals, so that each individual also benefits from the learning experiences made by others. Reinforcement-based learning experiences made by others can also lead to stereotypes, which in turn can influence one´s attentional distribution and consequently one´s conscious perception (Brown-Iannuzzi, et al., 2014)

4.2 Answer to Research Question I

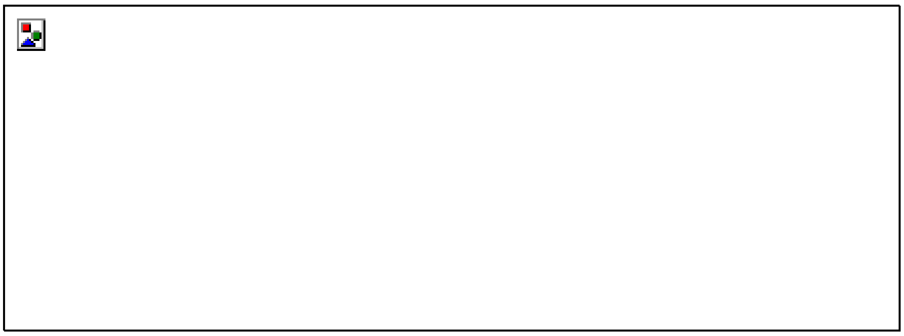
Research Question I (“Does the semantic value of a stimulus influence the threshold of awareness towards the respective stimulus and, thus, the susceptibility to inattentional blindness?”) has been partially covered by the previous literature. However, the resulting findings do not paint a clear and conclusive picture of the influence of semantic value on inattentional blindness but rather strongly adumbrate such an effect. Therefore, I set out to contribute to a more conclusive and general picture of the semantic value´s influence on inattentional blindness and aimed to replicate and extend previous findings. First, I investigated the effect of semantic value of secondary reinforcers learned through monetary reward. This was done in *Publication I,* in which a total of 537 participants first learned the association between a color and a monetary reward value (high, low, or none reward) and afterwards performed an inattentional-blindness task. For *Experiment 1* in *Publication I*, I used a static inattentional blindness-paradigm in which the unexpected object occurred for 200 ms. In *Experiment 2*, I generalized the findings of *Experiment 1* to a dynamic paradigm and controlled for a potential influence of the limited time to perceive and process the semantic value of the unexpected stimulus by presenting the unexpected object for 3880 ms. Furthermore, I controlled for a successful manifestation of the stimulus´ semantic value (i.e., association between a certain stimulus colors and different types of monetary value) by using the exact same training phase as Anderson and colleagues (2011a) used successfully in combination with different attention tasks. Additionally, I successfully replicated the effect of monetary value on attentional capture in a visual search task, as found by Anderson and colleagues (2011a), in the *Pre-study* of *Publication I*. Nevertheless, the findings in *Experiment 1* and *Experiment 2* (*Publication I*) did not support the assumption that the semantic value of a secondary reinforcer based on the personal meaning of monetary reward affects the probability of inattentional blindness: My findings revealed that stimuli possessing a color associated with high monetary reward were not more likely to be detected than stimuli possessing a color associated with low monetary reward or stimuli containing a color not at all associated with monetary reward. Thus, whereas the established semantic value is strong enough to influence a visual search task (pre-study; Anderson et al., 2011b, Anderson, 2013, 2016), it does not seem to be strong enough to affect whether or not an unexpected stimulus crosses the threshold of awareness.

Moreover, these findings seem to support the assumption that the underlying mechanism of semantic value based on personal meaning, as monetary reward in *Publication I*, might be rather complex and flexible. According to the aim to cover the semantic value of a stimulus as a whole and provide evidence for a general effect of semantic value on inattentional blindness, in *Publication II* and *Publication IV* I focused on semantic value of primary reinforcers based on evolutionary meaning as it might be a more stable construct of semantic value with a probably clearer influence on inattentional blindness. For this, instead of transferring effects of semantic value from one attentional mechanism to another (as from visual search to conscious perception in *Publication I*), I aimed to replicate, extend, and generalize an effect of semantic value that already existed in inattentional blindness. More specifically, in *Publication II*, I built on the work by Li and colleagues (2015) who investigated the effect of semantic value associated with ice-cream as a specific food on the susceptibility to inattentional blindness. Ice-cream contained semantic value as a primary reinforcer based on the evolutionary meaning of food, as well as a secondary reinforcer based on the personal meaning through high or low level of ice-cream cravings; for participants with a high level of ice-cream craving the semantic value of ice cream as a secondary reinforcer should be strong, whereas for participants with a low level of ice-cream craving its semantic value as a secondary reinforcer should be rather weak. Indeed, Li and colleagues (2015) found that ice-cream stimuli associated with high semantic value (i.e., in participants with high ice-cream craving) were more likely to be noticed than ice-cream stimuli associated with low semantic value. In order to extend and generalize the work by Li and colleagues (2015), I used a broader variation of food cues (burger, chocolate, bread) and furniture cues (sofa, bucket, chair), examined males as well as females, and aimed to increase the semantic value of the food cues, as primary reinforcers, by manipulating the participants' hunger instead of focussing on a specific food craving in *Publication II*. I assumed that a person's hunger is an optimal evolutionary mechanism of a primary reinforcer to investigate a more general effect of semantic value on inattentional blindness since hunger constitutes an evolutionary highly relevant physiological state. Indeed, cognitive effects of hunger have already been found in other paradigms, such as selective attention (Mogg et al., 1998), memory (Morris & Dolan, 2001), attentional shifting (Piech, Hampshire et al., 2009), and attentional capture (Piech, Pastorino, & Zald, 2010). Thus, I assumed that hunger would increase the food stimuli´s goal-relevance (since the goal should be to satisfy hunger with food), thereby increasing the food stimuli´s semantic value, and consequently, increasing the food stimuli´s probability to be detected under conditions of inattention. A total of 240 participants first completed a hunger (16 hours of fasting) or satiation (no fasting) manipulation and afterward performed a static inattentional-blindness task (adapted from Mack and Rock, 1998). In contrast to my expectations, the findings of *Publication II* revealed that hunger neither led to higher noticing rates for unexpected stimuli in general, nor did it increase the probability to consciously perceive food stimuli specifically. These findings do not support a general effect of the primary reinforcers´ semantic value based on the evolutionary highly relevant physiological state of hunger. Similar to semantic value based on personal meaning of monetary reward (*Publication I*), the evolutionary semantic value of primary reinforcers based on hunger seems to have an influence on cognitive mechanism in general (e.g., attentional selection) but might sometimes be too weak to be found in other - less sensitive - phenomena, such as inattentional blindness.

In *Publication IV*, I investigated the effect of emotional facial expressions as primary reinforcers on inattentional blindness, as faces seem to inherently possess semantic value based on evolutionary meaning (Devue et al., 2009; Mack et al., 2002). Thus, in contrast to *Publication I* and *II*, no additional creation or modulation of semantic value was needed. In order to clarify the inconsistent findings of previous studies (Devue et al., 2009; Lee & Telch, 2008; Mack & Rock, 1998) and investigate the effect of emotional facial expressions as primary reinforcers and their semantic value based on evolutionary meaning, I aimed to replicate previous findings (Lee & Telch, 2008; Mack & Rock, 1998) with two different types of paradigms and sufficient statistical power (457 participants). I used happy, frowning, and scrambled faces as unexpected stimuli (see Figure 4) in a static inattentional-blindness paradigm (*Experiment 1*; adapted from Mack & Rock, 1998) and in a dynamic inattentional-blindness paradigm (*Experiment 2*; adapted from Most, Simons, Scholl, Jimenez, et al., 2001).

Figure 4

Illustration of the shapes of the unexpected stimuli used in both Experiments of Publication IV.



Note. The unexpected stimuli were drawn in black for *Experiment 1* and drawn in white for *Experiment 2* (adapted from *Publication IV*).

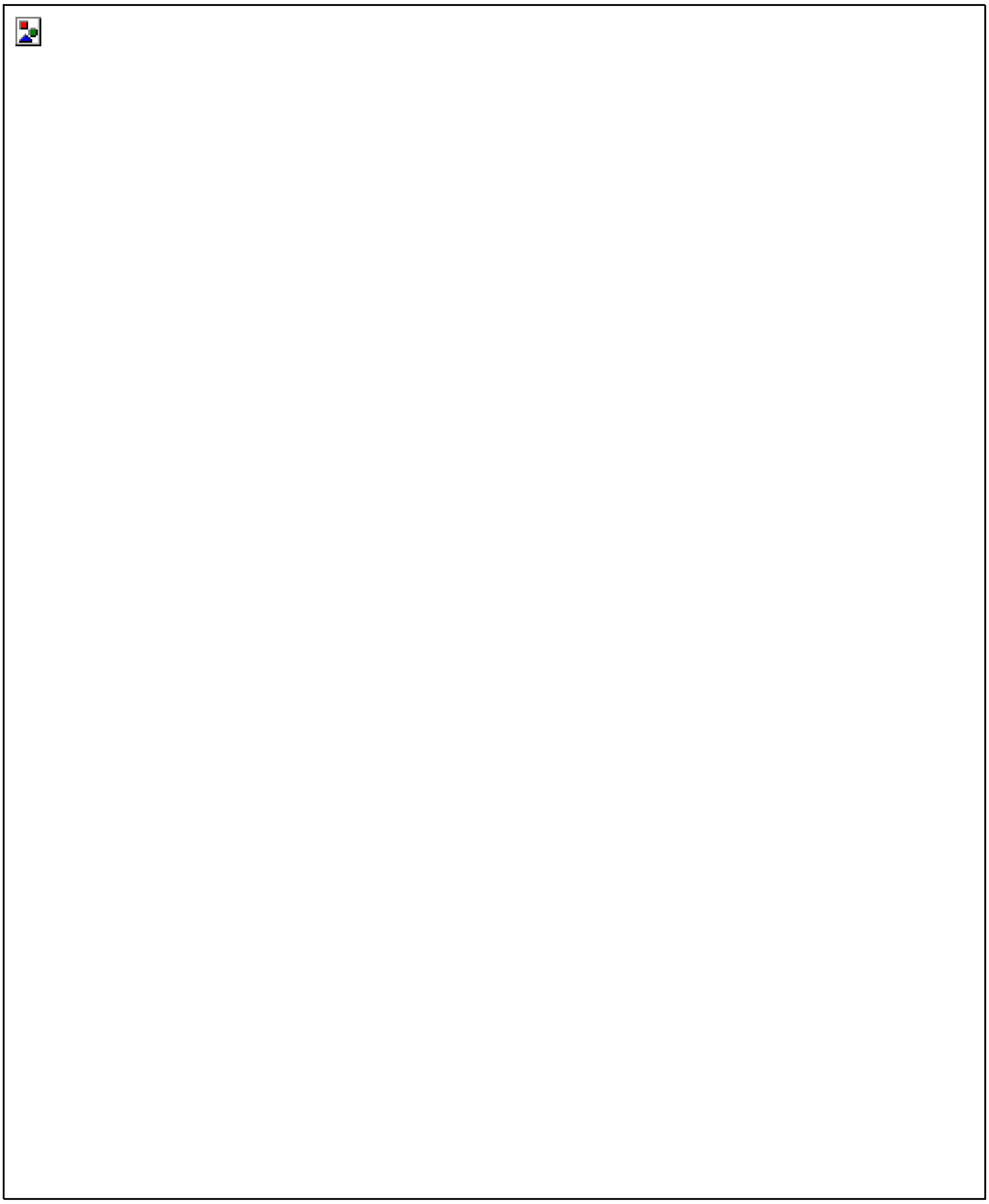
My findings showed that the likelihood to consciously detect an unexpected stimulus under conditions of inattention is only partly influenced by its semantic value based on facial emotional expressions. Participants were coded as noticers, if they reported that they had noticed the unexpected stimulus in the critical trial and correctly defined the location /movement direction or shape of the unexpected stimulus; here, only frowning faces were detected significantly more often and only in the static inattentional-blindness paradigm (Figure 5A) but not in the dynamic inattentional-blindness task (Figure 5B). In the additional analyses, I applied different definitions of noticing, namely the (a) *face identification* and the (b) *valence identification.* Participants were coded as noticers based on the correct *face identification* when they reported that they had noticed the unexpected stimulus in the critical trial and also correctly reported the location/ movement direction of the unexpected stimulus and that it was a scrambled or intact face (shape type). Participants were coded as noticers based on the correct *valence identification* when they reported that they had noticed the unexpected stimulus in the critical trial and also correctly reported the location/ movement direction of the unexpected stimulus and the exact shape of the unexpected stimulus.

Interestingly, though, the likelihood to *identify* an unexpected stimulus under conditions of inattention was strongly influenced by its semantic value based on facial emotional expressions independent of the expressions emotional valence (Figure 5).

In five experiments in *Publication I*, *Publication II*, and *Publication IV*, I systematically investigated the effect of different types of semantic value on inattentional blindness. I created semantic value of secondary reinforcers based on personal meaning through monetary reward (*Publication 1*), modulated semantic value of primary reinforcers based on evolutionary meaning by a hunger induction (*Publication II*), and utilized the inherent semantic value of primary reinforcers based on the evolutionary meaning of emotional facial expressions (*Publication IV*). In line with previous findings that employed pre-established types of semantic value, for example based on the semantic value of primary reinforcers based on the evolutionary meaning of threat (New & German, 2015) or the semantic value of secondary reinforcers based on the personal meaning of overlearned and self-related stimuli as one´s name (Mack & Rock, 1998), I found an effect of primary reinforcers´ semantic value based on emotional facial expressions on the susceptibility to inattentional blindness. Nevertheless, I neither found an effect of semantic value of secondary reinforcers based on personal meaning of monetary reward through reinforcement-based learning, nor did I found an effect of semantic value of primary reinforcers based on evolutionary meaning modulated by hunger.

Figure 5

Noticing rates of the used unexpected stimuli (happy face, frowning face, & scrambled face) based on the different definitions of noticers (adapted from Publication IV).



Note. Noticing rates of the used unexpected stimuli in (a) the static inattentional-blindness paradigm of *Experiment 1* and (b) the dynamic inattentional-blindness paradigm of *Experiment 2*. Significant differences have been found for different definitions of noticers; * p < .05, ** p < .01, *** p < .001.

With regard to Research Question I, the findings of my research seem to discard a general effect of semantic value on the conscious perception of unexpected stimuli but further provide evidence for the complex and context-dependent mechanisms that underly the semantic value of stimuli. One important moderating factor for the creation of semantic value might be the duration of the reinforcement-based learning process in which a stimulus´ semantic value is established. Semantic value created through a long-term reinforcement-based learning process might be stronger compared to semantic value created through a short-term reinforcement-based learning process. In addition, the findings of *Publication IV* indicate that methodological aspects, as the operationalization of inattentional blindness, might contribute to the mixed findings prevalent in the literature. Instead of simply comparing and summarizing the mixed findings of the literature, each finding should rather be considered in its respective context taking the type of paradigm, the used unexpected stimuli, and the definition of inattentional blindness including noticing/detection as well as identification /recognition-rates into account (for a detailed discussion see *Publication III*). My findings highlight the need for a more differential approach in which the experimental context of each finding is considered.

5. The creation of semantic value and its influence on inattentional blindness

A stimulus´ semantic value can be based on a predetermined evolutionary meaning, as the semantic value of primary reinforcers, or is acquired through social or personal reinforcement-based learning, as the semantic value of secondary reinforcers (adapted from Skinner, 1935). One might wonder if a reinforcement-based learning process can be experimentally performed or guided to create semantic value, perhaps even within a short period of time. A successful stimulus specific creation of semantic value through experimental reinforcement-based learning might provide a promising tool to prevent inattentional blindness for stimuli of major relevance for our daily life in sports (Furley et al., 2010), traffic (Pammer & Blink, 2013), and medical diagnostic (Drew et al., 2013). This section will take up this idea and aims to answer Research Question II ("Can the semantic value of a stimulus be modulated or established and, thus, influence the threshold of awareness towards the respective stimulus?"). To answer this question, I will review the previous literature on the creation and modulation of semantic value and its relevance for their influence on inattentional blindness. Furthermore, I will integrate my own findings to extend the possibilities of short-term reinforcement-based learning of a secondary reinforcer´s semantic value and short-term modulation of a primary reinforcer´s semantic value.

