Representations of the self: Conditions and effects of self-association

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Summary

Digital media allows us to expand our interactions to new types of environments. However, due to the impossibility of us being physically present, we exist in these environments in a way that lacks consistency. That is, each website or platform that we use represents us in a specific way which is unrelated to how we may be represented in other digital environments. Stimuli that we associate to ourselves and which serve as self-representations are relevant in information processing. They reduce cognitive load by prioritizing the stimuli that signal being directly relevant to us. Indeed, self-representations, such as our own name and face, and other familiar self-associated stimuli have been found to impact various stages of information processing, including affect and behavior (Bola et al., 2020; Gebauer et al., 2008; Oeberst & Matschke, 2017; Tajfel, 1970; Wood & Cowan, 1995). However, it is unclear whether such effects transfer to newly established self-representations like the numerous ones that we encounter in digital environments. Research has demonstrated that newly self-associated stimuli may indeed impact information processing (Janczyk et al., 2019; Schäfer et al., 2015; Sui et al., 2012), though maybe not as widely as familiar stimuli (Siebold et al., 2015; Stein et al., 2016). This dissertation investigated the role of familiarity in the impact of self-representations.

Across the three manuscripts that constitute the chapters of this dissertation, the role of familiarity in the attentional impact of self- and stranger-representations was tested. In each of the studies, a matching task was used in order to induce the association of neutral geometric shapes to the self and a stranger (Sui et al. 2012). Followingly, their attentional impact was comparatively measured in a dot-probe task as observed by a cuing effect

(Chapter 2) and inhibition of return (Chapter 3). Based on the types of stimuli used in prior literature, the studies in Chapters 2 and 3 both used word-labels as familiar representations and geometric shapes and new representations. In order to address this potential confound, a final study tested the attentional impact of self and stranger-representations when letter combinations were used for both familiar representations (word-labels) and new representations (nonwords; Chapter 4). Overall, results demonstrated that new self-representations impacted performance in the matching task but attentional prioritization of self-representations (vs. stranger-representations) was only observed when familiar representations were used.

It therefore seems that, although new stimuli may be tagged to the self, familiarity is a prerequisite for self-representations to capture attention. Hence, whether new self-representations become integrated into the self-concept and consequently impact information processing is rather dependent on its particular characteristics and the interactions with these representations. However, it does not occur immediately. In sum, this dissertation shows that self-association alone is insufficient to yield changes in the self-concept.

Zusammenfassung

Die digitalen Medien ermöglichen es uns, unsere Interaktionen auf neue Arten von Umgebungen auszudehnen. Da unsere physische Anwesenheit in diesen Umgebungen jedoch nicht möglich ist, fehlt unserer Darstellung in diesen Bereichen ein gewisses Maß an Konsistenz. Das bedeutet, jede Website oder Plattform, die wir nutzen, repräsentiert uns auf eine bestimmte Art und Weise, die nichts mit der Art und Weise zu tun haben muss, in welcher wir in anderen digitalen Umgebungen dargestellt werden. Stimuli, die wir mit uns selbst assoziieren und die uns als Selbstdarstellung dienen, sind bei der Informationsverarbeitung relevant. Sie reduzieren die kognitive Belastung, indem sie denjenigen Signalen Priorität einräumen, die für uns direkt von Bedeutung sind. Tatsächlich hat sich gezeigt, dass Selbstdarstellungen, wie unser eigener Name und unser eigenes Gesicht, und andere vertraute, mit uns selbst verbundene Reize verschiedene Stadien der Informationsverarbeitung beeinflussen, einschließlich Affekt und Verhalten (Bola et al., 2020; Gebauer et al., 2008; Oeberst & Matschke, 2017; Tajfel, 1970; Wood & Cowan, 1995). Es ist jedoch unklar, ob solche Effekte auf neu etablierte Selbstdarstellungen wie jene, die uns in digitalen Umgebungen begegnen, übertragen werden. Studien haben gezeigt, dass neue selbstassoziierte Stimuli die Informationsverarbeitung tatsächlich beeinflussen können (Janczyk et al., 2019; Schäfer et al., 2015; Sui et al., 2012), wenn auch vielleicht nicht so stark wie bekannte Stimuli (Siebold et al., 2015; Stein et al., 2016). Diese Dissertation untersuchte die Rolle von Vertrautheit bei der Wirkung von Selbstdarstellungen.

In den drei Manuskripten, die den Kapiteln dieser Dissertation entsprechen, wurde die Rolle der Vertrautheit bei der Aufmerksamkeitswirkung von Selbst- und

Fremdrepräsentationen getestet. In jeder der Studien wurde ein Matching Task verwendet, um die Assoziation von neutralen geometrischen Formen mit dem Selbst und einer fremden Person zu induzieren (Sui et al. 2012). Anschließend wurde ihre Aufmerksamkeitswirkung in einem Dot-Probe Task vergleichend gemessen, welche sich durch einen Cuing-Effekt (Kapitel 2) und eine Inhibition of Return (Kapitel 3) zeigte. Basierend auf den in der bisherigen Literatur verwendeten Stimuli, wurden in den Studien in Kapitel 2 und 3 sowohl Wörter und bekannte Darstellungen als auch geometrische Formen und neue Darstellungen verwendet. Um einer möglichen Konfundierung entgegenzuwirken, testete eine abschließende Studie die Aufmerksamkeitswirkung von Selbst- und Fremddarstellungen, wenn Buchstabenkombinationen sowohl für bekannte Darstellungen (Wörter) als auch für neue Darstellungen (Nicht-Wörter; Kapitel 4) verwendet wurden. Insgesamt zeigten die Ergebnisse, dass neue Selbstdarstellungen die Leistung innerhalb eines Matching Tasks beeinflussten, aber eine aufmerksamkeitsstarke Priorisierung von Selbstdarstellungen (im Vergleich zu fremden Darstellungen) wurde nur beobachtet, wenn vertraute Darstellungen verwendet wurden.

Es scheint daher, dass obwohl neue Stimuli in das Selbst integriert werden können, dennoch deren Vertrautheit eine Voraussetzung dafür ist, dass sich Selbstdarstellungen auf unsere Aufmerksamkeit auswirken. Ob neue Selbstdarstellungen in das Selbstkonzept integriert werden und sich folglich auf die Informationsverarbeitung auswirken, hängt also eher von deren besonderen Eigenschaften und ihren Interaktionen mit dem Selbst ab. Zusammenfassend zeigt diese Dissertation, dass Selbstassoziation allein nicht ausreicht, um Veränderungen des Selbstkonzepts herbeizuführen.

Acknowledgements

This dissertation is the culmination of two and a half years of theoretical and empirical work. However, the most valuable knowledge resulting from that work is not contained in this text nor did it come directly from reading scientific papers and analyzing data. Rather, it is the product of sharing with others, overcoming challenges, making mistakes and trying again. I could not have completed this work on my own and would like to give a very deserved thanks to those who contributed to it.

I acknowledge the guidance and input of my advisers, Ann-Katrin Wesslein and Christina Matschke. Ann-Katrin's dexterity in breaking down experimental processes and her eye for detail were essential in developing and reporting these studies. Christina's wealth of knowledge and experience, combined with her good nature, made it a pleasure to discuss ideas and work together. They are both admirable researchers and I am fortunate to have had the opportunity to learn from them. I thank them for constantly challenging me to do better.

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Declaration of Authorship

I hereby declare that I have produced the present work independently and without the use of any aids other than those indicated. All passages that have been taken literally or analogously from published or unpublished writings are marked as such. The work has not yet been submitted in the same or similar form or in excerpts in any other examination, nor has any attempt at a doctorate been made with this work or any other dissertation.

Gabriela Orellana Corrales

Tübingen, 22nd of June, 2020

Chapter 1: General Introduction

It is difficult to imagine a non-digital life. The current COVID-19 pandemic has reflected the extent to which the internet now sustains our everyday lives – allowing us to work, study, socialize, and somewhat continue our activities while quarantined in our homes. The internet has expanded our world by allowing us to interact with people and places far away, and people and places otherwise nonexistent. However, anyone who spent weeks stuck at home can confirm that it is by no means a replacement for the real world. Digital media presents instead a *new* type of environment and allows for the possibility to change from one environment to the other in a matter of seconds, or to be simultaneously present in multiple environments. Each of these digital environments (e.g., your online bank, social media accounts, service applications, videogames) represents us as users in its own specific way like a username, avatar, or photograph. Prior research has demonstrated that representations of the self such as one's own name (Arnell et al., 1999; Wood & Cowan, 1995) or face (Brédart et al., 2006; Liu et al., 2016) and other self-associated stimuli can impact cognitive information processing (Bargh, 1982; Bola et al., 2020; Brédart, 2016), attitudes (Beggan, 1992; Greenwald & Farnham, 2000), and behavior (Oeberst & Matschke, 2017; Tajfel, 1970). However, it is uncertain whether this applies to all self-representations, regardless of whether they are familiar, like our face and name, or newly established; as would be the case with an avatar. A growing body of research has demonstrated that newly established self-representations can have some impact on information processing (e.g., Dalmaso et al., 2019; Janczyk et al., 2019; Schäfer et al., 2015; Sui et al., 2012). However, results are not yet clear in specifying the stage at which they impact information processing, and whether or not it is comparable to the effects produced by familiar self-representations. This dissertation provides further insight into the role played by familiarity in the processing of self-representations.

We exist in a dynamic environment which is constantly changing; producing sounds, smells, and other sensations. In fact, the environment produces so much stimulation that the brain is unable to process it all at once (Franconeri et al., 2013; Kleiss & Lane, 1986; Shaw & Shaw, 1977). In order to manage the excessive amount of information that it receives, the mind relies on filters that reduce cognitive load by selectively allocating cognitive resources towards the processing of specific stimuli (Hafter et al., 2007; Wark et al., 2007). For example, a loud and unexpected sound can easily catch our attention, while we may not be constantly aware of our clothes being in contact with our skin. Thus, when processing information, specific characteristics of stimuli are used as signals that indicate their relevance in order to prioritize what is most important for us to respond to.