5.1 Previous research

One determinant of semantic value might be the period in which it was established through reinforcement-based learning; this period of learning seems to affect the strength of a stimulus´s semantic value. Although, according to Skinner (1935), the semantic value of primary reinforcers arises without any learning having taken place, one might argue that the evolutionary process responsible for the semantic value of primary reinforcers might also be considered as an evolutionary and consequently long-term reinforcement-based learning process. In contrast, the semantic value of secondary reinforcers is based on social or personal reinforcement-based learning processes which apply over different periods of time.

5.1.1 Semantic value created through long-term reinforcement-based learning processes and inattentional blindness

The probably longest period of reinforcement-based learning might be the evolutionary process itself establishing the semantic value of primary reinforcers, as animated stimuli (New & German, 2015), faces (Devue et al., 2009), as well as silhouettes and stick figures of human bodies (Downing et al., 2004).

The semantic value of secondary reinforcers can also be established through personal long-term reinforcement-based learning processes over a lifetime, such as the semantic value of one´s name (Mack & Rock, 1998), or social stereotypes, such as the erroneous African American–ape association (Rattan & Eberhardt, 2010), as well as social long-term reinforcement-based learning processes over several years, such as the semantic value of social relevant stimuli as the word “STOP” (Mack & Rock, 1998)

5.1.2 Semantic value created through immediate reinforcement-based learning processes and inattentional blindness

The semantic value based on long-term reinforcement-based learning might persist long after the learning process. In contrast, the semantic value of task-relevant secondary reinforcers persists only for a short time during the task itself, whereas the task itself can be seen as a short-term reinforcement-based learning process. The immediate created semantic value grounded in a personal short-term reinforcement-based learning process and its effect on inattentional blindness has been shown in the full-attention trials of several studies; the noticing rates strongly increased when participants were asked to explicitly look for the unexpected stimulus (e.g. Jingling & Yeh, 2007; Lathrop et al., 2011; Wiemer et al., 2013). Higher noticing rates have also been found for unexpected stimuli sharing physical characteristics with those stimuli which participants attended to during the primary task (i.e., match one´s attentional set; Most, Scholl et al. 2005, Most & Astur, 2007). This is due to the fact that the unexpected stimulus contains semantic value based on task relevance (Most, Scholl et al., 2005).

Besides the immediate creation of semantic value and the creation of semantic value established through evolutionary, social or personal long-term reinforcement-based learning processes, one might assume an interface as semantic value created through short-term reinforcement-based learning. Up to my knowledge, only Kreitz and colleagues, (2015b) aimed to raise this notion and investigated whether short-term reinforcement-based learning, as the pre-activation of semantic value associated with a stimulus´s physical characteristic, affects inattentional blindness. In their second experiment, participants had three minutes to read and memorize a short story that conspicuously featured multiple concepts strongly related to the colour of the unexpected stimulus before completing the inattentional-blindness paradigm. However, short-term reinforcement-based learning as the pre-activation of a color through a short story did not moderate the failure to consciously perceive an unexpected stimulus characterised through the preactivated colour, compared to a stimulus of which the color was not preactivated. Therefore, the authors assume that pre-activations without motivational relevance for a specific goal or task does not create the necessary semantic value for a stimulus or stimulus’s characteristic to cross the threshold of awareness. However, the difference between pre-activation and short-term reinforcement-based learning might prevent potential effects of semantic value: no reinforcement takes place in the used types of pre-activation, as reading a story or thinking about words related to a specific stimulus´s characteristic (i.e., color).

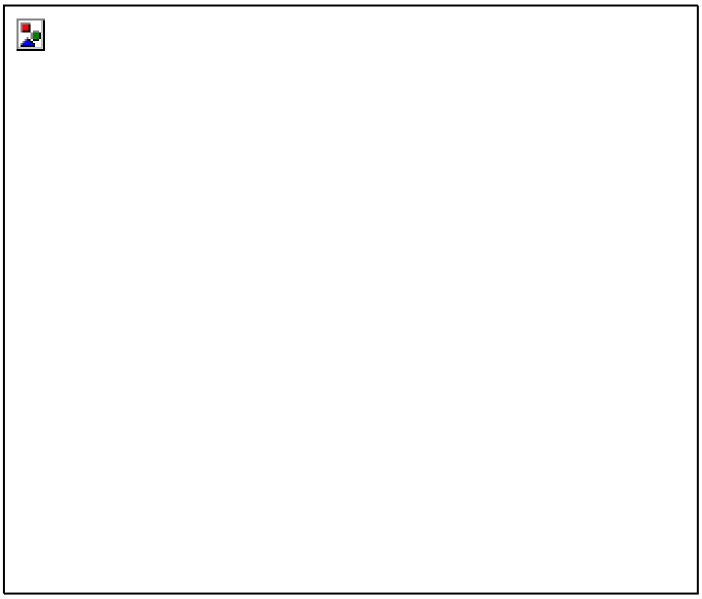
5.2 Answer to Research Question II

Based on previous research, the question whether semantic value can be created or modulated through short-term reinforcement-based learning to help a stimulus cross the threshold of awareness remains open (Research Question II). To close this gap, I set out to investigate the creation of semantic value through short-term reinforcement-based learning and their influence on inattentional blindness by using monetary reward (*Publication I*) as well as a modulation of participants' physical state (*Publication II*).

My approach in *Publication I* was based on previous literature, in which short-term reinforcement-based learning has already been shown to increase attentional capture during a subsequent visual-search task (Anderson, 2016; Anderson et al., 2011a); this effect was stable even if the respective stimulus characteristic was task irrelevant, physically non-salient, and no longer linked with monetary reward in the test phase (e.g., Anderson et al., 2011a, 2011b; Anderson & Yantis, 2012, 2013). Such automatic orientation of attention to stimuli associated with monetary reward has been termed *value-driven attentional capture* (Anderson et al., 2011b) and might be explained by an increase in a stimulus´ semantic value based on personal meaning. The reinforcement-based learning process itself was a training phase of 240 (Anderson et al., 2011b; Anderson et al., 2012), 300 (Anderson & Yantis, 2012), or 1,008 trials (Anderson et al., 2011a, 2011b). These findings suggest that stimuli (or stimulus characteristics) can be associated with semantic value in an experimental setting and create an attentional bias in subsequent tasks. The question remains, if such a bias can be strong enough to influence whether an unexpected stimulus crosses the threshold of awareness or not.

Figure 6

Schematic illustration of a trial during the training phase (details not drawn to scale; from Publication I).



Note. Participants responded to the orientation (vertical versus horizontal) of the bar in the ring whose color corresponded to one of the two target colors (blue, orange).

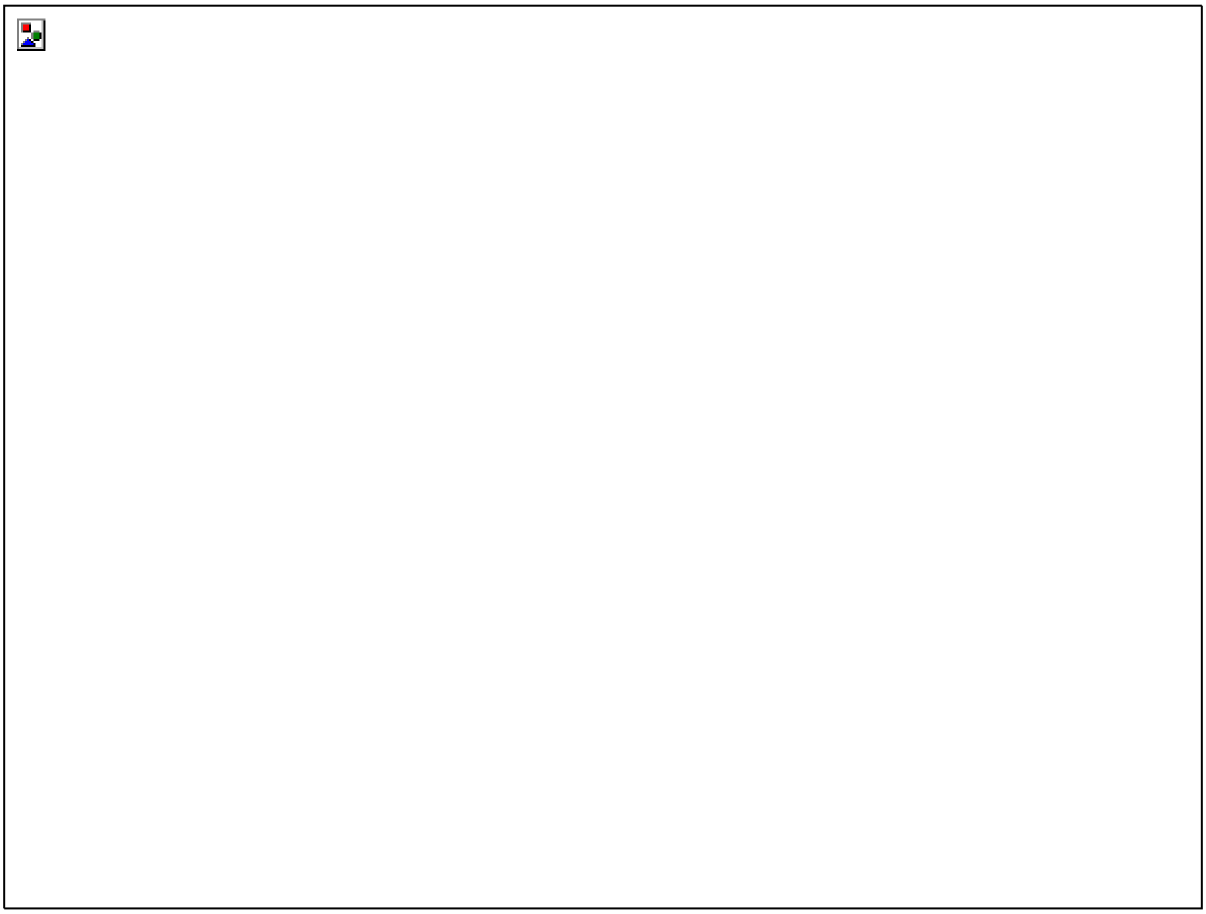
Therefore, in *Publication 1* I employed the training phase by Anderson et al. (2011a, 2011b, 2012) and combined it with two inattentional-blindness paradigms. In detail, the training phase contained 240 trials in which participants had to respond to the orientation of a bar in a target stimulus among other stimuli (Figure 6). The targets were defined by different colors, so that one target color was associated with high monetary reward and the other target color was associated with low monetary reward. This approach of short-term reinforcement-based learning should create a high semantic value based on the personal meaning of monetary reward for one color as a secondary reinforcer and a low semantic value based on the personal meaning of monetary reward for the other color as a secondary reinforcer. Evidence for the creation of semantic value through the training phase was provided by a *pre-study* in which the color of high semantic value was a more potent distractor as the color associated with low semantic value previously. In a next step, I used a static inattentional-blindness paradigm (E*xperiment 1;* adapted from Mack and Rock, 1998) to test whether different strengths of semantic value created through the association of monetary reward (high, low, or none) with a certain stimulus characteristic (colour) subsequently affected the likelihood of detecting an unexpected stimulus possessing this very characteristic. Interestingly, noticing rates did not differ. Furthermore, my findings revealed that potential reasons for these findings, such as interindividual differences in learning efficiency as well as other individual differences (e.g., working memory capacity, impulsivity), could be discarded. However, one might argue that there was not enough time to perceive and process the unexpected stimulus's semantic value as it appeared for only 200 ms in the static inattentional-blindness paradigm of *Experiment 1*. Indeed, various studies suggest that stimuli need to be processed for at least 300 ms to be consolidated into explicit memory (Potter, 1975, 1976) which might be a prerequisite for verbal report as well as the processing of a stimulus' semantic value. Thus, in *Experiment 2*, I took this potential limitation into account and replicated *Experiment 1* with a dynamic inattentional-blindness task (adapted from Most, Simons, Scholl, Jimenez, et al., 2001) in which the unexpected object appeared for nearly 4 seconds. However, in line with the results of *Experiment 1*, the findings of *Experiment 2* provided no evidence that stimuli characteristics associated with semantic value through short-term reinforcement-based learning affect the likelihood that an unexpected stimulus that possesses this very characteristic is detected under conditions of inattention.

As the findings in my pre-study as well as previous literature (Anderson et al., 2011a, 2011b) provide evidence that semantic value created through short-term reinforcement-based learning can indeed affect attentional orientation, it seems likely that the experimentally created semantic value might be strong enough to affect sensitive measures as attentional orientation (measured as reaction time in milliseconds) but is not strong enough to affect the less sensitive and binary measure of inattentional blindness. Supposedly, semantic value has to be established in a much stronger and longer reinforcement-based learning process as this might be the case for the above reviewed semantic value based on evolutionary (emotional facial expression, *Publication IV*), social (“STOP”, Mack & Rock, 1998), and personal (one´s own name, Mack & Rock, 1998) meaning or based on momentary task relevance (Most, Scholl et al., 2005; Most & Astur, 2007). Potentially, a reinforcement-based learning process (training phase) of thousands or more trials or with a much higher reinforcement magnitude (reward or loss) might be necessary to create a semantic value strong enough to influence inattentional blindness.

Another promising approach to modulate semantic value and, thus, attentional bias over a short period of time strong enough to influence noticing rates in an inattentional-blindness paradigm was implemented in *Publication II* by modulating an evolutionary highly relevant physiological state of the observer, namely hunger. Hunger might be especially suited to investigate the creation of semantic value and its influence on inattentional blindness as it can be experimentally manipulated over a short period of time but, nevertheless, it roots in strong evolutionarily long-term reinforcement-based learning. Therefore, the participants of *Publication II* were assigned to one of two conditions; those in the hungry-condition were instructed to refrain from eating for 16 hours prior to the inattentional-blindness task whereas those in the satiated-condition were instructed to eat as usual. To exclude potential confounding factors, I used food as well as furniture pictures as unexpected stimuli in the static inattentional-blindness paradigm (Figure 7; adapted from Mack & Rock, 1998), ensured a successful manipulation of hunger, and controlled for outlasting individual food-craving.

Figure 7

Schematic illustration of trials in the inattentional blindness phase used in Publication II (details not drawn to scale).



Note. (a) Standard trial during this phase, in which participants looked for the longer arm of the cross. (b) Critical trial, in which an unexpected object (food or furniture picture) appeared next to the to-be-attended cross. (c) Graphic representation, size and noticing rate of the used stimuli in the inattentional-blindness task.

Contradicting my hypotheses, I did not find an influence of the food stimuli´s semantic value, based on the short-term modulation of the participant´s hunger, on the conscious detection of unexpected food stimuli. Also, neither potential moderating factors (sex, food craving as a trait) nor an alternative operationalization of hunger (i.e., subjective perception of hunger) changed these null findings. This seemed surprising as this exact manipulation of hunger modulation is commonly used in the field of hunger research (Evers et al., 2011; Mogg et al., 1998; Morris & Dolan, 2001) and has created an attentional bias in previous studies (Morris & Dolan, 2001; Piech, Pastorino, & Zald, 2010; Tapper et al., 2010). My findings support the view that the effects of short-term fasting on cognition are rather complex (Benau et al., 2014). Potentially, as was the case for monetary reward too, either the semantic value has to be extremely strong (i.e., especially strong hunger) or the attentional measure has to be extremely sensitive (e.g., reaction times instead of binary measure) to uncover effects of semantic value based on short-term reinforcement-based learning.

To answer Research Question II (whether semantic value can be created or modulated through short-term reinforcement-based learning to help a stimulus to cross the threshold of awareness), I can conclude that my findings neither provide support for a successful creation of a secondary reinforcer´s semantic value through short-term reinforcement-based learning (*Publication I*) nor for a successful modulation of a primary reinforcer´s preexisting semantic value by a short-term physical state (*Publication II*). As already stated, the manipulations chosen in *Publication I* and *Publication II* were potent enough to affect sensitive measures as reactions times (see for *Publication I*: Anderson et al., 2011a, 2011b; *Pre-study Publication I*; see for *Publication II*: Piech, Pastorino, & Zald, 2010; Tapper et al., 2010) but might be too weak for the binary measure of conscious awareness. I assume that the critical factor is the strength of the created semantic value as it may need to be much more potent to not only increase the sensitive measure of attentional capture but also support the conscious detection of unexpected stimuli. However, the strength of the created semantic value might be based on several characteristics of the creation (reinforcement-based learning) or modulation process. This is in line with the general assumption that the concept of reward itself depends on a multitude of mechanism and determinants, such as the subjective reward magnitude and probability (Chapman et al., 2015) as well as the reward direction (gain vs. loss; Kahneman & Tversky, 1979).

6. Methodological approaches to investigating inattentional blindness

While taking a look at the previous literature investigating inattentional blindness one cannot ignore the increasing research effort on the subject and its determinants. While only four studies investigated determinants of inattentional blindness were published between 1998 and 2002, the number grew to 16 studies from 2003 to 2007, and 38 studies from 2008 to 2012, up to 64 studies between 2013 and 2018 (*Publication III*). However, this expansion of inattentional blindness research also leads to a growing number of inattentional-blindness paradigms so that one might wonder if different paradigms might be equally suitable to investigate determinants as semantic value on inattentional blindness. To pave the ground for future research investigating determinants of inattentional blindness, a structured overview on the employed methodological approaches was long overdue (Research Question IIIa). I assumed that the main motivation for scientific research might be based on the practical benefit for our daily life, and therefore focused on the question “which paradigms are easily transferable to and beneficial for the real world?” (Research Question IIIb). Despite the growing number and diversity of paradigms aiming to investigate determinants of inattentional blindness they all share similar characteristics as they are all based on the prevailing definition of inattentional blindness (see Chapter 1). Nevertheless, ambiguous research findings on various determinants as working memory capacity (Calvillo & Jackson, 2014; Hannon & Richards, 2010; Kreitz, Furley, Memmert, & Simons, 2016) or perceptual load (Koivisto & Revonsuo, 2009; Murphy & Greene, 2016) leads one to suspect that different subtypes of inattentional blindness exist which are based on different underlying mechanisms (Research Question IIIc).

An answer to these questions might provide new approaches to gain a better understanding of inattentional blindness itself, investigate its underlying mechanisms, as the stimulus´ semantic value, more efficiently, and provide findings easier applicable to our daily life.

6.1 Previous research

On first glance, the different paradigms seem to be equally suitable to investigate determinants as semantic value on inattentional blindness. Up to now, few researchers have bothered to explain their choice of specific paradigm. However, the mixed findings of my own research in combination with ambiguous findings on many other potential determinants of inattentional blindness give reason to look at the methodological aspects in more detail and provide answers to Research Questions IIIa, IIIb, and IIIc. While the issue of ambiguous findings is nothing new in inattentional blindness research, it has rarely been linked to methodological reasons. Most (2010) hypothesized that different inattentional-blindness paradigms might reflect different underlying mechanism of inattentional blindness; the author differentiates between spatial inattentional blindness, which should be driven by covert allocation of spatial attention, and central inattentional blindness, which should be driven by preoccupation or disruption of cognitive resources such as attention or working memory capacity. However, previous research putting these subtypes to test were not able to support such a dichotomy (Kreitz, et al., 2015a; Memmert & Furley, 2010). Another distinction might be made between static and dynamic paradigms as they differ on several important dimensions (e.g., duration of the unexpected object, being static or dynamic, whether or not distractors are present), performances in static and dynamic inattentional-blindness tasks do not correlate (Horwood & Beanland, 2016; Kreitz et al., 2015a) and noticing rates differ (Beanland & Pammer, 2012). Related to this, Memmert (2010) already suggested that it needs to be investigated “how many subtypes of IB actually exist and respectively integrate these in an overarching attentional framework” (Memmert, 2010, p.1108).

Assuming that most of the potential subtypes of inattentional blindness may be reflected in different paradigms (Most, 2010; Beanland & Pammer, 2011), in a first step, it might be useful to categorize the methodological approaches and paradigms used to investigate inattentional blindness (Research Question IIIa). A detailed categorization of inattentional-blindness paradigms also offers the possibility to take a look at those paradigms and methodological approaches that are transferable to the real world (Research Question IIIb). Promoting paradigms whose findings are easily transferable into our daily life seems to be beneficial since an understanding of these paradigms and the related specific subtypes of inattentional blindness might be useful to prevent real-life consequences as in traffic (Murphy & Green, 2016; Pammer & Blink, 2013) or medical diagnostics (Drew et al., 2013; Williams et al., 2020).

Although the growing number of paradigms investigating inattentional blindness might reflect different subtypes of inattentional blindness, they still refer to the same phenomenon that occurs only within a certain framework, defined by the prevailing core aspects of inattentional blindness. White and colleagues (2018) challenged this prevailing definition of inattentional blindness and dealt especially with the core aspect, that one needs to identify the unexpected stimulus as something new, distinctive, or unusual when one's attention is not engaged in the primary task, to fall prey to inattentional blindness. Most paradigms include a control trial, called *full-attention trial*, in which the unexpected stimulus occurs but the observer’s attention is not engaged by a primary task. Observers, who do not notice the unexpected stimulus in this full-attention trial are often excluded from analysis as they do not fulfill the core aspect of inattentional blindness which is to identify the unexpected stimulus as something new when one's attention is not engaged in the primary task. White and colleagues (2018) showed that missing the critical stimulus in the full-attention trial can represent continued inattentional blindness for very potent determinants. The work by White and colleagues (2018) provides a first step in questioning the prevailing definition of inattentional blindness and may release the phenomenon from its constricting definition. Such a release might provide an opportunity to investigate and understand inattentional blindness as one of several failures of awareness, in relation to associated phenomena, and as a useful tool to investigate broader concepts of attention and awareness. One aim of future studies should be to follow up this first step by rethinking inattentional blindness as a phenomenon and restructure its defining core aspects (Research Question IIIc).

6.2 Answer to Research Question IIIa

Following the suggestion by Memmert (2010), I set out to systematically review the methodological approaches and paradigms used so far to investigate inattentional blindness (Research Question IIIa). Reviewing 219 experiments in *Publication III* clearly showed that three paradigms (and their adapted versions) were by far the most prominent ones covering 59% of all experiments investigating inattentional blindness: the cross task (Mack & Rock, 1998), the gorilla video (Simons & Chabris, 1999), and the object-tracking task (Most, Simons, Scholl, Jimenez et al., 2001; for a detailed description see Chapter 3.1). In the remaining 41% experiments other paradigms were employed including tasks in which objects had to be identified (e.g., Calvillo & Hawkins, 2016; Gao & Jia, 2017; Koivisto & Revonsuo, 2007), pictures or sport situations needed to be judged (e.g., Furley et al., 2010; Pammer, Raineri et al., 2018; Pammer, Sabadas, & Lentern, 2018), real-world simulations or custom video games were used (Murphy & Greene, 2016; Stothart, Wright et al., 2017), specific movements were counted (Oktay & Cangöz, 2018), or tasks which take place in a real-world setting (Chabris et al., 2011; Simons & Schlosser, 2017), to name a few. Besides those differences in primary tasks, those paradigms also differed in the duration of individual trials (e.g., 200 milliseconds, Mack & Rock, 1998; up to 42 minutes, Näsholm et al., 2014), the number of experimental trials prior to the critical trial (no prior trials, Simons & Chabris, 1999; 647 prior trials, Chen & Treiseman, 2008), the duration of the unexpected stimulus´s occurence (60 milliseconds, Fougnie & Marois, 2007; 30 seconds, Hughes-Hallett et al., 2015), or the use of afterimages of the unexpected stimulus (use of afterimages, Koivisto & Revonsuo, 2007; no use of afterimages, Most, Simons, Scholl, Jimenez et al., 2001).

This immense variety of inattentional-blindness paradigms should be considered by future research, especially having different subtypes of inattentional blindness and their underlying mechanisms in mind. If different paradigms reflect different underlying mechanisms, it seems essential that each paradigm is well chosen to fit the respective research purpose. One approach to identify different subtypes of inattentional blindness would be to investigate a single determinant in different paradigms as they might reflect different subtypes of inattentional blindness, so realized in the work by Hüttermann and Memmert (2012). Furthermore, one might gain a better understanding of the underlying mechanism of each identified subtype of inattentional blindness when several determinants are investigated within a single paradigm.

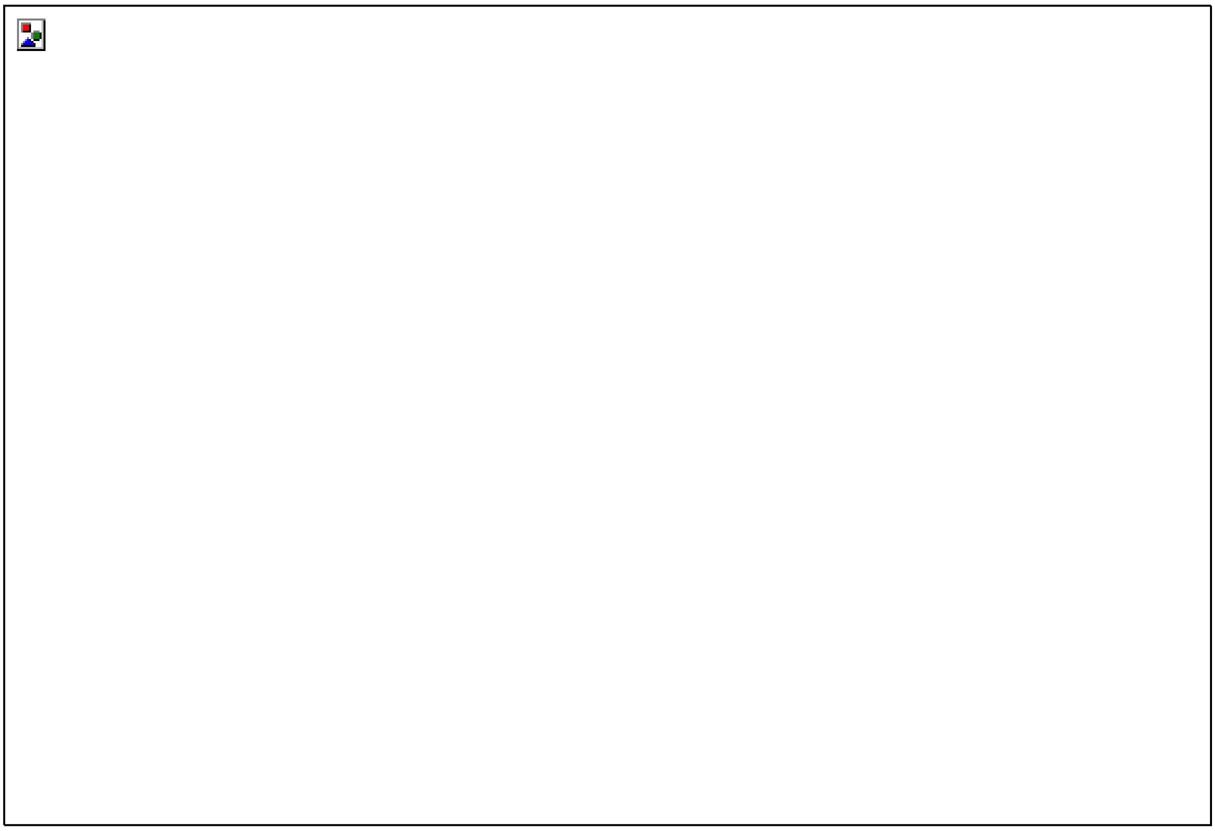
6.3 Answer to Research Question IIIb

Besides reviewing all inattentional-blindness paradigms used up to now, in *Publication III*, I additionally focused on those paradigms whose findings are easily transferable to the real world (Research Question IIIb). Our daily life might significantly benefit from the transferability of gained knowledge of inattentional blindness into the real world. Therefore, I classified each paradigm on a 10-point Likert Scale based on its *functionality* and *representativeness*. *Representativeness* was defined as “the extent to which a primary task is operationalized according to our natural environment” (*Publication III*, p. 140), so that paradigms rated high in *representativeness* represent a smaller gap to real-world settings and contribute more to the transferability of findings into the real world. *Functionality* was defined as “the unexpected object´s relevance, meaning, or [semantic] value for the observer” (*Publication III*, p. 141). Here, the investigation of relevant stimuli might be beneficial for our daily life since unexpected stimuli are most crucial in our daily life when they are in some ways functional or relevant for the observer. However, one might argue that the functionality of a stimuli violates the defined requirement of unexpectedness as a stimulus's task relevance automatically increases one´s expectations toward respective task relevant stimuli. This functionality-unexpectedness issue will be solved in the answer to Research Question IIIc.

The results of my classification (Figure 8) led to the assumption that the employed inattentional-blindness paradigms can be roughly divided into two main clusters based on their *representativeness* and *functionality* (Figure 8). One cluster comprises most inattentional-blindness paradigms, mainly representing the three most prominent ones (Mack & Rock, 1998; Most, Simons, Scholl, Jimenez et al., 2001; Simons & Chabris, 1999) and encapsulates paradigms that are rarely representative and use less functional unexpected stimuli. One example of this cluster might be the cross-task by Mack and Rock (1998), as judging the arms of a cross, which is presented for 200 milliseconds, is not a common task in our daily life and therefore less representative. Furthermore, the often-used unexpected stimuli, as geometric shapes, are neither task-relevant (cross judgement), nor relevant of the observer's other aims or wellbeing and therefore less functional. The second cluster comprises fewer paradigms in total, however, more diverse ones and includes more representative paradigms and those using more functional unexpected objects. One example for this second cluster might be the simulated police vehicle traffic stop (Simons & Schlosser, 2017), which is already very close to the daily work of a police officer. Similar is a gun as the unexpected stimulus in this case not only task relevant, but would be also relevant for the police officer's well-being and might therefore be seen as highly functional. This distribution is quite interesting as neither do highly representative paradigms use less functional unexpected stimuli, nor do fewer representative paradigms use highly functional unexpected stimuli. The variety of paradigms rated as highly representative and functional might be a promising area for further investigations as they meet the aforementioned requirements to benefit our daily life through the transferability of the findings into the real world.

Figure 8

The distribution of the different inattentional paradigms based on their functionality and representativeness (from Publication III).



6.4 Answer to Research Question IIIc

My systematic overview of inattentional blindness in *Publication III* allows assumptions on whether different subtypes of inattentional blindness exist and if they are described by the prevailing and predefined core aspects of inattentional blindness. (Research Question IIIc). The variety of inattentional-blindness paradigms can be seen as a strong indicator for the robustness and external validity of inattentional blindness. However, the recurring mixed results in inattentional blindness research, as they occur for working memory capacity (Calvillo & Jackson, 2014; Hannon & Richards, 2010; Kreitz, Furley, Memmert, & Simons, 2016), perceptual load (Koivisto & Revonsuo, 2009; Murphy & Greene, 2016), or semantic value (*Publication IV*; Devue et al., 2009; Lee & Telch, 2008; Mack & Rock, 1998) fuel the assumption that it might not be a single type of inattentional blindness. Instead, inattentional blindness might be an overarching phenomenon which encompasses different subtypes with their respective underlying mechanisms. Considering the different operationalizations and research methods used in inattentional blindness research so far, it is likely that mixed results are the simple consequence of comparing apples with pears, i.e., trying to draw parallels where there likely are few or none.

When going one step further, one might argue, that for a definition of inattentional blindness as the sum of different subtypes of inattentional blindness, it is essential to consider all subtypes of inattentional blindness. This, however, can only be achieved when all subtypes fall within the prevailing and predefined core aspects of inattentional blindness. After White and colleagues (2018) first put the prevailing core aspects of inattentional blindness up for discussion, my systematic overview also fuels doubt on the usefulness of the existing definition, especially for paradigms close to real-world settings. Actually, I excluded 17 studies which violated the requirement for complete unexpectedness. The systematic overview in *Publication III* demonstrates that those paradigms whose findings are likely to be transferred to our daily life contain functional and, thus, expected additional stimuli. This is due to the fact, that functional stimuli are related to the primary task, and are thus, partly expected, such as a motorbike in traffic (Pammer, Sabadas, & Lentern, 2018) or a gun in a simulated police vehicle traffic stop (Simons & Schlosser, 2017). Therefore, paradigms not meeting the requirements for inattentional blindness, i.e., complete unexpectedness, should not be excluded from the phenomenon but rather seen as paradigms investigating expectedness as a determinant of inattentional blindness. This seems to be especially obvious as participants´ expectations are clearly a robust determinant of inattentional blindness observed in almost all publications that used critical-, divided-, and full-attention trials. Following the suggestions of White and colleagues (2018), I also argue that the full-attention trial should not be seen as an exclusion criterion to control for the unexpected stimulus´ perceptibility, but rather as a good example for the determining influence of one´s expectations on inattentional blindness. Therefore, the full-attention trial might be excluded from paradigms that do not aim to investigate the influence of expectancy on inattentional blindness, as done by Wood and Simons (2017), and might be included in analyses if expectations are one of the determinants examined in the respective study.