One particular filter which directs information processing is the self-concept, resulting in the prioritization of information that is associated to our self (Cunningham & Turk, 2017; Markus, 1977; Smith, 1996; Woźniak, 2018). This prioritization is reflected in common incidents of daily life, such as how we can easily hear our name being called out within the noise of a busy room (the so-called “cocktail party effect”; Moray, 1959), or how easily we can find ourselves in a group picture in comparison to when we try to identify someone else. As information that refers to us is more likely to be relevant and require a response from us, it is only natural that we are biased towards attending it. The impact of self-association can even go beyond cognitive information processing, affecting our attitudes and behavior. This can be reflected, for instance, in how we feel more positively towards belongings that have sentimental value in comparison to similar objects that may be in better condition, and how we can be extra friendly to a fellow compatriot who we randomly meet in a foreign country. Consequently, information and elements that we interact with – such as our personal characteristics (Bargh, 1982; Moray, 1959; Tacikowski & Nowicka, 2010), social relationships (Brewer, 1979; Zickfeld & Schubert, 2016), and possessions (Muñoz et al., 2020; Van Dyne & Pierce, 2004) – are categorized in the cognitive system by our relationship to them in order to form a hierarchy of sorts which is based on the degree to which these elements are associated to the self and integrated into the self-concept (Woźniak, 2018).

In the present day, however, our interactions are not solely bound to the physical world. With the ubiquitous use of the internet and digital media, we now also interact with people, characters, objects, and ideas in an ever-growing number of virtual environments. Consequently, the number of elements which we associate to ourselves has grown exponentially. Consider the number of online accounts that you use, the applications on your smartphone, and the transactions you complete online. All websites, platforms, and applications present a new environment in which we, as a user, are represented in a specific way. Some of these representations may be familiar to us – such as our real name or a photograph of ourselves – but some of these are completely new. New representations may include avatars, usernames that differ from our real name, or symbols such as the ones used to represent our location on a navigator. In some cases, we are not represented at all. Thus, the question is raised whether these new representations of the self, which have only recently become associated to the self, have the potential to impact information processing in a way that is similar to that of familiar representations. For example, it is common to see people who are playing a videogame refer to their avatars as themselves, saying things like “I” achieved a goal, “I” went to a certain location, or even complaining about the damage they were caused. What does this reflect? Are the avatars cognitively evaluated as an equivalent of, say, a photograph of one's self?

In the last decade, a growing body of research has focused on studying the impact of recently established self-representations (Janczyk et al., 2019; Macrae et al., 2017; Schäfer et al., 2015; Siebold et al., 2015; Sui et al., 2012). However, it is not yet clear whether the effects of familiar and new self-representations on cognitive processing are comparable. The aim of this dissertation is to contribute to this body literature by exploring the process of associating new representations to the self, the cognitive impact of these new self-representations, and how their impact compares to the effects yielded by familiar self-representations. Specifically, I will present a set of three manuscripts describing the attentional impact of self-association when using familiar and new representations for the self and a stranger.

The self-concept: Context and definition

The study of the self in Western culture spans a long history dating back to the ancient Greeks, but it wasn't until the end of the 19th century when it was first conceptualized scientifically by William James (Barresi & Martin, 2011). James (1890) considered that the self is constituted by multiple dimensions which refer to the different spheres in which a person develops: the physical, social, and spiritual – all of which could potentially be further subdivided. In addition, he theorized that the self can be regarded as both subject (nominative self) and object (empirical self; James, 1890). Namely, "self as subject" refers to the subjective experience of consciousness. In other words, it refers to one's own interpretation of events as experienced in the first-person. In contrast, "self as object" refers to an understanding of one's self as an object that exists in the world and consists of specific properties associated to it (Lougheed, 2014). In this case, it alludes to the mental image I hold of myself in the third person: a woman named Gabriela, of Guatemalan nationality, with a specific hair color, height, and so on. Although research has since moved on from James' conceptualization in various aspects, the distinction of "self as subject" and "self as object" is still relevant to how researchers frame their work today (e.g., Christoff et al., 2011; Sui & Gu, 2017; Truong et al., 2017), as it defines their theoretical and research approach towards studying the self.

In this dissertation, I refer to the self-concept within the consideration of "self as object", which is the common approach in cognitive psychology. In detail, cognitive psychology posits the self-concept as a cognitive structure made up of information about the self (Sui & Gu, 2017). That is, when talking about the self-concept, I am referring to the set of properties which someone associates with themselves and which constitute their own mental representation of themselves. The information units that constitute this structure result from different cognitive and social processes and therefore vary in type (Carlston & Smith, 1996; Markus, 1977). They can be, for example, social relationships (Brewer & Gardner, 1996; Zickfeld & Schubert, 2016), possessions (Muñoz et al., 2020; Van Dyne & Pierce, 2004), and personal goals (Burkley et al., 2015). Such units of information are interconnected and perceived as one integrated concept of the self (Carlston & Smith, 1996; Markus, 1977). Furthermore, within the perspective of "self as object", it is considered that the concept of self can be operationalized, empirically manipulated, and measured (Sui & Gu, 2017). This means that the properties of the self are inferred from quantitative measures that assess bias towards self-associated stimuli. In this case, self-association is a gradual measure on a scale that reflects the strength of a stimulus' relationship to the self (Woźniak, 2018) and can be used to evaluate its categorical and gradual integration into the self-concept (i.e., whether it has been integrated into the self-concept or not, and to which degree.)

Current neurological views of the self mirror the conceptualization of the self-concept as a mechanism which influences information processing and provides a general framework to make judgments and decisions (Markus, 1977; Smith, 1996; Woźniak, 2018). Specifically, research demonstrates that self-related processing activates several neural regions (rather than one localized area of the brain), and that the activation patterns of these regions may not be exclusive to self-related processing (Y.-A. Chen & Huang, 2017; Murray et al., 2012, 2015; Sui & Gu, 2017). Deriving from this, researchers have suggested that the self is composed by the interaction of multiple neural regions (Murray et al., 2015; Sui & Gu, 2017; Vogeley & Gallagher, 2011) and that it fulfills an integrative role that facilitates different stages of cognitive information processing (Humphreys & Sui, 2015; Sui et al., 2013; Sui & Gu, 2017; Sui & Rotshtein, 2019). That is, the self-concept provides a criterion by which information can be categorized, thus establishing self-association as one of the filters by which information can be selected and prioritized in the allocation of cognitive resources.

The way in which the cognitive structure of the self-concept first develops is not yet fully understood. However, research suggest that humans already express a “minimal self” at birth (Rochat, 2011, 2019). Newborns are believed to hold a basic, innate perception of their own body as a distinct and integrated object, and they can also differentiate non-self entities as distinct and integrated objects (Rochat, 2011). This view is based on the fact that infants’ basic body coordination reflects the integration of their different body parts, such as opening their mouths before inserting their hand (Blass et al., 1989; J. S. Watson, 1995). Additionally, their movements are motivated and responsive to environmental stimuli (Rochat, 2011). In other words, we are born with a basic sense of self which is grounded on the bodily experience. During the first two years of life, the cognitive development of infants traverses various stages in their capacity to recognize themselves in mirrors and visual media, which is generally accepted as a reflection of self-perception and which is the basic foundation of the self-concept (Butterworth, 1992). Referring back to the perspective of self as object, it could be said that this perspective develops by first recognizing the self as an object (the body) in infancy and is later developed by defining the properties associated to it – namely, the self-concept.

Due to the broad range of information that constitutes the self, researchers have generally echoed James' (1890) conceptualization of a multi-dimensional self. Different disciplines have focused on specific facets of the self-concept such as the cognitive self, the ecological self, the extended self, and the social self, to name a few (Barresi & Martin, 2011; Strawson, 1999; Sui & Gu, 2017). Gallagher (2013) suggested organizing the interdisciplinary approach to the self via a "pattern theory of self". Namely, he proposed that the self is a cluster concept made up of numerous elements which can only make up a self once a sufficient number of them are combined, but which cannot individually constitute a self. Furthermore, he posed that each of these elements are in themselves pattern systems as well. Admitting the complexity of producing a comprehensive categorization, he tentatively proposed eight general categories that conform the self, which include biological and ecological aspects that guide the differentiation between the self and not self, intersubjective elements involved in social relationships and the differentiation of self and others, and cognitive elements relating to the conceptual understanding of the self as object (note the parallel of these categories with the previously mentioned facets studied by different disciplines). In summary, the self-concept is a cognitive structure which consists of units of information pertaining to multiple categories that can be independently identified but are inherently interrelated. This dissertation will focus on the cognitive and social aspects of the self by exploring the integration of new self-representations into the cognitive conceptualization of the self, the differential processing of information related to the self and others, and its observable effects on cognition, affect, and behavior.

Inclusion of stimuli in the self-concept

As a construct that encompasses one's relationships with individual elements in the environment, the self-concept is dynamic, complex, and can be altered by different cognitive, emotional, and social-behavioral processes (Deaux, 1996). In other words, the self-concept is dynamically constructed by the interactions between different environmental elements and the individual. This implies a constant balancing between external forces and internal, self-driven forces. Acknowledging this dynamic interplay, Brewer and Gardner (1996) conceptualized the following three dimensions in which the self-concept functions, and which range from the individual to the (socially) external: the personal self-concept is constituted by the individual traits of a person, the relational self-concept consists of the different roles that a person plays in interpersonal relationships, and the collective self-concept is defined by social identities which refer to group memberships. Thus, it is assumed that the environment does hold the potential to impact an individual's self-concept by presenting a new representation of the self, although many other factors may also come into play.

Indeed, theorists have proposed that changes in the external environment can have an important impact on different aspects of the individual conceptualization of the self (Amiot et al., 2007; Breakwell, 2015; Deaux, 1996). In detail, external circumstances can yield short-term and long-term change in the self-concept (Deaux, 1996). Short-term change refers to fluctuations in how a specific identity is expressed, and it is based on contextual demands and the way in which the self-concept is structured. Long-term change in the self-concept consists of a permanent alteration that requires reorganizing the self-concept as a whole in order to integrate, eliminate, or re-define a specific element (Amiot et al., 2007; Deaux, 1996). The ways in which the environment can influence the self-concept are by ascribing roles, defining role categories, and by presenting repetitive behavior patterns which strengthen the association of a specific element to the self (Deaux, 1996; Markus, 1977). Hence, familiarity may indeed play a role on the impact of a self-representation on information processing. This also means that the self-concept can develop certain stability and resistance to threatening information which contradicts it, but it is always vulnerable to environmental influence that may cause it to change (Markus, 1977). That is, in order to adapt to the fluctuating nature of the environment and relationships with others, and to assimilate the information it receives, the self-concept must remain flexible (Tajfel, 1981).

According to Deaux (1966), there are two main requirements to integrate an element into the self-concept. The first requirement is to associate a specific element to the self. This is absolutely necessary and, in some cases, sufficient for the element to become integrated to the self-concept (Deaux, 1996). Such is the case observed, for example, when the arbitrary categorization into a group immediately yields identification with the group and behaviors associated to group identification (Brewer, 1979). This is also the case regarding observed effects of playing a specific role in a videogame, by which players identify a role they played in a videogame as more congruent with themselves in comparison to other roles (Klimmt et al., 2009, 2010). This labelling process may be regarded as relevant in inducing (at least) short-term change. By this account, then, the presentation of new representations of the self in digital environments should have some impact on the self-concept, at least for a limited period of time. The second requirement involves a process of analyzing and consciously accepting the element that has been integrated into the self-concept (Deaux, 1996). This process refers to an acknowledgment and understanding of the characteristics associated to the integrated element and has the final end of facilitating the processing of future information which may be contradicting and threatening to the self-concept. That is, the requirement of analyzing a self-associated element is one that strengthens the self-association and allows the self-concept to remain stable in the long term, even when presented with conflicting information that could threaten the self-concept.

Nevertheless, the self-concept is not only modified by the influence of the environment, as an individual may also choose to integrate or eliminate elements from their self-concept (Deaux, 1996). Likewise, an individual may choose *not* to endorse a role that has been ascribed by the social environment (Deaux, 1996). There are different motivations behind the personal decision to integrate, eliminate, or re-define an element of the self-concept. To begin with, there is a general drive to maintain consistency and preserve social integrity (Becker & Tausch, 2014; Tajfel, 1981). Therefore, the self-concept can be repeatedly re-evaluated and adapted – for example, increasing the relevance of a particular element – in order to perceive the self-concept as congruent. Additionally, individuals constantly strive to find a balance between individual differentiation and social inclusion (Brewer, 1991, 1993). In other words, we strive to accept the associations imposed by the environment in order to feel accepted while still feeling distinct, which may result in the re-interpretation of generic roles. Instrumental motivations also influence self-driven modifications of the self-concept. Individuals hold an implicit inclination to acquire resources that enhance their ability to achieve specific goals (Aron et al., 1991; Deaux, 1996). When an element is integrated to the self-concept, the characteristics and resources of that element are perceived to become accessible to the self as well. Thus, an individual may be motivated to associate specific elements to their self-concept when such elements are characterized by features that the individual finds valuable. From this, then, different types of new self-representations can also vary in their potential impact due to the ideas associated to them based on their characteristics and the particular digital context in which they are presented.

Considering the breadth of the self-concept – encompassing numerous dimensions and including multiple elements – the judgements made based on the self-concept must occur contextually. Following the way in which Brewer and Gardner (1996) proposed that the self-concept can be structured in levels that range from the individual to the collective, self-categorization theory describes how individuals can perceive themselves at different levels of abstraction – ranging from the individual to the collective – and how the level of abstraction at which the individual perceives themselves in a given moment will depend on environmental conditions that activate specific elements of these identifications (Turner & Onorato, 1999). In other words, the expression of different self-associated elements will vary according to the specific situation and what is considered relevant to that particular situation (Humphreys & Sui, 2015). For example, one's profession and academic title may be salient in a work context, but different to what is salient in a family context where family roles are more salient, and one may be referred to by a nickname. As elements are categorized by their relationship to the self, or their degree of self-association, differentiation of the self and not-self can both be viewed as gradual or categorical, based on the context. Consider the way in which one may think of a spouse as both a part of one's self-concept in some contexts (e.g., someone introducing themselves as someone else's spouse at a party hosted by said spouse's friends) yet is able to make a categorical difference that the two are separate individuals (e.g., the same person will have a discussion with their spouse referring to each of them individually as “you” and “I”). Similarly, a circle may be an efficient representation of myself when its presented in a navigator, but not in any other context. Thus, self-association of elements is gradual, but categorical differentiations of self and other occur at the physical level, grounded on the body. That is, though I may integrate external elements such as an avatar into my self-concept and feel somehow represented by them, I can also clearly differentiate between myself and these elements as separate, discrete entities.

To summarize, the self-concept is flexible and is dynamically shaped by the impact of external influences and internal motivations. Thus, although the environment does indeed hold the potential to impact the self-concept in the short and long-term, its impact will depend on various characteristics. These characteristics include the individual’s perception of an element as desirable and congruent to their self-concept, and the consistency and frequency of interactions with the element, among many others. Therefore, new self-representations presented in digital media will vary in their potential to impact the self-concept based on its characteristics and the specific environment in which it is presented.

The impact of self-association

As previously mentioned, the self-concept functions as a mechanism that selects, structures, and manages incoming information based on its relationship to the self. That is, the self-concept influences information processing by directing cognitive resources towards self-associated stimuli; consequently affecting cognition, attitudes, and behavior. The purpose of this is to reduce cognitive load by directing cognitive resources to what is specifically relevant to the self. Thus, it facilitates interactions with the environment. It should therefore follow that measurable observations can be made about the impact of individual self-associated stimuli. These measures can then be interpreted as evidence that a specific stimulus is in fact associated to the self, and to which degree it is so. In other words, the degree to which a stimulus is associated to the self can be interpreted from its measurable impact on cognition, attitudes and behavior.

Considering that a broad range of elements can be included in the self-concept, it is unsurprising that a wide variety of self-associated stimuli have been shown to impact information processing. So far, such evidence has been observed for stimuli that directly reference the self by functioning as its representation, such as one's own name (Alexopoulos et al., 2012; Cherry, 1953; Höller et al., 2011; Koole et al., 2001; Moray, 1959; Tacikowski & Ehrsson, 2016; Tacikowski & Nowicka, 2010; Wood & Cowan, 1995; Yamada et al., 2012; Yang et al., 2013), and one's face (Bola et al., 2020; Bortolon & Raffard, 2018; Liu et al., 2016; Tacikowski et al., 2011; Tacikowski & Nowicka, 2010; Tong & Nakayama, 1999; Wójcik et al., 2018). It has even been observed for the individual letters and numbers included in one's own personal name, one's own birthdate (Kitayama & Karasawa, 1997; Koole et al., 2001; Nuttin, 1985; Tacikowski & Ehrsson, 2016), one's nationality (Tacikowski & Ehrsson, 2016) and arbitrary visual stimuli that have only recently been associated to the self, such as geometric shapes (Sui et al., 2012) and completely unfamiliar avatars (Woźniak & Knoblich, 2019). Thus, both familiar and new self-representations in digital environments – such as a profile photograph and an avatar – have the potential to impact information processing.

Additionally, it has been demonstrated that such effects are not exclusive to stimuli that actually serve as representations of ourselves, but they are also extended to environmental elements that we associate to ourselves. For example, there is evidence demonstrating an impact of people and objects such as close others (Smith et al., 1999; Smith & Henry, 1996; Zickfeld & Schubert, 2016), groups (Brewer, 1979; Tropp & Wright, 2001), and possessions (Constable et al., 2018; Muñoz et al., 2020; Van Dyne & Pierce, 2004) on information processing, attitudes, and behavior. Finally, abstract concepts such as goals, ideas (Hatvany et al., 2018) and roles (Klimmt et al., 2010) have also been observed to have an impact on information processing. This can be the case, for example, with people who define themselves by their religious beliefs, and researchers who feel represented by the theories they have authored.

In other words, the dynamic nature of the self-concept involves interactions with numerous environmental elements. These elements entail diverse cognitive, affective, and behavioral processes which have the potential to yield different cognitive, affective, and behavioral consequences (Deaux, 1996). Followingly, I will describe some of the main effects that have been reported to be induced by the listed self-associated stimuli.

Cognitive impact of self-association

The self-concept is considered to be, by nature, a cognitive structure (Markus, 1977; Sui & Gu, 2017). Therefore, the integration of elements into the self-concept is an action which already impacts cognition by modifying the mental schema of the self. When associating another person to the self, for example, characteristics of that person can become integrated into the self-concept and recognized as one's own (Aron et al., 1991; Smith et al., 1999; Smith & Henry, 1996). The overlap of mental representations of the self and the elements associated to the self have been measured and observed via explicit measures in which individuals represent their relationships by drawing overlapping circles (Aron et al., 2004; Tropp & Wright, 2001), via implicit cognitive measures (Hatvany et al., 2018), as well as by neurological data (Y.-A. Chen & Huang, 2017; Murray et al., 2012, 2015; Sui & Gu, 2017; Vogeley & Gallagher, 2011). That is, the self-concept is restructured in order to integrate a new element.

Furthermore, the self-concept fulfills the purpose of facilitating information processing (Markus, 1977; Sui & Gu, 2017). Therefore, the impact of self-association has been observed at different stages of information processing such as perception (Pannese & Hirsch, 2011), attentional capture (Brédart et al., 2006), and memory (Kim et al., 2018).

Self-associated stimuli can access awareness and guide attention more easily than stimuli associated to others. For example, words that relate to the self – such as personal names and surname – and characteristics directly attributed to the self – such as nationality and birthday date – can preferentially access awareness in comparison to the same type of stimuli when they refer to someone else (Cunningham & Turk, 2017; Rathbone & Moulin, 2010). Specifically, self-associated stimuli yield a stronger priming effect than stimuli associated to others and are thus posteriorly categorized as relating to the self with greater ease than stimuli associated to others being categorized as relating to others (Tacikowski & Ehrsson, 2016). The same is true for the effect of seeing one's own face than someone else´s face, which even facilitates the perception of subliminal stimuli consisting of (non-visible) faces of the same gender (Pannese & Hirsch, 2011). Self-association also captures and holds attention. For example, one's own name captures attention more easily than other names (Alexopoulos et al., 2012) and one's own face captures attention more easily than other faces (Bortolon & Raffard, 2018). One's own face also acts as a distractor that interferes with the identification of stimuli that are related to others (Brédart et al., 2006).

Although some evidence suggests that conscious awareness is a necessary precondition to observe prioritization effects of self-associated stimuli in information processing (Kim et al., 2018), there is substantial evidence indicating that this may not necessarily be so. For example, even if not attending an auditory channel, one´s own name can still be perceived while other unattended content is not perceived (Bargh, 1982; Wood & Cowan, 1995). Research also shows that attention can be captured by subliminal presentations of one's own face (Bola et al., 2020). Remarkably, evidence even demonstrates that one's own name yields stronger neurological responses than other names during natural states of unconsciousness in sleep (Blume et al., 2017).

Memory is also impacted by self-association. In detail, it is easier to remember names of people who share one's own name in comparison to the names of people who do not match one's own (Brédart, 2016). Additionally, the presentation of one's own name in conjunction to other stimuli yields an effect of enhanced memory for the accompanied content in comparison to content that are not accompanied by self-associated stimuli (Bower & Gilligan, 1979; Kim et al., 2018).