To preserve the original idea and definition of inattentional blindness (i.e., the additional object is completely unexpected and occurs while the observer carries out the primary task; Jensen et al., 2011; Simons & Chabris, 1999), expectation could be divided into explicit and implicit expectation. The label of “implicitly expected” might apply to additional stimuli that play a functional role in the respective context of the primary task, whereas the label of “explicitly expected” might apply to stimuli that one already expects although they are not functional for or related to the actual primary task. Such a division of expectancy would solve the above-mentioned functionality-unexpectedness issue, as functionality might rather adopt different levels of implicit expectancy and should not be equated with explicit expectancy. I assume that this view might path the way for the use of paradigms which include functional stimuli in inattentional blindness research. More specifically, I suggest treating implicit expectancy as a continuous determinant of inattentional blindness defined as the continuous probability for a stimulus to occur in a certain environment and not as an all-or-nothing criterion. This suggestion is also in line with the literature beyond inattentional blindness, since expectancy has been already described as a continuous concept in our daily life (Kok et al., 2013; Summerfield & de Lange, 2014). Furthermore, the legitimation for implicit expectancy as a continuous determinant of inattentional blindness is in line with the effect of one´s attentional set on inattentional blindness. Among other determinants, the attentional set reflects the demands and characteristics of the primary task so that the observer's attention is focused on specific stimulus´s characteristics. Observers have been found to be less likely to fall prey to inattentional blindness if the additional stimulus possesses some of these physical or semantic characteristics (Most, Simons, Scholl, Jimenez et al., 2001; Pammer, Sabadas, & Lentern, 2018). Such focus on specific stimulus´s characteristics can also be seen as one´s implicit expectation toward the respective specific stimulus´s characteristics. Therefore, one might say that different levels of implicit expectation have already been investigated by the inattentional research community without naming them as such and without discussion them in this context.

Another core aspect that also falters with these thoughts is the need for a primary task to engage attention and experience inattentional blindness. The full-attention trial might be a good example demonstrating that inattentional blindness can also be experienced without an attention demanding primary task (see White et al., 2018). Following Lavie and colleagues (2004), we are always occupied with something that could be described as a primary task containing a very small load so that no additional primary task is needed for the experience of inattentional blindness. Consequently, we might need to develop and adapt the defining core aspects and our understanding of inattentional blindness, rethink inattentional blindness as a phenomenon with potential different subtypes and underlying mechanisms. Further, instead of trying to create a bubble and structurally separate it from other fields of research, we rather need to integrate this phenomenon in the bigger picture of attention and consciousness research.

7. Conclusion and Future Directions

This chapter provides a concluding overview of the work presented in this thesis and outlines its implications for the field of inattentional blindness research. More in detail, I will discuss the methodological limitations of my work and inattentional blindness research with reference to the defining framework of inattentional blindness, link my work to the theoretical background of inattentional blindness, and illustrate potential directions for further research.

7.1 Aim of the thesis and summary of key findings

Within this thesis I aimed to extend the knowledge about a potentially important determinant of inattentional blindness - a stimulus´ semantic value. I used different approaches to create and modulate semantic value and investigated its influences on inattentional blindness. First, I investigated the influence of an unexpected stimulus´ semantic value based on personal meaning utilizing monetary short-term reinforcement-based learning (secondary reinforcer) on the probability of its detection under conditions of inattention. In a second step, I investigated the influence of an unexpected stimulus´ semantic value based on evolutionary meaning on inattentional blindness, modulated through the induction of perceived hunger (primary reinforcer). In a third publication, I also investigated the influence of an unexpected stimulus´ semantic value based on evolutionary meaning, namely the semantic value of primary reinforcers as facial expressions. Further, I reviewed the methodological approaches used to investigate and operationalize this failure of awareness up to now. Table 3 provides an overview of the empirical answers to the Research Questions posed at the beginning of this synopsis derived from my research and its integration in the previous literature.

Table 3

Answers to the Research Questions Addressed in the Synopsis

I. Does the semantic value of a stimulus influence the threshold of awareness towards the respective stimulus and, thus, the susceptibility to inattentional blindness?	
	In three experiments, we found that the semantic value of monetary reward and food has no impact on inattentional blindness. In contrast we demonstrated in two experiment, that the semantic value of facial emotional expressions, dependent on its valence and the used inattentional blindness paradigm, influences its conscious detection; unexpected frowning faces were significantly more likely to be noticed in a static inattentional blindness task than scrambled faces, whereas no differences were found between happy and scrambled faces. Furthermore, we found that the semantic value of emotional facial expressions, independent of its valence and the used inattentional blindness paradigm, have a substantial influence on inattentional blindness if inattentional blindness is operationalized by the identification of unexpected stimuli. Both, unexpected happy and unexpected frowning faces were more likely to be correctly identified than unexpected scrambled faces under conditions of inattention.
II. Can the semantic value of a stimulus be modified (created or modulated) and thus, influence the threshold of awareness towards the respective stimulus?	
	In two experiments we created semantic value through the short-term reinforcement-based learning of monetary reward. The findings show, that the created semantic value was potent enough to significantly affect attentional capture, but insufficient to help a stimulus cross the threshold of awareness. In one experiment we modulated the preexisting semantic value of food through hunger, but failed to strengthen the food´s semantic value to influence its conscious detection.
III. Which methodological aspects should be considered when investigating inattentional blindness?	
IIIa. Which paradigms are used to investigate inattentional blindness?	We reviewed 219 Experiments in *Publication III* and found besides three most frequently used inattentional blindness paradigms an immense variety of additional ones.

IIIb. Which paradigms are easily transferable and benefit to the real world?	The characterisation of different paradigms in *Publication III* revealed, that indeed several different paradigms exist which could be considered to simply transfer their findings into the real world, based on a high level of the unexpected stimulus´s *functionality* and the paradigm´s *representativeness* of the real world, but that they are rarely used in inattentional blindness research.
IIIc. Do different subtypes of inattentional blindness exist and are they covered by the prevailing and predefined core aspects of inattentional blindness?	The review of different inattentional blindness paradigms in *Publication II* and an intensive study previous approaches to define different subtypes of inattentional blindness lead to the assumption, that sub types exist, but that the pre-existence and prevailing core aspects of inattentional blindness do not cover every sub type of inattentional. Rethinking inattentional blindness from its underlying mechanism might provide a better ground to differentiate between different subtypes of inattentional blindness, as it goes along with a redefinition of the defining core aspects.

7.2 Theoretical implications

7.2.1 Semantic value as a determinant of IB

As presented in Chapter 3, a general effect of semantic value could not be supported, rather mixed results have been found for different types of semantic value and different inattentional-blindness paradigms. These findings raise the question if a stimulus´ semantic value really is the main factor that impacts the likelihood of noticing it under conditions of inattention as it was assumed by Arien Mack (Mack & Rock, 1998) or if it is just one determinant of inattentional blindness similar to others whose influence is only partially confirmed by the inattentional blindness literature as well.

When comparing the semantic value of unexpected stimuli with other determinants of inattentional blindness we can differentiate between determinants that moderate one´s amount of available attentional resources that can be directed towards an unexpected stimulus and determinants that moderate the salience of the unexpected stimulus.

The determinants that moderate the available attentional resources to process additional stimuli can further be subdivided into determinants of attentional resources and determinants of attentional distribution. Determinants of attentional resources summarize neuroanatomical differences between different groups, such as defined by age (Walhovd et al., 2011), developmental disorders (Vieira de Melo et al., 2018), or giftedness (Geake, 2009) which influence one´s executive capability and consequently the amount of attention available to process an unexpected stimulus. Determinants of attentional distribution summarize different mechanism that distribute one´s available attentional resources towards a specific area or stimuli characteristics, as for example the perceptual load (Calvillo & Jackson, 2014), individual traits (Li et al., 2015), or one´s mindset (Schofield et al., 2015; Shi & Li, 2020), so that stimuli within the attended area are more likely to be consciously processed than stimuli outside the attended area.

The determinants that moderate a stimulus's salience include, both, physical value and semantic value as stimulus´ characteristics. For example, stimulus characteristics that possess physical value and determine inattentional blindness include size (Mack & Rock, 1998), color (Koivisto et al., 2004) or location (Most, Simons, Scholl, & Chabris, 2000; Stothart et al., 2015) of an additional stimulus. Similarly, stimuli can also possess semantic value as pictures of faces (*Publication IV*), one´s own name (Mack & Rock, 1998), or threats (New & German, 2015).

Instead of identifying these determinants as single determinants, they could rather be seen as an interacting construct of determinants that influences inattentional blindness. The determinants of attentional distribution seem to have an impact on the attentional attraction of an additional stimulus if the additional stimulus fits within the scope of distributed attention. This effect might account for both, the physical value as well as semantic value of a stimulus. An example here is one´s attentional set as a determinant of attentional distribution: people who tune their attentional set towards a specific stimulus characteristic, such as color, are more likely to notice an additional stimulus also possessing the attended color, whereas the color itself does not contain enough physical value to influence the conscious detection of an additional stimulus under conditions of inattention (Most, Scholl et al., 2005; Simons & Chabris, 1999).

This effect of one´s attentional set has also been found for a stimulus´ semantic value (Most, 2011). The influence of determinants of attentional distribution on the attentional attraction of additional stimuli is reflected particularly strong in the different strengths of stimuli´s semantic values. The semantic value of ice-cream pictures is enhanced for observers with an ice-cream craving trait and prevents ice-cream pictures from falling prey to inattentional blindness (Li et al., 2015). Similar effects have been found for one´s mood on the semantic value of facial emotional expressions (Becker & Leinenger, 2011), perceptual load on the semantic value of sad facial emotional expressions (Gupta & Srinivasan, 2015), the fear of spiders on the semantic value of spider pictures (Brailsford et al., 2014), or different levels of social anxiety on the semantic value of socially threatening cues (Lee & Telch, 2008). This assumption of an interacting construct of determinants is in line with Most, Scholl and colleagues (2005) who assume: “although some stimulus properties can influence noticing of unexpected objects, the most influential factor affecting noticing is a person’s own attentional goals”, whereby attentional goals can be seen as the determinants of attentional distribution (Most, Scholl et al., 20015, p.217).

Besides the interaction with other determinants, additional aspects seem to influence the strengths of a stimulus’s semantic value as a measure of its ability to attract attention, and thus, the stimulus´s likelihood to be consciously perceived. The strengths of a stimulus’s semantic value might be based on different characteristics of the underlying mechanisms of semantic value. The first characteristic influencing the strengths of a stimulus´s semantic value might be the duration of the reinforcement-based learning process in which a stimulus is associated with semantic value (long term vs. short term). The semantic value of spiders and snakes (New & German, 2015) as well as the semantic value of emotional facial expression (*Publication IV*) might be strong enough to influence inattentional blindness as they were learned through a long-term reinforcement-based process. In contrast, the semantic value of stimuli associated with monetary reward might be too weak to influence inattentional blindness if it is learned within only 20 minutes as a short-term reinforcement-based learning process (*Publication I*). Similarly, 16 hours of fasting as a short-term physical state modulation might be too short to substantially activate the semantic value of food stimuli, based on a long-term reinforcement-based learning process, in the context of an inattentional blindness setting (*Publication II*). Potentially, semantic value is sensitive for the duration of the reinforcement-based learning process and rates of noticing unexpected stimuli would be affected if stimuli were coupled in a longer learning process. The second characteristic might be the quality of the reinforcement-based learning process, that is, whether it constitutes a highly relevant situation. For example, traumatic events are more likely to facilitate the engagement toward threatening stimuli which might cause its semantic value to increase steeply (see Bomyea et al., 2017). In contrast, everyday experiences might not lead to such strong semantic value. According to these characteristics, short-term reinforcement-based learning processes can nonetheless affect attentional direction if the inherent meaning is especially strong, or an additional context enhances the meaning of the stimulus.

In conclusion, the semantic value of primary and secondary reinforcers, and their various manifestations (evolutionary, social, & personal) could be seen as one determinant of inattentional blindness besides others, influenced on one hand by determinants of attentional resources and attentional distribution and, on the other hand, based on different characteristics of its underlying mechanism.

7.2.2 Operationalization and definition of inattentional blindness

Regarding the mixed findings of *Publication I, Publication II, Publication IV* and the previous literature, in Chapter 6.4 I proposed to develop and adapt the defining core aspects and, thus, our understanding of inattentional blindness. Therefore, it might be useful to discuss the strengths and weaknesses of each prevailing core aspects and its usefulness for an appropriate definition of inattentional blindness.

The first core aspect assumes that an observer needs to engage in an attention demanding task (i.e., primary task) to experience inattentional blindness (Simons & Chabris, 1999; Mack & Rock, 1998). However, complex visual tasks do not seem necessary to experience inattentional blindness as hearing music (Chen & Pai, 2018; Hyman Jr et al., 2014) or just thinking (Fougnie & Marois, 2007) were shown to induce this failure of awareness. Humans spend a considerable portion of their lives engaged in spontaneous thoughts, and memories, which is termed daydreaming, stimulus-independent thought, or mind-wandering (Gross et al., 2021; Mason et al., 2007; Schooler et al., 2011; Seli et al., 2018; Singer, 1966). Thus, one might conclude that not the engagement in a specific attention demanding task per se, but rather the attentional load of an engagement should be seen as a core aspect of inattentional blindness (Lavie et al., 2014; Lavie et al., 2004). This assumption is in line with White and colleagues (2018) who argue for the occurrence of inattentional blindness on the full-attention trial of inattentional-blindness paradigms which explicitly do not contain any attention-demanding task.

The second prevailing core aspect of inattentional blindness is the need for an unexpected stimulus that occurs while the observer carries out a primary task (Jensen et al., 2011; Simons & Chabris, 1999). Besides the primary task, which will be discussed at the fifth core aspect, this core aspect can be agreed with since an additional stimulus is necessary so that observers can miss it - which is the fundamental idea of the inattentional blindness phenomenon.

The third prevailing core aspect of inattentional blindness, namely that the unexpected stimulus occurs at or near fixation within the visual field to experience inattentional blindness, might only be slightly adjusted based on the inattentional blindness literature. Eye tracking studies found that the fixation of the additional stimulus does not increase the probability of its conscious detection (Memmert, 2006a) and that additional stimuli were even detected without fixating it (Pappas et al., 2005; Richards, Hannon, & Vitkovitch, 2012). Therefore, it might be sufficient for the additional stimulus to occur within one´s visual field and not necessarily at or near fixation to experience inattentional blindness.

The fourth core aspects to identify the additional stimulus as something new, distinctive, or unusual seems comprehensible in order to distinguish inattentional blindness from other failures of awareness, such as change blindness (see Jensen et al., 2011). However, one might argue that some paradigms measuring inattentional blindness might, up to a certain amount, refer to change blindness as an additional stimulus occurring at a location of a previous fixation point/cross (Koivisto et al., 2004; Mack & Rock, 1998) could be seen as a change of the fixation cross rather than the occurrence of an additional stimulus. In another study, the failure to miss the change of a background curtain's colour was rather related to inattentional blindness than change blindness (Simons, 2010). To manifest a clear definition of inattentional blindness, the differences between change blindness and inattentional blindness needs to be considered in future studies. Furthermore, there is room for interpretation regarding the stimulus´s identification which is often put on the same level as its detection, notice or recognition. Different approaches have been used to operationalize the correct identification of an unexpected stimulus including statements about its detection and a detailed description (Becker & Leinenger, 2011), its detection and the correct selection of its location (Kreitz, Schnuerch, Furley, Memmert, 2018), its detection and the correct selection of its shape (Lee & Telch, 2008) or only the correct selection of its shape (Devue et al., 2009). Such different operationalizations of the correct identification of an unexpected stimulus have been found to lead to different findings (*Publication IV*). To ensure a consistent and comparable *identification* operationalization, I would suggest that participants need to report that they have seen anything in addition to the primary task and correctly select its shape out of at least five choices to be labelled as a participant who identified the additional stimulus as something new, distinctive or unusual.