Beyond one's own name and face, which are pretty much stable and less likely to change through time, some elements that are integrated into the self-concept are more dynamic and thus have a more active role in providing "feedback" for the self-concept to adapt accordingly to the way the element changes. Such is the case with goals, which can be integrated in the self-concept but are prone to change with time and can be categorically defined as having been accomplished or failed. In fact, as the goal is part of the self-concept, its outcome can either strengthen the self-concept by providing congruent information that confirms it or diminish a person's clarity of their self-concept when failure to achieve the goal presents incongruent information that threatens the self-concept (Burkley et al., 2015).

Taken together, there is an overwhelming amount of evidence establishing that self-association impacts cognition at all stages. In particular, an overwhelming amount of this evidence is derived from the processing of one's own name and face, reflecting the usefulness and cognitive impact of using profile photos and users' own names as their representations in digital environments. The evidence about the cognitive impact of self-association is congruent with the supposition of the self-concept as a mechanism that facilitates information processing. Furthermore, it also provides an explanatory basis for more complex effects induced by self-association in affect and behavior. Followingly, I will briefly describe the results observed in studies testing the affective effects of self-association.

Affective impact of self-association

A particularity of the dynamics of the self is the tendency to evaluate the self more positively than would objectively be done (Brown, 1986). By proxy, self-associated stimuli are generally evaluated more positively when compared to stimuli that are not associated to the self (Beggan, 1992). Therefore, self-association yields an impact on affect – such as influencing implicit attitudes. Implicit attitudes refer to evaluative associations that are held by someone without them necessarily advocating them or being aware of them (Greenwald & Banaji, 1995). By comparing the degree of association of two distinct categories (e.g., me and not me) and two affective categories (e.g., pleasant and unpleasant). That is, the degree of congruency perceived between the combination of categories (me-pleasant and not me-unpleasant in comparison to not me-pleasant and me-unpleasant) denotes a bias towards evaluating one category (self or other) as positive. In the case of evaluative judgements such as “pleasant” and “unpleasant”, there is indeed a tendency to judge the “pleasant” judgement as more congruent with “me” than “not me”, and the “unpleasant” judgement as less congruent with “me” than “not me” (Boucher et al., 2009; Greenwald & Farnham, 2000). However, positive evaluations are not limited the implicit. Research has demonstrated a tendency towards explicit positive evaluations of self-associated stimuli, such as letters included in one’s own name and numbers related to one’s own birthday date, in comparison to non-self-associated stimuli (Kitayama & Karasawa, 1997; Koole et al., 2001). One´s own possessions are also valued more highly than other objects solely because of being associated to the self (Beggan, 1992).

In addition to direct valence evaluations of the objects included in the self-concept, self-association can impact attitudes towards the relationship with such elements. For example, including a group into the self-concept increases in-group bias expressed as in-group favoritism (in which in-group refers to a group in which one is included) and a higher level of commitment (Brewer, 1979). Specifically, in-group bias and in-group favoritism refer to a pattern of presenting attitudes (and, consequently, behaviors) that benefit the group to which one holds a membership for the sole reason that one is a member of said group. Furthermore, integrating an organization into the self-concept leads to greater organizational satisfaction (Knapp et al., 2014).

To summarize, self-association enhances positive attitudes towards self-associated elements themselves and towards the relationship individuals have with that element. Thus, digital self-representations can be relevant in influencing attitudes towards the use of specific digital services or platforms. Considering the affective and cognitive impact of self-association in combination, these logically give way to facilitate the behavioral effects of self-association which have been previously observed, which I will describe in the following section.

Behavioral impact of self-association

Building on the cognitive and affective effects previously described, self-association has been observed to impact behavior in ways that echo the biases listed above. Specifically, interaction with elements associated to the self yields behaviors that favor and prioritize self-associated elements in comparison to elements that are not associated to the self.

For example, self-association is linked to behaviors that favor the self-associated object by prioritizing it and by assigning or investing more resources towards the self-associated object (Burkley et al., 2015; Oeberst & Matschke, 2017; Tajfel, 1970). This effect can commonly be observed in the context of group behaviors, especially in situations of conflict or competition. An example of this is the incidence of the "me-first" rule (Cooper & Ross, 1975) – a semantic principle describing the tendency to mention self-related things first when listing items – when referring to group conflicts. Oeberst and Matschke (2017) found that, in names of historical conflicts which (1) involve two groups who speak different languages and (2) refer to both groups in the name, there is a tendency name the in-group first. For example, one conflict has the French name "French-German War" (Guerre franco-allemande) and the German name "German-French War" (Deutsch-Französischer Krieg). Furthermore, when asked to spontaneously come up with a name that refers to a fictitious conflict, there is a tendency to name the in-group first; even if the assignment to the in-group is recent and arbitrary. Moreover, when asking participants to rate groups mentioned in the names of group conflicts, the group that was mentioned first was generally rated as more powerful and important (Oeberst & Matschke, 2017). Thus, the “me-first” rule reflects a bias regarding the perceived importance of the in-group as greater than another group.

Behavioral bias is also observable in resource allocation. For example, when dividing resources between the in-group and another group, or between a close other and a stranger, there is a tendency towards strategies that maximize the profit of the self-associated social entity (be it group or individual) and create the greatest possible difference between the profits of the in-group and the out-group (Aron et al., 1991; Tajfel, 1970). This is also occurs even if groups have been assigned arbitrarily (Tajfel, 1970; Tajfel et al., 1971). A similar behavioral bias has also been observed in relation to goals. In detail, the consideration of a goal as part of the self-concept leads to a greater investment of resources, such as time, effort, and money, towards achieving the self-associated goal. Furthermore, the degree to which a goal is associated to the self can predict goal achievement (Burkley et al., 2015).

To summarize, the consequences of self-association are observable throughout various stages of information processing as well as in attitudes and behavior. This reflects the role of the self-concept as a cognitive structure that guides information processing and cognitively structures specific elements on the basis of their association to the self. Thus, it also highlights the importance of understanding the impact of the self-representations in digital environments, as they can greatly influence the use of digital media.

Integrating new stimuli into the self-concept: Self-prioritization effect

The majority of the stimuli used in the studies presented so far entail different confounds. For example, stimuli such as one’s own name are characterized by a high level of exposure. Others, such as goals, carry a specific meaning of personal value. Even studies involving the arbitrary categorization into groups involve an element of competition against the other group. Thus, it is difficult to evaluate the extent to which such effects are due to self-association itself, rather than these aggregated elements. Considering that many of the self-representations in digital media are entirely new (as well as the environments in which they are presented) it is necessary to understand the extent to which the effects presented in the literature are due to self-association alone, in absence of familiarity or other additional elements.

Within the last decade, a growing body of literature has focused on testing the impact of self-association in absence of familiarity (Janczyk et al., 2019; Macrae et al., 2017; Schäfer et al., 2015; Siebold et al., 2015; Sui et al., 2012). This has been done by inducing self-association of a neutral stimulus and then testing its impact in a cognitive task. The established paradigm used to induce self-association was established by Sui, He, and Humphreys (2012) and proceeds in the following way: Participants are first asked to associate three geometric shapes to themselves, a close other (e.g. friend or mother), and a stranger or neutral object (e.g. chair). The instructions are followed by a matching task, which consists of the presentation of random pairings of the geometric shapes and word-labels referring the associated entities (i.e. “self”, “friend”, “stranger”). Participants are tasked with responding whether the presented combinations are matching (both representing the same entity) or non-matching (each representing different entities) as per the original instructions. The analysis of performance in the matching task focuses only on trials presenting matching pairs. What results show is that confirmation of the matching self-associated shape-label is pair is significantly faster and more accurate than any other combination. Furthermore, the confirmation of the matching friend-associated pair is faster than that of the stranger-associated pair (Schäfer et al., 2015; Sui et al., 2012). Thus, the SPE has been interpreted as evidence that simple and arbitrary stimuli can become tagged to the self and consequently impact information processing.

Studies have replicated the SPE by using various stimuli in different sensory modalities. The original study reporting the SPE used geometric shapes (Sui et al., 2012) and numerous other studies have replicated this observation by using the same stimuli (Macrae et al., 2017; Schäfer et al., 2015). However, the SPE has also been replicated using other pictorial stimuli, including diagonal lines (S. Payne et al., 2017; Siebold et al., 2015), Gabor patches (Stein et al., 2016) and new faces which are either illustrated (Zhao et al., 2015) or photographed (S. Payne et al., 2017; Woźniak et al., 2018). Even characteristics of pictorial stimuli, such as color, have been observed to yield the SPE (Sui et al., 2009). However, beyond the visual dimension, studies have replicated the SPE with auditory stimuli such as tones (Schäfer, Wesslein, et al., 2016) and voices (B. Payne et al., 2019), as well as tactile stimuli such as vibration patterns (Schäfer, Wesslein, et al., 2016). As a whole, the results from these studies demonstrate that different types of stimuli can become tagged to the self and that the SPE is highly robust.

Later studies have followingly expanded research on the SPE, testing what yields self-association and specifying how it impacts cognition. Generally, results are mixed and further research is necessary in order to fully understand the SPE and how it compares to the cognitive impact yielded by familiar self-associated stimuli. However, the research that has been done so far provides already some insights about recently established self-associations and how its impact compares to that yielded by familiar self-association. In the original report of the SPE, Sui and her colleagues (2012) described the SPE as a perceptive effect due to the impact of self-association vs. other-association in categorizing low-contrast stimuli in the SPE matching task. That is, self-association facilitated perception of low-contrast stimuli. In related studies, the use of compound stimuli using both socially salient (i.e., shapes associated to self or others) and perceptually salient elements (i.e., color) reflected an interaction of both social salience and perceptual salience. However, claims about the perceptive nature of the SPE have been disputed by later studies. For example, when using a continuous flash suppression paradigm – in which a high contrast mask presented in one eye temporarily interferes in the perception of a stimulus presented in the other eye – no difference was observed regarding the breakthrough to perception of self-associated and other-associated stimuli. That is, neither seemed to be privileged into awareness (Stein et al., 2016). The research that has followed has thus hinted at the other possible mechanisms at play in yielding the SPE.