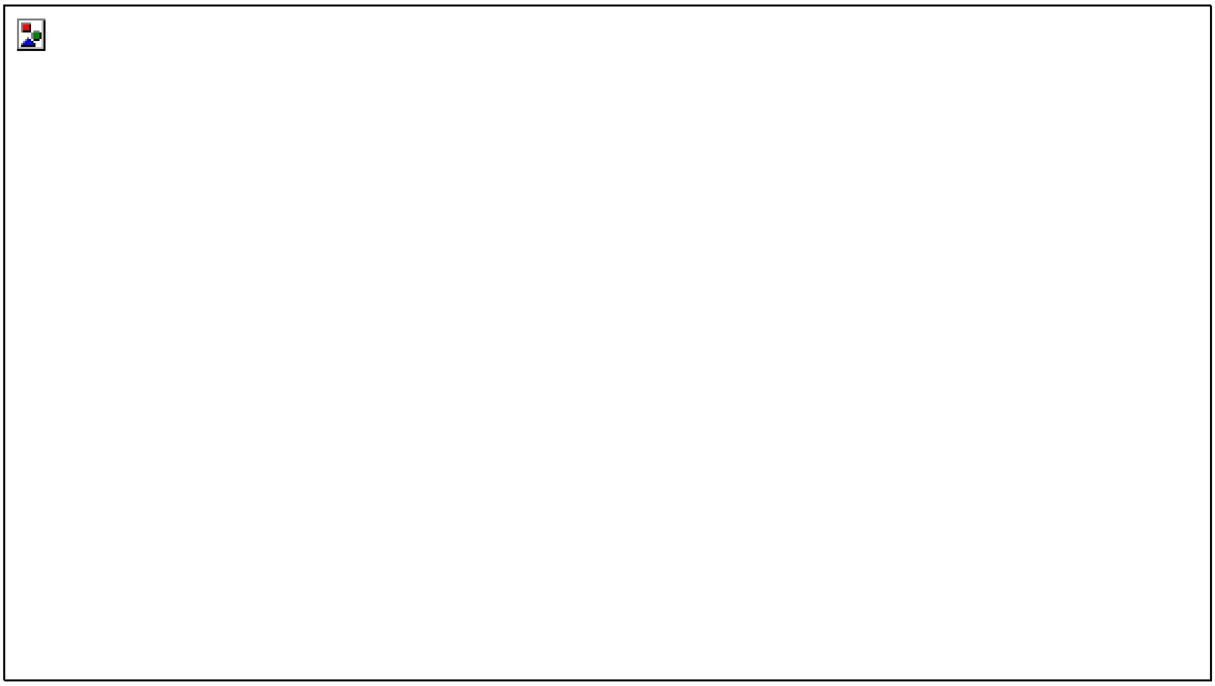
Finally, the fifth prevailing core aspect of inattentional blindness claims that the unexpected stimulus needs to be completely unexpected to avoid top-down guidance and the intentional allocation of attentional resources towards the unexpected stimulus (Jensen et al., 2011, Simons, 2007). Despite this criterion, it became common in inattentional blindness research to use functional stimuli potentially involving an implicit level of expectation rather than being truly unexpected (for a discussion see *Publication III*). For example, handball players may not be completely unexpected in handball-specific situations (Memmert & Furley, 2007), and motorcycles may not be completely unexpected in traffic situations (Pammer, Sabadas, & Lentern, 2018), as both situations are representative of environments in our daily life. Therefore, I argue that expectancy should not be considered as a binary construct in inattentional blindness research but rather - as in our daily life - as "the continuous probability for a stimulus to occur in a certain environment" (*Publication III,* p.144). Furthermore, and in accordance with the original prevailing "unexpectedness" core aspect of inattentional blindness, I propose to differentiate between explicit and implicit expectations. The failure to miss stimuli that are explicitly expected (i.e., participant knows that additional critical objects will occur) should still be excluded from the concept of inattentional blindness, whereas functional stimuli should be labelled as expected implicitly (similar to stimuli matching one´s attentional set) and play a crucial role in future inattentional blindness research. This view is supported by Hutchinson (2019) who assumes that expectations as prior knowledge is a critical component of inattentional blindness. Deriving from this, I propose to define inattentional blindness as the phenomenon to miss an additional and not explicitly expected stimulus within one´s visual field.

In addition, the mixed findings in inattentional blindness research and the immense variety of inattentional-blindness paradigms (see *Publication III*) lead to the assumption that the phenomenon might rather be a collection of different subtypes of inattentional blindness (see Chapter 6.1). These might differ in their underlying mechanism but share the same phenomenology: to miss an additional and not explicit expected stimulus within one´s visual field.

The categorization used in *Publication III* aimed to categorize inattentional blindness paradigms based on their methodological approaches but not the phenomenon itself. Therefore, I propose that distinct subtypes of inattentional blindness are probably better reflected based on the different determinants of inattentional blindness. Consequently, inattentional blindness can be divided into three subtypes: An additional stimulus is not consciously perceived due to (A) the insufficient amount of neuro-physiological attentional resources to consciously perceive additional stimuli (e.g. age or mental illness), due to (B) the occupation/direction of potentially available attentional resources to consciously perceive additional stimuli during early or late processing (e.g., inhibition of stimulus characteristics or location, locally directed to another location, or directed to another task leading to cognitive/attentional load), and due to (C) the insufficient amount of an additional stimulus´ salience (i.e., physical or semantical value; Figure 9).

Figure 9

Types of inattentional blindness (IB) based on its different determinants.



These different subtypes of inattentional blindness might also provide some valuable contributions to future approaches investigating theories on attention, perception, and consciousness. Pitts, Lutsyshyna, and Hillyard, (2018, p. 9) found that a general "conscious perception of *something* occurs during both the 'perceived' and 'not-perceived' conditions". However, the differentiation between different subtypes of inattentional blindness based on its determinants might be a good fit to target potential different neuronal correlates of consciousness in future research.

7.2.3 Sports-related implications

In the beginning of this thesis, I argued that the understanding of attentional processes and conscious perception are essential to better understand performance in sports. Besides the example of the chess-world championship in 2014 in Chapter 1, different studies provided evidence for the occurrence of inattentional blindness within sport and its influence on sport performance (Furley et al., 2010; Klatt & Nerb, 2021; Memmert & Furley, 2007). The aim of this thesis is to extend the knowledge of a stimulus' semantic value as a potentially important determinants of inattentional blindness and rather contributes to basic research on inattentional blindness, its determinants and underlying mechanism. However, the extended knowledge on inattentional blindness can also be transferred to the context of sport and might usher further research investigating attentional processes and conscious perception as essential aspects of sport performance.

My findings, together with previous research, suggest that the likelihood to miss open teammates, fouls or game-winning moves depends on a variety of determinants including a stimulus´s semantic value. One determinant that can be used to decrease the probability to fall prey to inattentional blindness would be a stimulus´s salience. The benefit of an increased physical value seems to be well understood in the context of sport, as different colored jerseys are widely used in team-sports. It would be useful to investigate if the semantic value of open players and game winning moves can be increased through a reinforcement-based learning process which would consequently decrease a player´s likelihood to miss such chances. As illustrated in Chapter 7.2.1, the duration and quality of such a reinforcement-based learning process might be key to significantly increase the semantic value of, for example, open players and game winning moves. Therefore, the reinforcement-based learning process might be an integral part of the training sessions over weeks or months and the used reward should be of personal or social importance, such as monetary reward or the release from team duties.

Another determinant that might decrease a player's likelihood to miss an unexpected open teammate might be the player´s attentional distribution. This can be modulated through tactical instructions which has already been shown to influence a player´s probability to miss an unexpected open player (Memmert & Furley, 2007). Similarly, the effect of previous mindfulness instructions on inattentional blindness (Schofield et al., 2015) might be transferable into the context of sport as mindfulness seems to distribute one´s attention more widely.

The effect of different approaches to modulate a player´s attentional distribution, or to associate an open player or game-winning move with semantic value should be investigated in future research by using sport-specific inattentional blindness paradigms as already used for handball (Memmert & Furley, 2007), basketball (Furley et al., 2010), or football (Klatt & Nerb, 2021).

7.3 Limitations

This thesis has dealt intensively with the effect of semantic value on inattentional blindness and its impact on a different understanding of the phenomenon and its determinants. Based on a retrospective and renewed view on studies investigating inattentional blindness, a variety of limitations becomes obvious.

One of the major methodological limitations of inattentional blindness research is the binary nature of the dependent variable; people are labelled as inattentional blind depending on whether they have consciously perceived an additional stimulus or not. This inevitable dichotomy reduces the statistical power of any inattentional-blindness paradigm (Royston et al., 2006). Another methodological limitation responsible for a reduced statistical power is the single-trial nature of inattentional-blindness paradigms. To ensure the complete unexpectedness of the additional stimulus, the additional stimulus can only be presented once. Participants who have been queried about the additional stimulus after the first critical trial will inevitably deploy attentional resources towards further additional stimuli and consequently expect them in following trials. The reduced power might contribute to the mixed results in inattentional blindness literature and makes it difficult to detect smaller effects of inattentional blindness. The missing ability to detect small effects might be reflected in the null findings of semantic value of monetary reward in *Publication I* and/or the semantic value of food for hungry people in *Publication II*. Even though I tried to counteract these limitations in my studies by big sample sizes, statistical power is even higher in paradigms that employ more sensitive dependent variables and many critical trials.

As in all research, each study in *Publication I, II and IV* used specific designs and materials to successfully target the respective research questions. Consequently, different limitations apply to the different methodologies. In *Publication I*, I associated the semantic value of monetary reward only with one stimulus feature (color), rather than with the whole stimulus. Thus, the null findings might or might not be generalizable to other features of the critical stimulus or to the combination of stimulus features representing the whole stimulus. Another limitation of *Publication I* is the difference between the context of the training phase and the context of the inattentional-blindness paradigms; contextual cuing is an important mechanism in implicit visual learning (e.g., see Jiang & Leung, 2005) and significant findings found in the pre-study of *Publication I* and by Anderson et al. (2011a, 2013) were based on several similarities between the learning phase and the following visual search task. The contextual difference in *Experiment 1* and *Experiment 2* of *Publication I* might have precluded the activation of the associated semantic value which might explain the null findings. In regard to *Publication II*, the manipulation of hunger provides an area of limitations: The fasting duration to implement hunger (and consequently increase the semantic value of food cues) might have been too short. Even though Morris and Dolan (2001) had shown that 16 hours of fasting can lead to increased hunger ratings, alternative manipulations might have been more efficient; hunger induced by the presentation of appetitive food cues prior to testing have been found to produce a stronger effect on attentional shifting than hunger induced through fasting (Piech, Hampshire et al., 2009). Although this limitation was faced by a successful manipulation check that confirmed the effectiveness of the manipulation in *Publication II,* future studies might want to use hunger manipulations that are even more potent.

Finally, the implementation of *Publication IV* as online experiments might be considered as another limitation, since online experiments contain diverse and uncontrollable situations during testing. Even though I aimed to control for the technical devices, screen size and seating position used by the participants, other situational aspects were beyond my reach.

7.4 Directions for future research

Inattentional blindness research does not only play a usefull role in deconstructing the mechanisms of awareness (see Pitts, Martínez, & Hillyard, 2012), but is also highly relevant in our everyday life (e.g., traffic, medical diagnostics and sports). Consequently, it seems sensible to investigate the determinants of inattentional blindness more systematically and detailed in further studies to maximize the creation as well as the transfer of knowledge about the conscious perception of unexpected stimuli. Embedding my findings into the inattentional blindness literature led me to the conclusion that a stimulus´ semantic value is a complex determinant of inattentional blindness which makes it difficult to systematically investigate its influence on inattentional blindness. In order to break down this complexity, future studies should systematically investigate different types and strengths of a stimulus` semantic value. Another approach to face this complexity might be the characterization of a stimulus´ semantic value as a continuous concept based on its strength defined by the duration, quality, and valence of the reinforcement-based learning process. Furthermore, the immense variety of inattentional-blindness paradigms is another important aspect which future studies should be aware of: I propose that the existence of different subtypes of inattentional blindness based on different underlying mechanism should be considered and individually targeted in future studies. Such an approach might prevent a further scattering of paradigms and mixed results in inattentional blindness research and promote their combinations and comparisons into an overall picture of inattentional blindness.

Future studies might also rethink the defining core aspects of inattentional blindness in order to not only differentiate themselves from other failures of awareness but also focus on similarities and promote knowledge transfer between different phenomena. This might be especially important when paving the way for a more in-depth understanding of inattentional blindness since the underlying mechanism and concepts of inattentional blindness might be shared with other failures of awareness.

7.5 Concluding remarks

Experiencing inattentional blindness and missing a better positioned player or game winning move in high performance sport can make the difference between victory and defeat. Therefore, a better understanding of attentional processes and conscious perception in different kinds of sports are essential to better understand sports performance.

This thesis aimed at improving the understanding of the phenomenon of inattentional blindness and set out to investigate whether the semantic value of information in our environment determines if one remains intentionally blind to this information or consciously perceives it. My own as well as previous research has produced mixed findings which cannot confirm nor confute a general effect of a stimulus´ semantic value on its probability to cross the threshold of consciousness. Rather it demonstrates that a stimulus´ semantic value should be seen as an important but complex determinant of inattentional blindness. Consequently, future research should take the potential different types of semantic value and their underlying mechanism as well as their interactions into account. Furthermore, it provides the opportunity to redefine, rethink, and categorize subtypes of inattentional blindness as a failure of awareness based on their underlying mechanism and its determinants.

Taking this into account might recalibrate one's compass on the path of unwinding the phenomenon of inattentional blindness and its determinants. This is a path worth pursuing to gain a more complete picture of the phenomenon itself as well as to advance general theories of attention, perception and consciousness which can be used to better understand performance in sport and provide applicable knowledge for our daily life.

8. References

Anderson, B. A. (2013). A value-driven mechanism of attentional selection. *Journal of vision*, 13(3), 7-7. https://doi.org/10.1167/13.3.7

Anderson, B. A. (2016). The attention habit: How reward learning shapes attentional selection: The attention habit. *Annals of the New York Academy of Sciences*, 1369, 24–39. https://doi:10.1111/nyas.12957

Anderson, B. A., Laurent, P. A., & Yantis, S. (2011a). Learned value magnifies salience-based attentional capture. *PLoS One*, 6, e27926. https://doi.org/10.1371/journal.pone.0027926

Anderson, B. A., Laurent, P. A., & Yantis, S. (2011b). Value-driven attentional capture. *Proceedings of the National Academy of Sciences*, USA, 108, 10367– 10371. https://doi.org/10.1073/pnas.1104047108

Anderson, B. A., Laurent, P. A., & Yantis, S. (2012). Generalization of value-based attentional priority. *Visual Cognition*, 20, 647–658. https://doi:10.1080/13506285.2012.679711

Anderson, B. A., & Yantis, S. (2012). Value-driven attentional and oculomotor capture during goal-directed, unconstrained viewing. *Attention, Perception, & Psychophysics*, 74(8), 1644-1653. https://doi.org/10.3758/s13414-012-0348-2

Anderson, B. A., & Yantis, S. (2013). Persistence of value-driven attentional capture. *Journal of Experimental Psychology: Human Perception and Performance*, 39, 6–9. doi:10.1037/a0030860. https://doi.org/10.1037/a0030860

Aru, J., Bachmann, T., Singer, W., Melloni, L., (2012). Distilling the neural correlates of consciousness. *Neurosci. Biobehav. Rev.* 36 (1), 737–746. https://doi.org/10.1016/j.neubiorev.2011.12.003

Banaschewski, T., & Brandeis, D. (2007). Annotation: what electrical brain activity tells us about brain function that other techniques cannot tell us – a child psychiatric perspective. *Journal of child Psychology and Psychiatry*, 48(5), 415-435. https://doi.org/10.1111/j.1469-7610.2006.01681.x

Baars, B. J., Franklin, S., & Ramsøy, T. Z. (2013). Global workspace dynamics: cortical "binding and propagation" enables conscious contents. *Frontiers in psychology*, 4, 200. https://doi.org/10.3389/fpsyg.2013.00200

Beanland, V., & Chan, E. H. C. (2016). The relationship between sustained inattentional blindness and working memory capacity. *Attention, Perception, & Psychophysics*, *78*(3), 808-817. https://doi.org/10.3758/s13414-015-1027-x

Beanland, V., Allen, R. A., & Pammer, K. (2011). Attending to music decreases inattentional blindness. *Consciousness and cognition*, 20(4), 1282-1292. https://doi.org/10.1016/j.concog.2011.04.009

Beanland, V., & Pammer, K. (2012). Minds on the blink: The relationship between inattentional blindness and attentional blink. *Attention, Perception, & Psychophysics*, 74(2), 322–330. https://doi.org/10.3758/s13414-011-0241-4