The SPE has been demonstrated to occur at a conceptual level – implicating stages of information processing that occur later than perception (Schäfer, Wesslein, et al., 2016). That is, rather than tagging a specific stimulus to the self, the association tags a concept. When presenting different stimuli that belong to the same concept – such as images and sounds representing the same instrument – results still reflected a significant SPE. Thus, the evidence suggests that the SPE may not solely depend on perception. This is further supported by the use of the SPE matching task when assigning the self and other labels to stimuli that are described by multiple features (e.g. "blue" and "triangle"; Schäfer, Frings, et al., 2016). In this case, partial matches (i.e., those in which the presented stimulus complies with only one of the assigned features) did not interfere with results. That is, the SPE was observed specifically for stimuli that complied with both assigned features (Schäfer, Frings, et al., 2016). The effect demonstrates that the features are integrated into one single reference object – a characteristic observed in later stages of information processing rather than earlier stages (such as perception). Indeed, self-associated stimuli can yield redundancy gains (Humphreys & Sui, 2015). When presenting multiple self-associated stimuli that are conceptually related can increase the SPE. Such results echo the supposition that dynamics observed in later stages of information processing are at play.

Additionally, evidence suggests that self-association yields similar results to positive valence and reward. That is, positive stimuli and reward stimuli can both yield result patterns similar to the SPE (Stolte et al., 2017; Sui & Humphreys, 2015a, 2015b; Yankouskaya et al., 2018). However, positive stimuli do not affect the size of the SPE (Stolte et al., 2017), and reward stimuli do not yield redundancy gains (Sui & Humphreys, 2015a). Thus, it seems like positive valence and reward may play some role in the SPE, yet they have independent impacts as well.

Although the paradigm established by Sui and her colleagues (2012) is consistently used in the literature as a manipulation to induce self-association of generic stimuli, the task presents limitations in specifying effects in information processing and at which stage they occur. One of the limitations of the matching task used in the SPE paradigm is that the recently self-associated shapes are always presented alongside labels that are familiar, have a semantic meaning, and are socially salient. Thus, the SPE cannot be entirely attributed to the recently self-associated shape. For this reason, researchers have opted for combining the SPE paradigm with established cognitive tasks in order to specify the dynamics that come into play in yielding the SPE. However, the methodologies used have not yet been standardized. Therefore, multiple tasks and stimuli have been used to explore similar effects. This has so far yielded mixed results regarding the impact of newly established self-association from which diverse theories have been developed to explain the SPE.

In regard to attentional capture by newly self-associated shapes alone (i.e., in absence of a label), mixed evidence has been obtained by researchers using the same cognitive tasks. One of these tasks is visual search, in which a target stimulus must be located from within a group of distractor stimuli. Target stimuli varying in salience (e.g., self-associated and other-associated) are used and response time and accuracy are measured. Faster and more accurate response towards a particular stimulus are considered an advantage in attentional capture. When presenting self-associated and stranger-associated diagonal lines within set of parallel lines, there was no advantage towards locating the self-associated line (Siebold et al., 2015). However, in a similar task presenting self- and stranger-associated shapes amongst sets of distractor shapes, an advantage was observed in regards to the speed of locating the self-associated shape in comparison to the speed at which the stranger-associated shape was located (Wade & Vickery, 2018).

In parallel, some studies have used variations of Posner's cuing task (1980) in order to measure attention (Sui et al., 2009; Zhao et al., 2015). The task consists of identifying the location of a target that may appear on one of two opposite locations (e.g., left and right). Before the target is presented, one of two cues varying in salience – in this case, self-associated and other-associated – is shown either orienting towards the location where the target will appear (congruent trials), or towards the opposite direction (incongruent trials). Response times and accuracy are measured to estimate attentional capture. It is expected that stimuli that capture attention will facilitate responses towards the cue in congruent trials and interfere with responses in incongruent trials. One study using this task had participants associate colors to themselves and a friend. Later, an arrow in either one of the two colors was presented in the center of the screen, before the target appeared. Results observed that arrows presented in the self-associated color facilitated responses in comparison to arrows presented in the friend-associated color (Sui et al., 2009). A similar study which presented illustrated faces that gazed to the right or left before presenting auditory targets that were heard to the right or left. Namely, the auditory target was manipulated and presented as either a tone or a voice. The use of a voice target significantly impacted the size of the attentional effect (Zhao et al., 2015). Taken together, these studies demonstrate that, while self-associated stimuli do hold the potential to orient attention, there may be limitations to this effect.

Newly established self-association has also been observed to impact the control of oculomotor responses. In one task, participants were asked to complete the SPE matching task by responding with pro-saccades when non-matching shape-label pairs were presented at either side of the screen and responding with anti-saccades when matching shape-label pairs were presented at either side of the screen. Results showed that anti-saccades from matching self-associated shape-label pairs were initiated later than anti-saccades from matching friend-associated shape-label pairs (Yankouskaya et al., 2018). That is, self-associated stimuli held attention and interrupted responses in comparison to friend-associated stimuli – denoting an attentional impact of self-association. In a similar task, participants were asked to perform anti-saccades away from self- and stranger-associated shapes presented at the center of the screen, towards a target presented at either side of the screen. Results again demonstrated that antisaccades were initiated later when self-associated shapes were presented at the center of the screen than when stranger-associated shapes were presented (Dalmaso et al., 2019). That is, self-association, in comparison to stranger-association, impacts attention by holding the gaze.

There is some evidence suggesting that the SPE occurs in memory rather than in perception or attention. In detail, result patterns similar to that of the SPE can also be induced by memory differences (Reuther & Chakravarthi, 2017). When pairing geometric shapes to non-words (instead of labels referring to social entities) and manipulating the number of times in which the shape-label pairs were presented in the practice trials (low exposure, medium exposure, and high exposure), memory differences accounted for a pattern similar to that of the SPE. Although this effect could be interpreted as evidence that the SPE originates in memory rather than perception, introducing the same memory differences to the original SPE paradigm which uses labels referring to social entities, the SPE was unaffected. This results evidence that the SPE may not be solely explained as an effect in perception, and that the matching task alone may be insufficient to identify specific effects in different stages of cognitive information processing.

Further evidence for the involvement of memory in the SPE was obtained by using a process refractory period paradigm. The paradigm consists of having participants simultaneously perform two tasks which require distinct responses. Because it is necessary to have available cognitive resources in order to perform a task, the stage in which an event occurs in information processing can be assumed by manipulating the timing in the task (that is, the period of time in between the presentation of the two stimuli requiring a response) and observing when the response to one task interferes with the ability to respond to the second task. Namely, events can be catalogued as occurring in an early perceptual stage, a central stage, or motor stage. Thus, participants were asked to perform the SPE matching task while simultaneously performing an auditory discrimination task. Response patterns excluded the possibility that the task was being performed at the earlier or later stages. Namely, results suggest that cognitive prioritization of recently self-associated stimuli occurs in memory. This is supported by the observation of self-association on memory in a working memory task (Yin et al., 2019). Specifically, in a task requiring the memorization of multi-color visual patterns and then confirm the location of the items conforming it, working memory performance was enhanced for items presented in the self-associated color than items presented in colors associated to others. Thus, strong evidence also exists to substantiate the claim that prioritization of newly self-associated stimuli involves memory processes.

Altogether, research regarding newly established self-association has not yet clarified how exactly it impacts cognition. So far, there is mixed evidence as to what stage of information processing is impacted by newly established self-association. Adding to this, the SPE methodology typically used in the study of newly established self-association presents a confound which hinders the interpretation of its effects as being generated by the new self-representation. Specifically, its presentation of the newly self-associated shape along with the familiar label referring to the self does not allow for the SPE to be interpreted as an effect of the new self-representation only. Finally, the use of pictorial stimuli as new self-representations in the overwhelming majority of studies – while pictorial stimuli are not used in studies testing the effects of familiar self-representations – presents a potential confound which thwarts the comparison of the effects yielded by new self-representations to the effects yielded by familiar self-representations. Thus, it cannot be said whether new self-representations in digital media, such as symbols or avatars, have the potential to impact information processing in a way similar to familiar self-representations like one's own name or a profile photo of one's self.

Overview

In order to elucidate how different self-representations in digital media can affect information processing, the manuscripts that constitute the chapters of this dissertation will test the role of familiarity in the impact of self-association. Specifically, the aim of this set of manuscripts is to directly compare the attentional impact of newly established self-association to that of familiar self-association in order to provide further insights on how (and which) stimuli are integrated into the self-concept and consequently impact information processing.

The focus of Chapters 2 and 3 is on the attentional impact of newly established self-association and its comparison to familiar self-association. Specifically, Chapter 2 aims to measure whether a representation of the self can immediately capture attention with greater ease than the representation of a stranger, as reflected in a cuing effect. Furthermore, familiar, new, and paired (combining both familiar and new) representations are used in order to compare whether the familiarity of the representation has an impact on the size of the effect of attentional prioritization of the self over a stranger. Following the method of the prior literature, the words "self" and "stranger" are used as familiar representations, and geometric shapes were used as new representations.

Chapter 3 consists of two studies that replicate and extend the results from the studies in Chapter 2. First, the potential of the self and stranger representations to capture attention are compared when these are represented by familiar, new, and paired representations. Secondly, the attentional task is manipulated in order to observe whether such representations yield another common attentional effect; namely, inhibition of return (Posner et al., 1985). Again, the words “self” and “stranger” are used as familiar representations, and geometric shapes are used as new representations. The paired representations used in the first two manuscripts fulfill the purpose of comparing their impact to that of the shape and label alone in order to disentangle the effects of both elements and clarify the role they play in producing the SPE as observed in the matching task.

Chapter 4 approaches the use of different stimuli modalities as familiar and new representations (namely, words and pictorial stimuli) as a potential confound. Familiar words and word-like letter combinations are used to compare the attentional capture of familiar and new representations of the self, when both types of representations use the same stimulus modality.

Finally, Chapter 5 will summarize the empirical results presented in Chapter 2 – 4. Their theoretical and practical implications will then be jointly discussed. Finally, the strengths and limitations of the presented studies will be considered, as well as possible directions for future research.

Note that the manuscripts conforming the following chapters have been written with co-authors for publication. Thus, there are content overlaps regarding explanations of the theory substantiating the reported studies.

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Declaration regarding § 5 Abs. 2 No. 8 of the PhD regulations of the Faculty of Science

- Share in collaborative publications/manuscripts -

The subsequent chapter (Chapter 2) consists of a manuscript which is currently in preparation for submission and which was co-authored by Dr. Christina Matschke and Dr. Ann-Katrin Wesslein. The proportional contributions to the manuscript are presented in the following table.

Manuscript 1

Author	Author position	Scientific ideas	Data generation	Analysis & interpretation	Paper writing
Gabriela Orellana-Corrales	first author	20%	90%	50%	40%
Christina Matschke	second author	10%	0%	20%	25%
Ann-Katrin Wesslein	third author	70%	10%	30%	35%

Title of paper:	(When) Do self-associated stimuli lead to attention holding?
Status in publication process:	In preparation for submission

Chapter 2: Attentional Capture of Self-Representations

(When) Do self-associated stimuli lead to attention holding?