Becker, M. W., & Leinenger, M. (2011). Attentional selection is biased toward mood-congruent stimuli. *Emotion*, 11(5), 1248. https://doi.org/10.1037/a0023524

Benau, E. M., Orlof, N. C., Janke, E. A., Serpell, L., & Timko, C. A. (2014). A systematic review of the effects of experimental fasting on cognition. *Appetite*, 77, 52–61. https://doi.org/10.1016/j.appet.2014.02.014

Benet-Martinez V, John OP (1998) Los Cinco Grandes across cultures and ethnic groups: Multitraitmultimethod analyses of the Big Five in Spanish and English. *Journal of Personality and Social Psychology*, 75: 729–750. https://doi.org/10.1037/0022-3514.75.3.729

Block, N. (1995). On a confusion about a function of consciousness. *BEHAVIORAL AND BRAIN SCIENCES*, 18, 227-287. https://doi.org/10.1017/S0140525X00038188

Block, N. (2011). Perceptual consciousness overflows cognitive access. *Trends in Cognitive Sciences*, 15, 567–575. https://doi.org/10.1016/j.tics.2011.11.001

Bomyea, J., Johnson, A., & Lang, A. J. (2017). Information processing in PTSD: Evidence for biased attentional, interpretation, and memory processes. *Psychopathology Review*, 4(3), 218-243. https://doi.org/10.5127/pr.037214

Brailsford, R., Catherwood, D., Tyson, P. J., & Edgar, G. (2014). Noticing spiders on the left: Evidence on attentional bias and spider fear in the inattentional blindness paradigm. *Laterality: Asymmetries of Body, Brain and Cognition*, 19(2), 201-218. https://doi.org/10.1080/1357650X.2013.791306

Bredemeier, K., Hur, J., Berenbaum, H., Heller, W., & Simons, D. J. (2014). Individual differences in emotional distress and susceptibility to inattentional blindness. *Psychology of Consciousness: Theory, Research, and Practice*, 1(4), 370. https://doi.org/10.1037/cns0000032

Bredemeier, K., & Simons, D. J. (2012). Working memory and inattentional blindness. Psychonomic Bulletin & Review, 19, 239–244. https://doi:10.1080/02699931.2015.1085366

Bronfman, Z. Z., Brezis, N., Jacobson, H., & Usher, M. (2014). We see more than we can report: ”cost free” color phenomenality outside focal attention. *Psychological Science*, 25(7), 1394–1403. https://doi.org/10.1177/0956797614532656

Brown-Iannuzzi, J. L., Hoffman, K. M., Payne, B. K., & Trawalter, S. (2014). The invisible man: Interpersonal goals moderate inattentional blindness to African Americans. *Journal of Experimental Psychology: General*, 143(1), 33. https://doi.org/10.1037/a0031407

Bundesen, C. (1990). A theory of visual attention. *Psychological review*, 97(4), 523, https://doi.org/10.1037/0033-295x.97.4.523

Calvillo, D. P., & Hawkins, W. C. (2016). Animate objects are detected more frequently than inanimate objects in inattentional blindness tasks independently of threat. *The Journal of general psychology*, 143(2), 101-115. https://doi.org/10.1080/00221309.2016.1163249

Calvillo, D. P., & Jackson, R. E. (2014). Animacy, perceptual load, and inattentional blindness. *Psychonomic Bulletin & Review*, 21(3), 670-675. https://doi.org/10.3758/s13423-013-0543-8

Cartwright-Finch, U., & Lavie, N. (2007). The role of perceptual load in inattentional blindness. *Cognition*, 102(3), 321-340. https://doi.org/10.1016/j.cognition.2006.01.002

Chabris, C. F., Weinberger, A., Fontaine, M., & Simons, D. J. (2011). You do not talk about Fight Club if you do not notice Fight Club: Inattentional blindness for a simulated real-world assault. *i-Perception*, 2(2), 150-153. https://doi.org/10.1068/i0436

Chapman, C. S., Gallivan, J. P., & Enns, J. T. (2015). Separating value from selection frequency in rapid reaching biases to visual targets. *Visual Cognition*, 23(1–2), 249–271. https://doi.org/10.1080/13506285.2014.976604

Chen, P. L., & Pai, C. W. (2018). Pedestrian smartphone overuse and inattentional blindness: an observational study in Taipei, Taiwan. *BMC public health*, 18(1), 1-10. https://doi.org/10.1186/s12889-018-6163-5

Chen, Z., & Treiseman, A. (2008). Distractor inhibition is more effective at a central than at a peripheral location. *Perception & psychophysics*, 70(6), 1081-1091. https://doi.org/10.3758/PP.70.6.1081

Cherry, E. C. (1953). Some experiments on the recognition of speech, with one and with two ears. *The Journal of the acoustical society of America*, 25(5), 975-979. https://doi.org/10.1121/1.1907229

Clifasefi, S. L., Takarangi, M. K., & Bergman, J. S. (2006). Blind drunk: The effects of alcohol on inattentional blindness. *Applied Cognitive Psychology: The Official Journal of the Society for Applied Research in Memory and Cognition*, 20(5), 697-704. https://doi.org/10.1002/acp.1222

Cohen, M. A., Cavanagh, P., Chun, M. M., & Nakayama, K. (2012). The attentional requirements of consciousness. *Trends in cognitive sciences*, 16(8), 411-417. https://doi.org/10.1016/j.tics.2012.06.013

de Liaño, B. G. G., Nartker, M., Pérez-Hernández, E., & Wolfe, J. M. (2020). Grandma, didn't you see that gorilla? Age effects in inattentional blindness during a hybrid foraging game. *Journal of Vision*, 20(11), 448-448. https://doi.org/10.1167/jov.20.11.448

Dehaene, S., & Changeux, J. P. (2004). *Neural mechanisms for access to consciousness*. In: Gazzaniga, M. S. (Ed.), The cognitive neuroscience (pp. 1145-1158). Cambridge, MA: MIT Press.

Dehaene, S., & Changeux, J. P. (2011). Experimental and theoretical approaches to conscious processing. *Neuron*, 70(2), 200-227. https://doi.org/10.1016/j.neuron.2011.03.018

Dehaene, S., Lau, H., & Kouider, S. (2017). What is consciousness, and could machines have it?. *Science*, 358(6362), 486-492. https://doi.org/10.1126/science.aan8871

Dehaene, S., Naccache, L., 2001. Towards a cognitive neuroscience of consciousness: basic evidence and a workspace framework. *Cognition* 79(1), 1–37. https://doi.org/10.1016/S0010-0277(00)00123-2

Desimone, R., & Duncan, J. (1995). Neural mechanisms of selective visual attention. *Annual review of neuroscience*, 18(1), 193-222, https://doi.org/10.1146/annurev.ne.18.030195.001205

Devue, C., Laloyaux, C., Feyers, D., Theeuwes, J., & Brédart, S. (2009). Do pictures of faces, and which ones, capture attention in the inattentional-blindness paradigm?. *Perception*, 38(4), 552-568. https://doi.org/10.1068/p6049

Dogers, P. (2014, November 15). Magnus Carlsen wins dramatic game 6 in Sochi world championship. Retrieved from https://www.chess.com/news/view/magnus-carlsen-wins-dramatic-game-6-in-sochi-world-championship-5001

Downing, P. E., Bray, D., Rogers, J., & Childs, C. (2004). Bodies capture attention when nothing is expected. *Cognition*, 93(1), B27-B38. https://doi.org/10.1016/j.cognition.2003.10.010

Drew, T., Võ, M. L. H., & Wolfe, J. M. (2013). The invisible gorilla strikes again: Sustained inattentional blindness in expert observers. *Psychological science*, 24(9), 1848-1853. https://doi.org/10.1177/0956797613479386

Driver, J. (2001). A selective review of selective attention research from the past century. *British Journal of Psychology*, 92(1), 53-78. https://doi.org/10.1348/000712601162103

Enns, J. T., & Di Lollo, V. (2000). What's new in visual masking?. *Trends in cognitive sciences*, 4(9), 345-352. https://doi.org/10.1016/S1364-6613(00)01520-5

Evers, C., Stok, F. M., Danner, U. N., Salmon, S. J., de Ridder, D. T., & Adriaanse, M. A. (2011). The shaping role of hunger on selfreported external eating status. *Appetite*, 57(2), 318–320. https://doi.org/10.1016/j.appet.2011.05.311

Eysenck, M. W., Derakshan, N., Santos, R., & Calvo, M. G. (2007). Anxiety and cognitive performance: attentional control theory. *Emotion*, 7(2), 336. https://doi.org/10.1037/1528-3542.7.2.336

Fanelli, D. (2010). “Positive” results increase down the hierarchy of the sciences. *PLoS ONE*, 5, e10068. https://doi:10.1371/journal. pone.0010068

Fecteau, J. H., & Munoz, D. P. (2006). Salience, relevance, and firing: a priority map for target selection. *Trends in cognitive sciences*, 10(8), 382-390, https://doi.org/10.1016/j.tics.2006.06.011

Folk, C. L., Remington, R. W., & Johnston, J. C. (1992). Involuntary covert orienting is contingent on attentional control settings. *Journal of Experimental Psychology: Human perception and performance*, 18(4), 1030. https://doi.org/10.1037/0096-1523.18.4.1030

Fougnie, D., & Marois, R. (2007). Executive working memory load induces inattentional blindness. *Psychonomic bulletin & review*, 14(1), 142-147. https://doi.org/10.3758/BF03194041

Furley, P., Memmert, D., & Heller, C. (2010). The dark side of visual awareness in sport: Inattentional blindness in a real-world basketball task. *Attention, Perception, & Psychophysics*, 72(5), 1327-1337. https://doi.org/10.3758/APP.72.5.1327

Gao, H., & Jia, Z. (2017). Detection of threats under inattentional blindness and perceptual load. *Current Psychology*, 36(4), 733–739. https://doi.org/10.1007/s12144-016-9460-0

Geake, J. G. (2009). Neuropsychological characteristics of academic and creative giftedness. In *International handbook on giftedness* (pp. 261-273). Springer, Dordrecht.

Graham, E. R., & Burke, D. M. (2011). Aging increases inattentional blindness to the gorilla in our midst. *Psychology and aging*, 26(1), 162. https://doi.org/10.1037/a0020647

Gross, M. E., Smith, A. P., Graveline, Y. M., Beaty, R. E., Schooler, J. W., & Seli, P. (2021). Comparing the phenomenological qualities of stimulus-independent thought, stimulus-dependent thought and dreams using experience sampling. *Philosophical Transactions of the Royal Society B*, 376(1817), 20190694. https://doi.org/10.1098/rstb.2019.0694

Grossman, E. S., Hoffman, Y. S., Berger, I., & Zivotofsky, A. Z. (2015). Beating their chests: University students with ADHD demonstrate greater attentional abilities on an inattentional blindness paradigm. *Neuropsychology*, 29(6), 882. https://doi.org/10.1037/neu0000189

Guo, Y., You, X., & Li, Y. (2016). The role of stimulus type and semantic category-level Attentional set in sustained Inattentional blindness. *Japanese Psychological Research*, 58(4), 332–341. https://doi.org/10.1111/jpr.12127

Gupta, R., & Srinivasan, N. (2015). Only irrelevant sad but not happy faces are inhibited under high perceptual load. *Cognition and Emotion*, *29*(4), 747-754. https://doi.org/10.1080/02699931.2014.933735

Hannon, E. M., & Richards, A. (2010). Is inattentional blindness related to individual differences in visual working memory capacity or executive control functioning? *Perception*, 39(3), 309–319. https://doi:10.1068/p637

Horwood, S., & Beanland, V. (2016). Inattentional blindness in older adults: effects of attentional set and to-be-ignored distractors. *Attention, Perception, & Psychophysics*, *78*(3), 818-828. https://doi.org/10.3758/s13414-015-1057-4

Hughes-Hallett, A., Mayer, E. K., Marcus, H. J., Pratt, P., Mason, S., Darzi, A. W., & Vale, J. A. (2015). Inattention blindness in surgery. *Surgical endoscopy*, 29(11), 3184-3189. https://doi.org/10.1007/s00464-014-4051-3

Hutchinson, B. T. (2019). Toward a theory of consciousness: a review of the neural correlates of inattentional blindness. *Neuroscience & Biobehavioral Reviews,* 104, 87-99. https://doi.org/10.1016/j.neubiorev.2019.06.003

Hüttermann, S., & Memmert, D. (2012). Moderate movement, more vision: Effects of physical exercise on inattentional blindness. *Perception,* 41(8), 963-975. https://doi.org/10.1068/p7294

Hüttermann, S., Memmert, D., & Nerb, J. (2019). Individual differences in attentional capability are linked to creative decision making. *Journal of Applied Social Psychology*, 49(3), 159-167. https://doi.org/10.1111/jasp.12572

Hyman Jr, I. E., Sarb, B. A., & Wise-Swanson, B. M. (2014). Failure to see money on a tree: inattentional blindness for objects that guided behavior. *Frontiers in psychology*, 5, 356. https://doi.org/10.3389/fpsyg.2014.00356

Jasny, B. R., Chin, G., Chong, L., & Vignieri, S. (2011). *Data replication & reproducibility. Again, and again, and again.... Introduction*. Science (New York, NY), 334(6060), 1225-1225. https://doi.org/10.1126/science.334.6060.1225

Jensen, M. S., Yao, R., Street, W. N., & Simons, D. J. (2011). Change blindness and inattentional blindness. *Wiley Interdisciplinary Reviews: Cognitive Science*, 2(5), 529-546. https://doi.org/10.1002/wcs.130

Jiang, Y., & Leung, A. W. (2005). Implicit learning of ignored visual context. *Psychonomic bulletin & review*, 12(1), 100-106. https://doi.org/10.3758/BF03196353

Jingling, L., & Yeh, S. L. (2007). New objects do not capture attention without a top-down setting: Evidence from an inattentional blindness task. *Visual Cognition*, 15(6), 661-684. https://doi.org/10.1080/13506280600926695

Kahneman, D., & Tversky, A. (1979). Prospect theory: an analysis of decision under risk. *Econometrica*, 47(2), 263–292. https://doi.org/10.2307/1914185

Kahneman, D. (1968). Method, findings, and theory in studies of visual masking. *Psychological Bulletin*, 70(6p1), 404. https://doi.org/10.1037/h0026731

Kennedy, B. L., & Most, S. B. (2012). Perceptual, not memorial, disruption underlies emotion-induced blindness. *Emotion*, 12(2), 199. https://doi.org/10.1037/a0026380

Klatt, S., & Nerb, J. (2021). Position-Specific Attentional Skills in Team Sports: A Comparison between Defensive and Offensive Football Players. *Applied Sciences*, 11(13), 5896. https://doi.org/10.3390/app11135896

Koivisto, M., Hyönä, J., & Revonsuo, A. (2004). The effects of eye movements, spatial attention, and stimulus features on inattentional blindness. *Vision research*, 44(27), 3211-3221. https://doi.org/10.1016/j.visres.2004.07.026

Koivisto, M., & Revonsuo, A. (2007). How meaning shapes seeing. *Psychological Science*, 18(10), 845-849. https://doi.org/10.1111/j.1467-9280.2007.01989.x

Koivisto, M., & Revonsuo, A. (2008). The role of unattended distractors in sustained inattentional blindness. Psychological Research, 72(1), 39-48. https://doi.org/10.1007/s00426-006-0072-4

Koivisto, M., & Revonsuo, A. (2009). The effects of perceptual load on semantic processing under inattention. *Psychonomic bulletin & review*, 16(5), 864-868. https://doi.org/10.3758/PBR.16.5.864

Kok, P., Brouwer, G. J., van Gerven, M. A. J., & de Lange, F. P. (2013). Prior expectations bias sensory representations in visual cortex. *Journal of Neuroscience*, 33(41), 16275–16284. https://doi.org/10.1523/JNEUROSCI.0742-13.2013

Kreitz, C., Furley, P., & Memmert, D. (2016). Inattentional blindness is influenced by exposure time not motion speed. *Quarterly Journal of Experimental Psychology*, 69(3), 495-505. https://doi.org/10.1080/17470218.2015.1055771

Kreitz, C., Furley, P., Memmert, D., & Simons, D. J. (2015a). Inattentional blindness and individual differences in cognitive abilities. *PLOS one*, 10(8), e0134675. https://doi.org/10.1371/journal.pone.0134675

Kreitz, C., Furley, P., Memmert, D., & Simons, D. J. (2015b). Working-memory performance is related to spatial breadth of attention. *Psychological Research*, 79(6), 1034-1041. https://doi.org/10.1007/s00426-014-0633-x

Kreitz, C., Furley, P., Memmert, D., & Simons, D. J. (2016). The influence of attention set, working memory capacity, and expectations on inattentional blindness. *Perception*, 45(4), 386-399. https://doi.org/10.1177/0301006615614465

Kreitz, C., Hüttermann, S., & Memmert, D. (2020). Distance is relative: Inattentional blindness critically depends on the breadth of the attentional focus. *Consciousness and cognition*, 78, 102878. https://doi.org/10.1016/j.concog.2020.102878

Kreitz, C., Pugnaghi, G., & Memmert, D. (2020). Guessing right: Preconscious processing in inattentional blindness. *Quarterly Journal of Experimental Psychology*, 73(7), 1055-1065. https://doi.org/10.1177/1747021820911324

Kreitz, C., Schnuerch, R., Gibbons, H., & Memmert, D. (2015). Some see it, some don't: Exploring the relation between inattentional blindness and personality factors. *PloS one*, 10(5), e0128158. https://doi.org/10.1371/journal.pone.0128158

Kreitz, C., Schnuerch, R., Furley, P. A., & Memmert, D. (2018). What's past is past: Neither perceptual preactivation nor prior motivational relevance decrease subsequent inattentional blindness. *Consciousness and Cognition*, 59, 1-9. https://doi.org/10.1016/j.concog.2018.01.003

Lamme, V.A., 2003. Why visual attention and awareness are different. *Trends in Cognitive Science*. 7, 12–18. https://doi.org/10.1016/S1364-6613(02)00013-X.

Lamme, V.A., 2004. Separate neural definitions of visual consciousness and visual attention: a case for phenomenal awareness. *Neural Networks*, 17(5), 861–872. https://doi.org/10.1016/j.neunet.2004.02.005.

Lamme, V.A., 2010. How neuroscience will change our view on consciousness. *Cogn. Neurosci*. 1 (3), 204–240. https://doi.org/10.1080/17588921003731586.

Lamme, V.A., 2015. *The crack of dawn: perceptual functions and neural mechanisms that mark the transition from unconscious processing to conscious vision*. In: Metzinger, T.K., Windt, J.M. (Eds.), Open MIND: 22(T). MIND Group, Frankfurt.

Lathrop, W. B., Bridgeman, B., & Tseng, P. (2011). Perception in the absence of attention: Perceptual processing in the Roelofs effect during inattentional blindness. *Perception*, 40(9), 1104-1119. https://doi.org/10.1068/p6859

Lau, H., & Rosenthal, D. (2011). Empirical support for higher-order theories of conscious awareness. *Trends in cognitive sciences*, 15(8), 365-373. https://doi.org/10.1016/j.tics.2011.05.009

Lavie, N., Beck, D. M., Konstantinou, N. (2014). Blinded by the load: attention, awareness and the role of perceptual load. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 369: 20130205. https://doi.org/10.1098/rstb.2013.0205

Lavie, N., Hirst, A., De Fockert, J. W., & Viding, E. (2004). Load theory of selective attention and cognitive control. *Journal of experimental psychology: General*, 133(3), 339. https://doi.org/10.1037/0096-3445.133.3.339

Leber, A. B., & Egeth, H. E. (2006). It’s under control: Top-down search strategies can override attentional capture. *Psychonomic bulletin & review*, 13(1), 132-138. https://doi.org/10.3758/BF03193824

Lee, H. J., & Telch, M. J. (2008). Attentional biases in social anxiety: An investigation using the inattentional blindness paradigm. *Behaviour Research and Therapy*, 46(7), 819-835. https://doi.org/10.1016/j.brat.2008.04.001

Li, X., Tao, Q., Fang, Y., Cheng, C., Hao, Y., Qi, J., ... & Zhang, X. (2015). Reward sensitivity predicts ice cream-related attentional bias assessed by inattentional blindness. *Appetite*, 89, 258-264. https://doi.org/10.1016/j.appet.2015.02.010

Mack, A., & Clarke, J. (2012). Gist perception requires attention. *Visual Cognition*, 20(3), 300-327. https://doi.org/10.1080/13506285.2012.666578

Mack, A., Pappas, Z., Silverman, M., & Gay, R. (2002). What we see: Inattention and the capture of attention by meaning. *Consciousness and cognition*, 11(4), 488-506. https://doi.org/10.1016/S1053-8100(02)00028-4

Mack, A., & Rock, I. (1998). Inattentional blindness. MIT press.

Makel, M. C., Plucker, J. A., & Hegarty, B. (2012). Replications in psychology research: How often do they really occur?. *Perspectives on Psychological Science*, 7(6), 537-542. https://doi.org/10.1177/1745691612460688

Mason, M. F., Norton, M. I., Van Horn, J. D., Wegner, D. M., Grafton, S. T., & Macrae, C. N. (2007). Wandering minds: the default network and stimulus-independent thought. *Science*, 315(5810), 393-395. https://doi.org/10.1126/science.1131295

Maunsell, J. H. (2004). Neuronal representations of cognitive state: reward or attention?. *Trends in cognitive sciences*, 8(6), 261-265. https://doi.org/10.1016/j.tics.2004.04.003

Memmert, D. (2006a). The effects of eye movements, age, and expertise on inattentional blindness. *Consciousness and cognition*, 15(3), 620-627. https://doi.org/10.1016/j.concog.2006.01.001

Memmert, D. (2006b). Developing creative thinking in a gifted sport enrichment program and the crucial role of attention processes. *High Ability Studies*, 17(1), 101-115. https://doi.org/10.1080/13598130600947176

Memmert, D. (2009). Noticing unexpected objects improves the creation of creative solutions—inattentional blindness by children influences divergent thinking negatively. *Creativity Research Journal*, 21(2-3), 302-304. https://doi.org/10.1080/10400410802633798

Memmert, D. (2010). The gap between inattentional blindness and attentional misdirection. *Consciousness and Cognition*, 19, 1097–1101. https://doi.org/10.1016/j.concog.2010.01.001

Memmert, D. (2014). Inattentional blindness to unexpected events in 8–15-year-olds. *Cognitive Development*, 32, 103-109. https://doi.org/10.1016/j.cogdev.2014.09.002

Memmert, D., & Furley, P. (2007). “I spy with my little eye!”: Breadth of attention, inattentional blindness, and tactical decision making in team sports. *Journal of Sport and Exercise Psychology*, 29(3), 365-381. https://doi.org/10.1123/jsep.29.3.365

Memmert, D., & Furley, P. (2010). Beyond inattentional blindness and attentional misdirection: From attentional paradigms to attentional mechanisms. *Consciousness and Cognition*, 19, 1107–1109. https://doi.org/10.1016/j.concog.2010.06.005

Memmert, D., Simons, D. J., & Grimme, T. (2009). The relationship between visual attention and expertise in sports. *Psychology of Sport and Exercise*, 10(1), 146-151. https://doi.org/10.1016/j.psychsport.2008.06.002

Memmert, D., Unkelbach, C., & Ganns, S. (2010). The impact of regulatory fit on performance in an inattentional blindness paradigm. *The Journal of General Psychology: Experimental, Psychological, and Comparative Psychology*, 137(2), 129-139. https://doi.org/10.1080/00221301003645061

Mogg, K., Bradley, B. P., Hyare, H., & Lee, S. (1998). Selective attention to food-related stimuli in hunger: are attentional biases specific to emotional and psychopathological states, or are they also found in normal drive states?. *Behaviour research and therapy*, 36(2), 227-237. https://doi.org/10.1016/S0005-7967(97)00062-4

Moray, N. (1959). Attention in dichotic listening: Affective cues and the influence of instructions. *Quarterly Journal of Experimental Psychology*, 11, 56–60. https://doi.org/10.1080/17470215908416289

Morris, J. S., & Dolan, R. J. (2001). Involvement of human amygdala and orbitofrontal cortex in hunger-enhanced memory for food stimuli. *Journal of Neuroscience*, 21(14), 5304-5310. https://doi.org/10.1523/JNEUROSCI.21-14-05304.2001

Most, S. B. (2010). What's "inattentional" about inattentional blindness?. *Consciousness and Cognition*, 19(4), 1102-1104. https://doi.org/10.1016/j.concog.2010.01.011

Most, S. B. (2011). Setting sights higher: Category-level attentional set modulates sustained inattentional blindness. *Psychological research*, *77*(2), 139-146. https://doi.org/10.1007/s00426-011-0379-7

Most, S. B., & Astur, R. S. (2007). Feature-based attentional set as a cause of traffic accidents. *Visual Cognition*, 15(2), 125-132. https://doi.org/10.1080/13506280600959316

Most, S. B., Chun, M. M., Widders, D. M., & Zald, D. H. (2005). Attentional rubbernecking: Cognitive control and personality in emotion-induced blindness. *Psychonomic bulletin & review*, 12(4), 654-661. https://doi.org/10.3758/BF03196754

Most, S. B., Scholl, B. J., Clifford, E. R., & Simons, D. J. (2005). What you see is what you set: sustained inattentional blindness and the capture of awareness. *Psychological review*, 112(1), 217. https://doi.org/10.1037/0033-295X.112.1.217

Most, S. B., Simons, D. J., Scholl, B. J., & Chabris, C. F. (2000). *Sustained inattentional blindness: The role of location in the detection of unexpected dynamic events*. Psyche, 6(14).

Most, S. B., Simons, D. J., Scholl, B. J., Jimenez, R., Clifford, E., & Chabris, C. F. (2001). How not to be seen: The contribution of similarity and selective ignoring to sustained inattentional blindness. *Psychological science*, 12(1), 9-17. https://doi.org/10.1111/1467-9280.00303

Most, S. B., & Wang, L. (2011). Dissociating spatial attention and awareness in emotion-induced blindness. *Psychological science*, 22(3), 300-305. https://doi.org/10.1177/0956797610397665

Münsterkötter, A. L., Notzon, S., Redlich, R., Grotegerd, D., Dohm, K., Arolt, V., ... & Dannlowski, U. (2015). Spider or no spider? Neural correlates of sustained and phasic fear in spider phobia. *Depression and Anxiety*, 32(9), 656-663. https://doi.org/10.1002/da.22382

Murphy, G., & Greene, C. M. (2016). Perceptual load induces inattentional blindness in drivers. *Applied Cognitive Psychology*, *30*(3), 479-483. https://doi.org/10.1002/acp.3216

Näsholm, E., Rohlfing, S., & Sauer, J. D. (2014). Pirate stealth or inattentional blindness? The effects of target relevance and sustained attention on security monitoring for experienced and naïve operators. *PLoS One*, 9(1), e86157. https://doi.org/10.1371/journal.pone.0086157

Neisser, U. (1976). *Cognition and reality: Principles and implications of cognitive psychology*. W.H Freeman and Company

Neisser, U. (1979). *The control of information pickup in selective looking*. In A. D. Pick (Ed.), Perception and its development: A tribute to Eleanor J. Gibson (pp. 201–219). Hills-dale, NJ: Lawrence Erlbaum Associates.

Neisser, U., & Becklen, R. (1975). Selective looking: Attending to visually specified events. *Cognitive psychology*, 7(4), 480-494. https://doi.org/10.1016/0010-0285(75)90019-5

New, J., Cosmides, L., & Tooby, J. (2007). Category-specific attention for animals reflects ancestral priorities, not expertise. *Proceedings of the National Academy of Sciences*, 104(42), 16598-16603. https://doi.org/10.1073/pnas.0703913104

New, J. J., & German, T. C. (2015). Spiders at the cocktail party: An ancestral threat that surmounts inattentional blindness. *Evolution and Human Behavior*, 36(3), 165-173. https://doi.org/10.1016/j.evolhumbehav.2014.08.004

Newby, E. A., & Rock, I. (1998). Inattentional blindness as a function of proximity to the focus of attention. *Perception*, 27(9), 1025-1040. https://doi.org/10.1068/p271025

Odegaard, B., Chang, M. Y., Lau, H., & Cheung, S.-H. (2018). Inflation versus filling-in: why we feel we see more than we actually do in peripheral vision. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 373(1755), 20170345. https://doi.org/10.1098/rstb.2017.0345

Oktay, B., & Cangöz, B. (2018). I thought I saw “Zorro”: An Inattentional blindness study. *Archives of. Neuropsychiatry*, 55(1), 59. https://doi.org/10.29399/npa.19227

O'Shea, D. M., & Fieo, R. A. (2015). Individual differences in fluid intelligence predicts inattentional blindness in a sample of older adults: a preliminary study. *Psychological research*, 79(4), 570-578. https://doi.org/10.1007/s00426-014-0594-0

Pammer, K., & Blink, C. (2013). Attentional differences in driving judgments for country and city scenes: Semantic congruency in inattentional blindness. *Accident Analysis & Prevention*, *50*, 955-963. https://doi.org/10.1016/j.aap.2012.07.026

Pammer, K., Raineri, A., Beanland, V., Bell, J., & Borzycki, M. (2018). Expert drivers are better than non-expert drivers at rejecting unimportant information in static driving scenes. *Transportation research part F: traffic psychology and behaviour*, 59, 389-400. https://doi.org/10.1016/j.trf.2018.09.020

Pammer, K., Sabadas, S., & Lentern, S. (2018). Allocating attention to detect motorcycles: The role of inattentional blindness. *Human factors*, *60*(1), 5-19. https://doi.org/10.1177/0018720817733901

Pappas, J. M., Fishel, S. R., Moss, J. D., Hicks, J. M., & Leech, T. D. (2005). *An eye-tracking approach to inattentional blindness*. In Proceedings of the Human Factors and Ergonomics Society Annual Meeting (Vol. 49, No. 17, pp. 1658-1662). Sage CA: Los Angeles, CA: SAGE Publications.

Phillips, I. (2018). The methodological puzzle of phenomenal consciousness. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 373(1755), 20170347. https://doi.org/10.1098/rstb.2017.0347

Piech, R. M., Hampshire, A., Owen, A. M., & Parkinson, J. A. (2009). Modulation of cognitive flexibility by hunger and desire. *Cognition and Emotion*, 23(3), 528-540. https://doi.org/10.1080/02699930802012153

Piech, R. M., Pastorino, M. T., & Zald, D. H. (2010). All I saw was the cake. Hunger effects on attentional capture by visual food stimuli. *Appetite*, 54(3), 579-582. https://doi.org/10.1016/j.appet.2009.11.003

Pitts, M. A., Lutsyshyna, L. A., & Hillyard, S. A. (2018). The relationship between attention and consciousness: an expanded taxonomy and implications for ‘no-report’paradigms. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 373(1755), 20170348. https://doi.org/10.1098/rstb.2017.0348

Pitts, M. A., Martínez, A., & Hillyard, S. A. (2012). Visual processing of contour patterns under conditions of inattentional blindness. *Journal of cognitive neuroscience*, *24*(2), 287-303. https://doi.org/10.1162/jocn_a_00111

Potter, M. C. (1975). Meaning in visual search. *Science*, 187, 965–966. https://doi:10.1126/science.1145183

Potter, M. C. (1976). Short-term conceptual memory for pictures. *Journal of Experimental Psychology: Human Learning and Memory*, 2, 509–522. doi:10.1037/0278-7393.2.5.509. https://doi.org/10.1037/0278-7393.2.5.509

Rattan, A., & Eberhardt, J. L. (2010). The role of social meaning in inattentional blindness: When the gorillas in our midst do not go unseen. *Journal of Experimental Social Psychology*, 46(6), 1085-1088. https://doi.org/10.1016/j.jesp.2010.06.010

Raymond, J. E., & O'Brien, J. L. (2009). Selective visual attention and motivation: The consequences of value learning in an attentional blink task. *Psychological Science*, 20(8), 981-988. https://doi.org/10.1111/j.1467-9280.2009.02391.x

Raymond, J. E., Shapiro, K. L., & Arnell, K. M. (1992). Temporary suppression of visual processing in an RSVP task: An attentional blink?. *Journal of experimental* *psychology: Human perception and performance*, 18(3), 849. https://doi.org/10.1037/0096-1523.18.3.849

Remington, A., Cartwright-Finch, U., & Lavie, N. (2014). I can see clearly now: The effects of age and perceptual load on inattentional blindness. *Frontiers in Human Neuroscience*, 8, 229. https://doi.org/10.3389/fnhum.2014.00229