Huge amounts of input arouse our senses at every waking moment, so our cognitive system needs to filter the incoming environmental information in order to select what is most relevant to direct our behaviour. A large body of research shows that stimuli referring to one's self are likely to guide this process of selective attention. In other words, self-associated stimuli such as one's own name (Alexopoulos et al., 2012; Moray, 1959; Yang et al., 2013) and one’s own face (Brédart et al., 2006; Wójcik et al., 2018) have been demonstrated to have a greater capacity to capture attention than non-self-associated stimuli. In the last years, it has been suggested that stimuli may benefit from prioritized attention even when they have only recently become self-associated (Dalmaso et al., 2019; Sui et al., 2009; Wade & Vickery, 2018). However, limitations of this effect have already been identified (Zhao et al., 2015), and some studies even failed to observe attentional prioritization of recently established self- as opposed to other-associated stimuli (Siebold et al., 2015). It is therefore unclear whether self-associated stimuli impact attention, and, furthermore, whether such an impact is generated by both familiar and newly self-associated stimuli. The purpose of the current study is to specifically compare the impact of self-association on attention for both recently established vs. highly familiar self-associated stimuli. Therefore, this paper will have two foci: (1) demonstrating how self-association specifically impacts attention by the use of two different methods that can be interpreted as attention holding, and; (2) the comparison of the attentional impact of familiar vs. newly self-associated stimuli.

Research gaps and purposes

Familiar self-associated stimuli have consistently been found to impact the distribution of attention in a variety of ways (see Sui & Rotshtein, 2019). For example, one's own name or a picture of one's own face have been found to capture attention more easily than others' names or faces (Alexopoulos et al., 2012; Moray, 1959; Wójcik et al., 2018; Yang et al., 2013). That is, responses towards one's own name as compared to others' names are facilitated (Arnell et al., 1999). Similarly, one's name and face are harder to ignore than those of others (Wójcik et al., 2018; Wood & Cowan, 1995). For one's own name, such attentional effects are maintained whether names are presented in the visual (Alexopoulos et al., 2012; Yang et al., 2013) or auditory sensory modality (Moray, 1959; Wood & Cowan, 1995). Moreover, targets that follow self-associated stimuli (i.e., occurring at a location that had previously been occupied by a self-associated stimulus) elicit faster responses than targets that follow other-associated stimuli (Alexopoulos et al., 2012). This indicates that the attentional focus remains at the location of the self-associated stimulus even after the stimulus has disappeared (Wójcik et al., 2018), reflecting attention holding. With directional stimuli like faces as oriented towards a specific location, responses are faster for targets at the location towards which one's own face orients as compared to targets at a distractor location – yet, this does not hold for a friend's vs. a stranger's face (Liu et al., 2016), indicating that directional self-associated cues serve to orient attention more efficiently that other-associated cues. In summary, familiar self-associated stimuli can efficiently guide attention as well as eliciting attentional capture and attention holding with greater ease than other-associated stimuli.

Notably, a growing body of literature has also observed prioritization effects for stimuli that have only recently become self-associated (e.g., Schäfer et al., 2016; Sui et al., 2012; Truong et al., 2017). This means that effects of self-related stimuli like one's name or face are not (or at least not merely) attributable to familiarity. The established method used to experimentally induce self-association consists of associating neutral stimuli – such as geometric shapes – to the self, a close other (i.e., mother or a friend) and a stranger or neutral object (i.e., a chair). Participants are then asked to complete a response time (RT) matching task comprising random combinations of the geometric shapes and the instances presented as word-labels (e.g., "I", "mother", "friend"). They are instructed to indicate whether the presented combinations are correct or incorrect according to the initial association. Interestingly, responses are typically fastest when confirming the correct self-associated shape-label pair. The advantage in verifying the self-associated shape-label pair in comparison to any other-associated shape-label combination is what has been called the self-prioritization effect (SPE; Sui et al., 2012).

Two points concerning the interpretation of the SPE – the evidence of which will be reviewed in the following sections - motivated the current research and will serve as the foci of this paper. First, the SPE has been interpreted to reflect (among other mechanisms) attentional prioritization of the self- as compared to other-associated shape-label pairs (Falbén et al., 2019; Humphreys & Sui, 2015). Still, the stage of information processing at which prioritization takes place cannot be clearly interpreted from the matching task alone; although stimuli have been manipulated to assume such information (Schäfer et al., 2015; Sui et al., 2012), the matching task is not an established paradigm to directly measure attention. It is therefore unclear whether or how attentional distribution is impacted by self-association. The matching task thus has to be combined with paradigms that serve as more specific measures of attention in order to test this assumption. Secondly, the SPE has been interpreted to show that a short association of some (previously arbitrary) stimulus to the self changes the way in which it is subsequently processed, implying that the stimulus which had previously been neutral is now prioritized due to its newly established association with the self. Along these lines, it has been assumed from the SPE that the association of a geometric shape to the self increases the likelihood of this shape to guide attention. However, only few published studies have investigated whether the self-associated shape alone can elicit prioritization effects – and, to the best of our knowledge, evidence for a prioritization of the shape alone is quite scarce. The current study therefore aims to (1) combine the matching task with an established cuing paradigm to specifically measure attention holding of self-associated stimuli, and (2) to compare prioritization effects for a newly established self- vs. other-associated shape alone and highly familiar self- vs. other-associated stimuli.

Attentional prioritization of self-associated vs. other-associated stimuli

In cognitive psychology, cuing paradigms represent a highly established tool to test the potential of specific stimuli to impact attention (Frischen et al., 2007; Hawkins et al., 1990; Posner, 1980; Verghese, 2001). In cuing tasks, stimuli varying in category/degree of saliency (namely, the cues) are presented to signal or distract from a target that requires a response. Targets are presented after the cue, either at the location that had previously been occupied or indicated by the cue (valid trials) or at a different location (invalid trials). Results typically show faster and more accurate responses on valid compared to invalid trials – an effect which is enhanced by the salience of cue (Ehrman et al., 2002; MacMahon et al., 2006). Previously, the impact of self-association on the distribution of attention has been concluded from the finding that a participant's own face or own name elicits faster RTs and a higher accuracy than other's faces and names in classical cuing paradigms such as the dot-probe task (Wójcik et al., 2018), the peripheral cuing task and the antisaccades task (Alexopoulos et al., 2012).

As explained, recent studies have used a matching task to measure the impact of recently established self- and other-association to previously arbitrary stimuli (Janczyk et al., 2019). Participants are asked to associate three geometric shapes to themselves, a close other, and a stranger or neutral object. They are later presented with random combinations of the shapes and word-labels referring to each of the entities, and participants must indicate whether they are correctly matched or not. The shapes and word-labels are simultaneously presented, and are thus referred to as shape-label pairs (Schäfer, Wesslein, et al., 2016; Sui et al., 2012). When presented with matching shape-label pairs, participants have been consistently faster at confirming that the self-associated shape-label pair is correct (see Humphreys & Sui, 2015; Janczyk et al., 2019; Sui et al., 2012). Such results have been interpreted by some as attentional effect (Humphreys & Sui, 2015; Sui & Rotshtein, 2019). However, the matching task alone is insufficient to confirm that the SPE represents (in part) an attentional effect.

Notably, the matching task has previously been combined with other established paradigms to investigate whether self-prioritization occurs at the perceptual level (Sui et al., 2012; see Macrae et al., 2017) or at a later stage of information processing (see Janczyk et al., 2019; Siebold et al., 2015; Stein et al., 2016). It has, however, not yet been combined with established paradigms that can be interpreted as attention holding. We therefore combine the matching task with an established cuing paradigm – namely, the dot-probe task – to measure attention holding of self-associated stimuli. Specifically, we will use the dot-probe task as a target discrimination task in which the target following the self- and other-associated cues will randomly vary in being presented as either a "q" or "p" which participants must identify (Imhoff et al., 2019).

Comparison of the attentional impact of familiar and recently-established self-associated stimuli

As already mentioned, cuing paradigms have only scarcely been used with recently established self-associated stimuli. In one study using a version of the Posner cuing task (1980), for example, recently established self-associated cues were found to guide visual attention more effectively than friend-associated cues (Sui et al., 2009). In detail, Sui et al. (2009) asked participants to associate themselves and a friend with distinctly coloured arrows (i.e., red vs. green). These stimuli were then used as central cues in a task with two possible target locations, one to each side of the cue. The cues preceded the target and they either pointed towards (valid) or away (invalid) from the location where the target would subsequently occur. The size of the cuing effect (RT on invalid trials minus RT on valid trials) was larger for self-associated cues than friend-associated cues. This has been interpreted to reflect that self-associated cues cause faster shifting of attention to cued locations than friend-associated cues. In other words, these results indicate that, similar to highly familiar self-associated cues (Liu et al., 2016), recently established self-associated cues that are directional also serve to orient attention more efficiently than recently established other-associated cues (Sui et al., 2009). Yet, limitations of this effect have also been identified: Using auditory targets, the effect of self-associated vs. other-associated arrows was only observed with voice-targets but not tone-targets; the same was true when generic faces gazing to the right vs. to the left were used as cues (instead of arrows; see Zhao et al., 2015). Taken together the evidence from these cuing studies, it remains unclear whether recently established self-associated stimuli *alone* elicit attentional prioritization as effectively as highly familiar self-associated cues.

In regard to attention holding in particular, evidence regarding the potential of recently established self-associated stimuli to impact attention comes from target-detection tasks. In an oculomotor task, for example, participants initiated saccades away from self-associated geometric shapes more slowly than saccades away from stranger-associated geometric shapes – an observation interpreted as an increased difficulty to steer attention away from self-associated as opposed to stranger-associated shapes (Dalmaso et al., 2019). This suggests that –like highly familiar self-associated stimuli (Wójcik et al., 2018) – recently established self-associated stimuli may hold attention. However, Dalmaso et al. (2019) observed the effect only in one of two experiments (namely, only when the self/other distinction was task-relevant). Hence, the current study aims to corroborate this result by specifically comparing the potential of recently established vs. highly familiar self-associated stimuli to capture and hold attention.

Note that the evidence from target-detection tasks suggesting the potential for recently established self-associated stimuli to hold attention has consistently used setups consisting of the self- and other-associated being displayed individually. That is, the recently established self- and other-associated stimuli are not presented simultaneously. In visual search, the experimentally-induced association of a shape to the self vs. another person has also been found to enhance the detection of the self-associated shape but not of the other-associated shape, again indicating that newly-learned self-associations hold the potential to capture attention (Wade & Vickery, 2018). However, this effect was observed only when the self- or other-associated shape were presented amongst a set of unfamiliar stimuli. In contrast, latencies of visual search saccades towards self- vs. stranger-associated geometric shapes did not differ significantly when the self- and stranger-associated shapes were presented on the same display (Siebold et al., 2015). Notably, in the matching task, responses towards self- vs. other-associated shapes are also compared across trials; self- and other-related information is not presented simultaneously in this paradigm. The same holds for the studies that provided evidence for attentional prioritization of recently established self-associated stimuli; the self- vs. other-associated cues were presented in isolation in these studies (Dalmaso et al., 2019; Sui et al., 2009). Since this strays from the reality of our environment in which various stimuli simultaneously compete for our attention, we test whether the established finding that self-relevance causes attentional prioritization actually holds in a context in which two socially salient stimuli – one self-relevant, one other-relevant – are presented simultaneously and thus compete for attentional resources.

The dot-probe task represents a classical cuing paradigm meeting this requirement. In this task, as opposed to the Posner cuing task and the oculomotor task used by Dalmaso et al. (2019), self- and other-related information is presented simultaneously. Hence, the current study will investigate whether recently established vs. highly familiar self-associations capture and hold attention under conditions of competition for attentional resources among different stimuli.

The use of the dot-probe task will allow us to test whether self-associated stimuli *themselves* capture attention and hold it when competing with other-associated stimuli for attentional resources. Studies have observed that familiar self-associated stimuli such as one's own name and face can impact attention with greater ease than others' names and faces in cuing tasks (Alexopoulos et al., 2012; Wójcik et al., 2018; Yang et al., 2013), but this has not yet been demonstrated for recently established self-associated stimuli. It therefore remains an open issue whether recently established self-associated stimuli, as compared to other-associated stimuli, also function differently as cues in a dot-probe task. The findings from the study using Posner's cuing task in this context (Sui et al., 2009) demonstrated that directional self-associated stimuli can more easily be used to orient attention towards a target in a different location than directional other-associated cues. Additionally, the findings from the study tracking saccades away from centrally-presented geometric shapes (Dalmaso et al., 2019) demonstrated that self-associated stimuli can hold attention for longer than stranger-associated stimuli when such stimuli are presented individually. In the current study, we thus specifically test whether self-associated cues are more efficient in capturing and holding attention than stranger-associated cues. To this end, pairs of newly associated self- and stranger-associated cues will be presented to the participants, followed by the presentation of a to-be-located probe target randomly occurring either at the location previously occupied by the self- or stranger-associated cue.

In the currents study, the elements typically used as self- and other-representations in the matching task will be used as stimuli in the dot-probe task in order to combine both paradigms within this experiment. As previously mentioned, in the matching task, performance in stimulus verification is enhanced for matching self-associated shape-label pairs compared to matching other-associated shape-label pairs (SPE). Often, the words "I", "friend" and "stranger" have been used as labels here (Janczyk et al., 2019; Macrae et al., 2017; Reuther & Chakravarthi, 2017; Sui et al., 2012; Sui & Humphreys, 2015b). These labels are highly familiar and should thus be strongly associated to the respective instances. In comparison, shapes (e.g., a triangle, a circle) become only shortly associated to the instances in the course of the experiment. In the current study, participants will first associate geometric shapes to the labels “I” and “stranger”. Then we will implement either the familiar labels, the recently learned shapes or shape-label pairs as cues in the dot-probe task in order to compare their effectiveness. If recently established self-associations have the same potential to guide attention as highly learned self-associations, then the magnitude of the effectiveness of the cues should not differ as a function of their representation format (shapes vs. labels vs. pairs). If, however, familiarity plays a role for prioritization under conditions of attentional competition, then the size of the cuing effect should be larger for the labels/pairs compared to the shapes. We acknowledge that there is compelling evidence indicating an advantage for the information processing of self-associated labels such as one’s own name and own personality traits as opposed to other-associated labels (Alexopoulos et al., 2012; Bargh, 1982; Yang et al., 2013), whereas the evidence indicating a potential advantage for the information processing of recently self-associated shapes is mixed (Dalmaso et al., 2019; Siebold et al., 2015; Sui et al., 2009; Wade & Vickery, 2018; Zhao et al., 2015). Thus, we assume that the attentional benefit of the self- compared to the stranger-associated cues in the dot-probe task is more pronounced when the labels (“I” and “stranger”) are presented compared to when the self and the stranger are represented by the shapes. In other words, we predict an interaction effect of representation familiarity (label vs. shape), by which prioritized responding toward self- vs. stranger-associated stimuli will be enhanced by familiar representations in comparison to new representations.

Interestingly, the size of the SPE increases when two self-associated shapes are presented on matching self-associated shape-label trials compared to when one self-associated shape is presented (Sui & Humphreys, 2015b). Similarly, the simultaneous presentation of both the self-associated shape and the self-associated label might lead to a greater processing advantage compared to the presentation of only the self-associated shape or only the self-associated label (see Lockhead, 1966, for the general concept of redundancy gains). In the dot-probe task, self-associated shape-label pairs might thus be more efficient in capturing attention than the self-associated shape or the self-associated label only. In other words, we expect a compound effect of self-association, where two self-associated stimuli (regardless of whether these are familiar or newly associated) will hold impact attention more than one stimulus alone.

In summary, in this study we will use the dot-probe task as a measure of attentional capture and attention holding capacity. After using the typical SPE manipulation consisting of associating geometric shapes to the self and a stranger, we will present stimuli representing both instances as cues in a dot-probe task in order to measure the attentional capture of self-associated vs. stranger-associated stimuli. We expect that identification of a target ("p" or "q") will be faster when it occurs at the location previously occupied by self-associated stimuli as opposed to that previously occupied by stranger-associated stimuli. In addition, we will manipulate the way in which the self and stranger are represented (shape vs. label vs. shape-label pair), expecting the beneficial effect of self vs. stranger-associated cues to be more pronounced when the label is present than when it is not. Moreover, we will test (1) whether attentional capture and attention holding of self-associated information is also observed when only the self- vs. stranger-associated shapes (as established during the preceding association phase of the experiment) are used as cues and (2) whether the attentional benefit of self-associated compared to stranger-associated information is stronger for shape-label pairs than for the label only. The results of our study will provide insights on the potential of recently established as compared to highly familiar self- vs. other-associations to impact the distribution of attention under conditions of attentional competition.

Method

Participants. A total of 34 participants (25 female, M_{age} = 23, SD_{age} = 3.5) completed the study. All participants had normal or corrected-to-normal vision and were able to complete the study in German. Data from four participants were excluded due to the average of their RTs falling within Tukey's (1977) definition of an outlier when compared to the sample distribution of all participants. The study was carried out according to the principles of the Declaration of Helsinki, on the basis of informed consent.

A priori power calculations were made to establish a minimum sample size. In previous studies, the SPE has been reported as medium to large in effect size (dz > 0.81 in Sui et al., 2012 and dz ≥ 0.58 in Schäfer et al., 2016) and previous studies using own face and other-face stimuli in a dot-probe task to measure attentional capture reported a large effect size for congruency between target location and self-associated stimuli (ηp2 = .19 in Wójcik et al., 2018). Based on this, we expected a medium effect size of f = .25 (Cohen, 1988) for the effect of self-prioritization in the dot-probe task. For a repeated-measures ANOVA of mean RTs with one group, 6 measurements (2 [target position: self vs stranger] × 3 [type of representation: shape vs. label vs. pair]), α = .05, correlation among the measures = .50, and nonsphericity correction ε = 1, a minimum sample size of N = 28 is needed to detect an effect with a power effect of 1 – β = .99 (Faul, Erdfelder, Lang, & Buchner, 2007). A total of 34 participants were tested to allow for dropouts and exclusion of outlier responses.

Design. The study consisted of a 2 (target position: self vs. stranger) × 3 (type of representation: shape vs. label vs. pair) within-participants design. The assignment of shapes to labels was randomized and balanced throughout participants, and the target position was randomized and balanced throughout trials.

Apparatus and Materials. The experiment was conducted on Acer Aspire E15 35-573G-54SK 15.6” laptops using standard computer mice, and it was run by E-Prime 2.0.

All stimuli were presented in white colour against black background and at a viewing distance of 50 cm. The visual geometric shapes were presented at a visual angle of approximately 5° × 5°. All verbal stimuli were represented in Courier New font size 18 at a visual angle of about 0.7°.

Procedure. Participants were greeted by an experimenter who shortly provided an overview of the study structure. All specific instructions that followed were presented on the computer screen.

At the beginning of the experiment, participants were asked to associate geometric shapes (triangle and square) to the labels "I" and "stranger" (“Ich” and “Fremder” in German) with the following instructions presented: “You are a [shape 1] and a stranger will be represented by a [shape 2]”. The images of the shapes were not presented during this association phase. Participants were to press any key to continue with the experiment after familiarizing themselves with the instructions.

Following, participants completed the dot-probe task (see Figure **2.1**). They first completed 24 practice trials in which they received feedback if their response was incorrect or exceeded 1, 500 ms (“incorrect”, “please respond faster”). Afterwards, they completed 240 experimental trials in which they did not receive feedback on their performance. Each trial began with a fixation cross in the centre of the screen (500 ms), followed by the stimuli representing the self and a stranger on opposite sides of the screen (left and right, located on 25% and 75% of the horizontal line of the screen and on 50% of the vertical line of the screen, 200 ms). Representations were a label, a geometric shape, or a matching shape-label pair – with the order of presentation being randomized. Then, a target consisting of either a “q” or “p” was presented on either the left or right side of the screen (on 25% or 75% of the horizontal line of the screen, respectively, and on 50% of the vertical line of the screen) until participants responded “q” or “p” to indicate which target was presented. The target (q or p) and the location of the target (left or right) were randomized between trials. A 1000 ms pause, consisting of a black screen, proceeded before the next trial started.

Finally, the matching task was presented. Each trial began with a black screen (500 ms) followed by a fixation cross (500 ms). A pair consisting of a shape and a label underneath it was then presented and remained on screen until the participant responded, or for a maximum of 1,500 ms. There were two possible responses: Participants had to press “d” to indicate that the shape-label pair matched the mapping learned during the association phase and “k” to indicate that it did not match the learned mapping. Participants received feedback if their response was incorrect or exceeded 1,500 ms (“incorrect”, “please respond faster”). Initially, four trials were administered as a practice phase, followed by 128 trials of the matching task to measure of the SPE as established in the literature (Sui et al., 2012).