Rensink, R. A., O'Regan, J. K., & Clark, J. J. (1997). To see or not to see: The need for attention to perceive changes in scenes. *Psychological science*, 8(5), 368-373. https://doi.org/10.1111/j.1467-9280.1997.tb00427.x

Reynolds, J. H., & Chelazzi, L. (2004). Attentional modulation of visual processing. *Annu. Rev. Neurosci.*, 27, 611-647. https://doi.org/10.1146/annurev.neuro.26.041002.131039

Richards, A., Hannon, E. M., & Derakshan, N. (2010). Predicting and manipulating the incidence of inattentional blindness. *Psychological research*, 74(6), 513-523. https://doi.org/10.1007/s00426-009-0273-8

Richards, A., Hannon, E. M., & Vitkovitch, M. (2012). Distracted by distractors: Eye movements in a dynamic inattentional blindness task. *Consciousness and cognition*, 21(1), 170-176. https://doi.org/10.1016/j.concog.2011.09.013

Richards, A., Hellgren, M. G., & French, C. C. (2014). Inattentional blindness, absorption, working memory capacity, and paranormal belief. *Psychology of Consciousness: Theory, Research, and Practice*, 1(1), 60. https://doi.org/10.1037/css0000003

Royston, P., Altman, D. G., & Sauerbrei, W. (2006). Dichotomizing continuous predictors in multiple regression: a bad idea. *Statistics in medicine*, 25(1), 127-141. https://doi.org/10.1002/sim.2331

Schofield, T. P., Creswell, J. D., & Denson, T. F. (2015). Brief mindfulness induction reduces inattentional blindness. *Consciousness and cognition*, 37, 63-70. https://doi.org/10.1016/j.concog.2015.08.007

Schooler, J. W., Smallwood, J., Christoff, K., Handy, T. C., Reichle, E. D., & Sayette, M. A. (2011). Meta-awareness, perceptual decoupling and the wandering mind. *Trends in cognitive sciences*, 15(7), 319-326. https://doi.org/10.1016/j.tics.2011.05.006

Seegmiller, J. K., Watson, J. M., & Strayer, D. L. (2011). Individual differences in susceptibility to inattentional blindness. *Journal of Experimental Psychology: Learning, Memory, & Cognition*, 37(3),785–791. https://doi.org/10.1037/a0022474

Seli, P., Kane, M. J., Smallwood, J., Schacter, D. L., Maillet, D., Schooler, J. W., & Smilek, D. (2018). Mind-wandering as a natural kind: A family-resemblances view. *Trends in cognitive sciences*, 22(6), 479-490. https://doi.org/10.1016/j.tics.2018.03.010

Seitz, A. R., Kim, D., & Watanabe, T. (2009). Rewards evoke learning of unconsciously processed visual stimuli in adult humans. *Neuron*, 61(5), 700-707. https://doi.org/10.1016/j.neuron.2009.01.016

Shapiro, K. L., Raymond, J. E., & Arnell, K. M. (1997). The attentional blink. *Trends in cognitive sciences*, 1(8), 291-296. https://doi.org/10.1016/S1364-6613(97)01094-2

Shi, Y., & Li, H. (2020). How a crisis mindset activates intuitive decision process: role of inattentional blindness. *Psychological Research*, 1-13. https://doi.org/10.1007/s00426-019-01281-4

Shuler, M. G. (2006). Reward Timing in the Primary Visual Cortex. *Science*, 311(5767), 1606–1609. https://doi.org/10.1126/science.1123513

Simons, D. J. (2007). Inattentional blindness. *Scholarpedia*, 2, 3244. Retrieved from www.scholarpedia.org/article/Inattentional_blindness.

Simons, D. J. (2010). Monkeying around with the gorillas in our midst: familiarity with an inattentional-blindness task does not improve the detection of unexpected events. *i-Perception*, 1(1), 3-6. https://doi.org/10.1068/i0386

Simons, D. J., & Chabris, C. F. (1999). Gorillas in our midst: Sustained inattentional blindness for dynamic events. P*erception*, 28(9), 1059-1074. https://doi.org/10.1068/p281059

Simons, D. J., & Levin, D. T. (1997). Change blindness. *Trends in cognitive sciences*, 1(7), 261-267. https://doi.org/10.1016/S1364-6613(97)01080-2

Simons, D. J., & Schlosser, M. D. (2017). Inattentional blindness for a gun during a simulated police vehicle stop. *Cognitive research: principles and implications*, 2(1), 1-8. https://doi.org/10.1186/s41235-017-0074-3

Singer, J. L. (1966). Daydreaming: An introduction to the experimental study of inner experience. Sperling, G. (1960). The information available in brief visual presentations. *Psychological Monographs: General and Applied*, 74(11), 1–29. https://doi.org/10.1037/h0093759

Skinner, B. F. (1935). Two types of conditioned reflex and a pseudo type. *The Journal of General Psychology*, 12(1), 66-77. https://doi.org/10.1080/00221309.1935.9920088

Sperling, G. (1960). The information available in brief visual presentations. *Psychological monographs: General and applied*, 74(11), 1. https://doi.org/10.1037/h0093759

Stothart, C. R., Boot, W. R., & Simons, D. J. (2015). Using Mechanical Turk to assess the effects of age and spatial proximity on inattentional blindness. *Collabra*, 1(1). https://doi.org/10.1525/collabra.26

Stothart, C. R., Wright, T. J., Simons, D. J., & Boot, W. R. (2017). The costs (or benefits) associated with attended objects do little to influence inattentional blindness. Acta psychologica, 173, 101-105. https://doi.org/10.1016/j.actpsy.2016.12.012

Summerfield, C., & de Lange, F. P. (2014). Expectation in perceptual decision making: Neural and computational mechanisms. *Nature Reviews Neuroscience*, 15(11), 745–756. https://doi.org/10.1038/nrn3838

Swettenham, J., Remington, A., Murphy, P., Feuerstein, M., Grim, K., & Lavie, N. (2014). Seeing the unseen: Autism involves reduced susceptibility to inattentional blindness. *Neuropsychology*, 28(4), 563. https://doi.org/10.1037/neu0000042

Tapper, K., Pothos, E. M., & Lawrence, A. D. (2010). Feast your eyes: hunger and trait reward drive predict attentional bias for food cues. *Emotion*, 10(6), 949. https://doi.org/10.1037/a0020305

Theeuwes, J. (1993). Visual selective attention: A theoretical analysis. *Acta psychologica*, 83(2), 93-154. https://doi.org/10.1016/0001-6918(93)90042-P

Theeuwes, J. (2004). Top-down search strategies cannot override attentional capture. *Psychonomic bulletin & review*, 11(1), 65-70. https://doi.org/10.3758/BF03206462

Todd, J. J., Fougnie, D., & Marois, R. (2005). Visual short-term memory load suppresses temporo-parietal junction activity and induces inattentional blindness. *Psychological science*, 16(12), 965-972. https://doi.org/10.1111/j.1467-9280.2005.01645.x

Treisman, A. M. (1960). Contextual cues in selective listening. *Quarterly Journal of Experimental Psychology*, 12(4), 242-248. https://doi.org/10.1080/17470216008416732

Treisman, A. (1964). Verbal cues, language, and meaning in selective attention. *The American Journal of Psychology*, 77, 206–219. https://doi.org/10.2307/1420127

Treisman, A. M., & Riley, J. G. (1969). Is selective attention selective perception or selective response? A further test. *Journal of Experimental Psychology*, 79(1p1), 27. https://doi.org/10.1037/h0026890

Vandenbroucke, A. R., Fahrenfort, J. J., Sligte, I. G., & Lamme, V. A. (2014). Seeing without knowing: neural signatures of perceptual inference in the absence of report. *Journal of cognitive neuroscience*, 26(5), 955-969. https://doi.org/10.1162/jocn_a_00530

Vieira de Melo, B. B., Trigueiro, M. J., & Rodrigues, P. P. (2018). Systematic overview of neuroanatomical differences in ADHD: Definitive evidence. *Developmental neuropsychology*, *43*(1), 52-68. https://doi.org/10.1080/87565641.2017.1414821

Walhovd, K. B., Westlye, L. T., Amlien, I., Espeseth, T., Reinvang, I., Raz, N., ... & Fjell, A. M. (2011). Consistent neuroanatomical age-related volume differences across multiple samples. *Neurobiology of aging*, 32(5), 916-932. https://doi.org/10.1016/j.neurobiolaging.2009.05.013

Wang, L., Kuroiwa, Y., Li, M., Wang, J., & Kamitani, T. (2001). Do P1 and N1 evoked by the ERP task reflect primary visual processing in Parkinson's disease?. *Documenta ophthalmologica*, 102(1), 83-93. https://doi.org/10.1023/A:1017550507839

Ward, E. J. (2018). Downgraded phenomenology: how conscious overflow lost its richness. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 373(1755), 20170355. https://doi.org/10.1098/rstb.2017.0355

Ward, E. J., & Scholl, B. J. (2015). Inattentional blindness reflects limitations on perception, not memory: Evidence from repeated failures of awareness. *Psychonomic Bulletin & Review*, 22(3), 722-727. https://doi.org/10.3758/s13423-014-0745-8

Wayand, J. F., Levin, D. T., & Varakin, D. A. (2005). Inattentional blindness for a noxious multimodal stimulus. *The American journal of psychology*, 339-352.

White, R. C., Davies, M., & Davies, A. M. A. (2018). Inattentional blindness on the full-attention trial: Are we throwing out the baby with the bathwater?. *Consciousness and cognition*, 59, 64-77. https://doi.org/10.1016/j.concog.2017.10.002

Wiemer, J., Gerdes, A. B., & Pauli, P. (2013). The effects of an unexpected spider stimulus on skin conductance responses and eye movements: an inattentional blindness study. *Psychological research*, 77(2), 155-166. https://doi.org/10.1007/s00426-011-0407-7

Williams, L., Carrigan, A., Auffermann, W., Mills, M., Rich, A., Elmore, J., & Drew, T. (2020). The invisible breast cancer: Experience does not protect against inattentional blindness to clinically relevant findings in radiology. *Psychonomic bulletin & review*, 1-9. https://doi.org/10.3758/s13423-020-01826-4

Wimmer, G. E., Li, J. K., Gorgolewski, K. J., & Poldrack, R. A. (2018). Reward learning over weeks versus minutes increases the neural representation of value in the human brain. *Journal of Neuroscience*, 38(35), 7649-7666. https://doi.org/10.1523/JNEUROSCI.0075-18.2018

Wolfe, J. M. (1999). Inattentional amnesia. *Fleeting memories*, 17(5).

Wood, N., & Cowan, N. (1995). The cocktail party phenomenon revisited: how frequent are attention shifts to one's name in an irrelevant auditory channel?. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 21(1), 255. https://doi.org/10.1037/0278-7393.21.1.255

Wood, K., & Simons, D. J. (2017). The role of similarity in inattentional blindness: Selective enhancement, selective suppression, or both?. *Visual Cognition*, 25(9-10), 972-980. https://doi.org/10.1080/13506285.2017.1365791

Zhang, H., Wang, J., Liu, Y., Yan, C., & Ye, X. (2021). Threat-relevant stimuli cannot be better detected by preschoolers in an inattentional blindness task. *Psychological Research*, 1-8. https://doi.org/10.1007/s00426-021-01530-5

Zhang, H., Yan, C., Zhang, X., & Fang, J. (2018). Sustained Inattentional Blindness Does Not Always Decrease With Age. *Frontiers in psychology*, 9, 1390. https://doi.org/10.3389/fpsyg.2018.01390

Zhang, H., Zhang, X., He, Y., & Shi, J. (2016). Inattentional blindness in 9-to 10-year-old intellectually gifted children. *Gifted Child Quarterly*, 60(4), 287-295. https://doi.org/10.1177/0016986216657158

9. Appendix

Appendix I: *Publication I*

Dollars do not determine detection:

Monetary value associated with unexpected objects does not affect the likelihood of inattentional blindness

Reference:

Redlich, D., Schnuerch, R., Memmert, D., & Kreitz, C. (2019). Dollars do not determine detection: Monetary value associated with unexpected objects does not affect the likelihood of inattentional blindness. *Quarterly Journal of Experimental Psychology*, 72(9), 2141-2154.

ABSTRACT

Conscious perception often fails when an object appears unexpectedly and our attention is focused elsewhere (inattentional blindness). Although various factors have been identified that modulate the likelihood of this failure of awareness, it is not clear whether the monetary reward value associated with an object can affect whether or not this object is detected under conditions of inattention. We hypothesised that unexpectedly appearing objects that contain a feature linked to high value, as established via reward learning in a previous task, would subsequently be detected more frequently than objects containing a feature linked to low value. A total of 537 participants first learned the association between a perceptual feature (colour) and subsequent reward values (high, low, or none reward). Afterwards, participants were randomly assigned to a static (Experiment 1) or dynamic (Experiment 2) inattentional blindness task including an unexpected object associated with high, low, or none reward. However, no significant effect of the previously learned value on the subsequent likelihood of detection was observed. We speculate that artificial monetary value, which is known to affect attentional capture, is not strong enough to determine whether or not an object is consciously perceived.

Keywords: Failure of awareness, value-driven attention, inattentional blindness

Appendix II: *Publication II*

Does hunger promote the detection of foods?

The effect of value on inattentional blindness

Reference:

Redlich, D., Memmert, D., & Kreitz, C. (2021). Does hunger promote the detection of foods? The effect of value on inattentional blindness. *Psychological Research*, 1-12

ABSTRACT

Although human perception has evolved into a potent and efficient system, we still fall prey to astonishing failures of awareness as we miss an unexpected object in our direct view when our attention is engaged elsewhere (inattentional blindness). While specific types of value of the unexpected object have been identified to modulate the likelihood of this failure of awareness, it is not clear whether the effect of value on inattentional blindness can be generalized. We hypothesized that the combination of hunger and food-stimuli might increase a more general type of value so that food stimuli have a higher probability to be noticed by hungry participants than by satiated participants. In total, 240 participants were assigned towards a hungry (16 h of fasting) or satiated (no fasting) manipulation and performed afterward a static inattentional blindness task. However, we did not find any effect of value on inattentional blindness based on hunger and food stimuli. We speculate that different underlying mechanisms are involved for different types of value and that value manipulations need to be strong enough to ensure certain value strengths.

Appendix III: *Publication III*

A systematic overview of methods, their limitations, and their opportunities to investigate inattentional blindness

Reference:

Redlich, D., Memmert, D., & Kreitz, C. (2021). A systematic overview of methods, their limitations, and their opportunities to investigate inattentional blindness. *Applied Cognitive Psychology*, 35(1), 136-147

SUMMARY

During the past two decades, the interest in investigating the phenomenon of inattentional blindness strongly increased and resulted in a fraying of paradigms investigating this specific failure of awareness. We reviewed 129 full-text articles containing 219 experiments for their design and methods to create awareness for the growing variety of inattentional blindness paradigms. Also, we promote a deliberate use of future paradigms (proposedly based on their functionality and representativeness) to improve the transferability of research findings to the real world. In general, we argue that paradigms should be well-chosen based on the respective purpose, as the concept of inattentional blindness represents most likely several sub-types with different underlying mechanisms rather than a single phenomenon. Finally, we propose to include expectancy as a continuous variable into the definition of inattentional blindness rather than using it as an exclusion criterion.

Keywords: conscious awareness, expectancy, primary task, unexpected object, visual perception

Appendix IV: *Publication IV*

Clarifying the effect of facial emotional expression on inattentional blindness

Reference:

Redlich, D., Memmert, D., & Kreitz, C. (2022). Clarifying the effect of facial emotional expression on inattentional blindness. *Consciousness and Cognition*, 100, 103304. Doi: https://doi.org/10.1016/j.concog.2022.103304

ABSTRACT

Conscious perception often fails when an object appears unexpectedly and our attention is focused elsewhere (inattentional blindness). While various factors have been identified that modulate the likelihood of this failure of awareness, the semantic value of facial emotional expression of the unexpected stimulus is not clear. A total of 457 participants performed a static or a dynamic inattentional blindness paradigm with one of three face icons as the unexpected stimulus. Whereas we only found an effect of frowning faceś semantic value on its conscious detection in the static paradigm, we found in both paradigms a substantial effect of frowning as well as happy faceś semantic value on their conscious identification. Thus, we assume that the semantic value of unexpected stimuli, based on facial emotional expressions, controls attentional prioritization and influences inattentional blindness. Furthermore, we argue that every finding in inattentional blindness research should be considered in its respective context.

Keywords: attention bias; semantic value; conscious awareness, facial expression