Participants were then thanked, debriefed, and compensated with 6 euros. Students of the Department of Psychology at the University of Tübingen could opt to receive class credit.

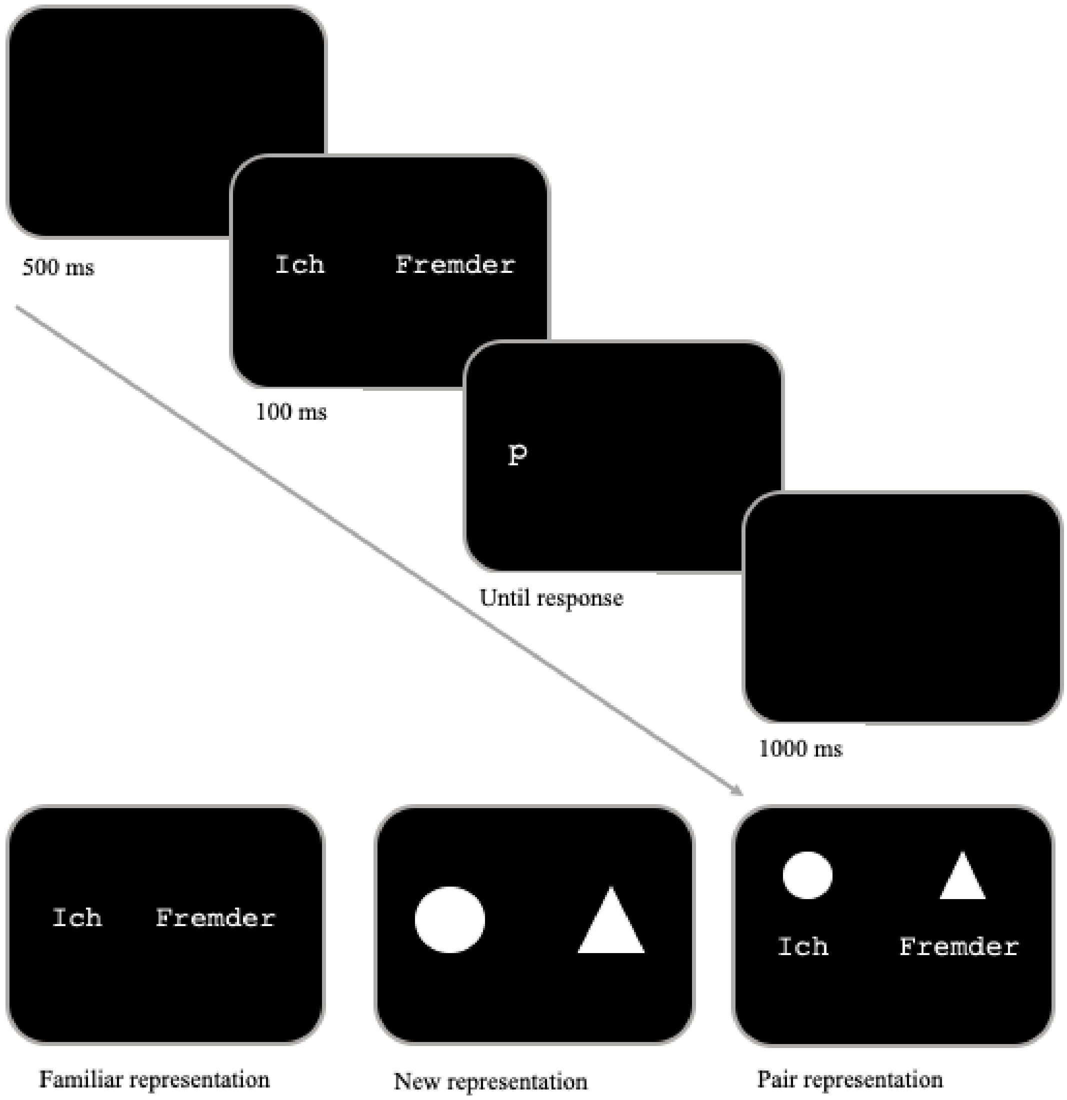

***Figure 2.1**. Schematic depiction of one trial of the dot-probe task (upper figure) and example displays demonstrating how the display differed as a function of the type of representation (familiar vs. new vs. pair; lower figure).*

Results

For all statistical analyses, a significance level of α = .05 was specified. For RT analyses, only correct responses with RTs above 100 ms and below three interquartile ranges above the third quartile of the overall individual RT distribution were used (see Tukey, 1977). Exclusions of trials were performed separately for the matching task and the dot-probe task.

Matching Task

As a manipulation check, we first analysed performance in the matching task.

Average RTs. The RT data (see Figure **2.2** for a summary depiction) were subjected to a 2 (shape: self-associated vs. stranger-associated) × 2 (trial type: matching vs. non-matching) within-participants MANOVA (see O'Brien and Kaiser, 1985, for the use of MANOVA to analyse repeated-measure designs). The main effects of shape, $F(1, 29) = 101.99$, $p < .001$, $\eta_p^2 = .78$, and trial type, $F(1, 29) = 36.83$, $p < .001$, $\eta_p^2 = .56$, were both significant. The interaction of shape and trial type, $F(1, 29) = 60.22$, $p < .001$, $\eta_p^2 = .68$, was also significant. To follow up on this interaction effect, RTs from matching trials were submitted to a one-factorial (shape: self-associated vs. stranger-associated) within-participants MANOVA to specifically analyse the SPE. The analysis revealed a significant main effect of shape, $F(1, 29) = 125.56$, $p < .001$, $\eta_p^2 = .81$, indicating a significant SPE in the RT data. That is, responses were faster for matching self-associated shape-label pairs than for matching stranger-associated shape-label pairs. The RTs from non-matching trials were submitted to the same analysis, again revealing a significant main effect of shape, $F(1, 29) = 5.96$, $p = .021$, $\eta_p^2 = .17$. Namely, responses were faster for trials presenting the self-associated shape with the label “stranger” than trials presenting the stranger-associated shape with the label “self”.

Sensitivity measure d’. Mean error rates are presented in Table **2.1**. Signal detection sensitivity indices (*d’*) for each shape condition were used to analyse error rates (Schäfer et al., 2015; Schäfer, Wesslein, et al., 2016; Sui et al., 2012). To this end, we defined responses in the following way: in matching trials, correct responses were considered hits and incorrect responses were considered misses; in non-matching trials, correct responses were considered correct rejections, and incorrect responses were considered false alarms. The loglinear approach was used to account for cases with 100% hits or 0% false alarms, meaning that 0.5 was added to the number of hits and the number of false alarms, and 1 was added to the number of signal trials and the number of noise trials before calculating the rates for hits and false alarms (see Hautus, 1995; Stanislaw & Todorov, 1999). The sensitivity measures were submitted to a one-factorial (shape: self-associated vs. stranger-associated) MANOVA. A significant main effect of shape was observed, $F(1, 29) = 40.14$, $p < .001$, $\eta_p^2 = .58$, indicating a higher sensitivity for self- than for stranger-associated shapes (i.e., a significant SPE in *d'*).

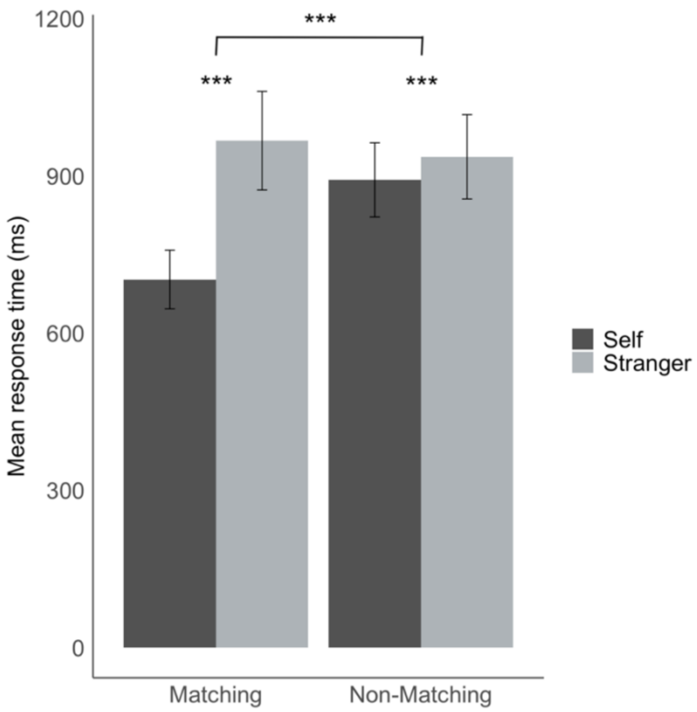

Figure 2.2 *Mean response time in the matching task as a function of shape (self-associated vs. stranger-associated) and trial type (matching vs. non-matching). Error bars represent standard errors. *** p < .001.*

Table 2.1 *Mean error rates as a function of trial type and shape in the matching task*

Trial type	Shape	Error rates (%)
Matching	Self-associated	0.9 (1.5)
	Stranger-associated	4.8 (3.7)
Non-matching	Self-associated	2.1 (2.6)
	Stranger-associated	2.1 (1.9)

Note. Standard deviation presented within parentheses.

Dot-probe task

Average RTs. Average RTs in the dot-probe task (see Figure **2.3**) were subjected to a 2 (target location: self vs. stranger) × 3 (type of representation: shape vs. label vs. shape-label pair) within-participants MANOVA. A significant main effect of target location was observed, $F(1, 29) = 99.68$, $p < .001$, $\eta_p^2 = .78$, indicating that responses were faster when the target was presented at the location previously occupied by the self-representation than when the target was presented at the location previously occupied by the stranger-representation. Furthermore, a significant main effect of type of representation was observed, $F(2, 58) = 40.14$, $p < .001$, $\eta_p^2 = .58$. Follow-up analyses revealed that, irrespective of the target location, mean RTs were significantly slower for targets following the self- and other-associated stimuli as represented by labels than for targets following the self- and other-associated stimuli as represented by shapes, $t(29) = 5.42$, $p < .001$, $d = 0.99$; further, mean RTs were significantly slower for targets following cues represented by shapes than targets following cues represented by pairs, $t(29) = 5.67$, $p < .001$, $d = 1.04$. The interaction of target location × type of representation, $F(2, 58) = 14.72$, $p < .001$, $\eta_p^2 = .34$, was also significant. To follow-up on this interaction, pairwise *t*-tests were conducted. In detail, these post-hoc analyses revealed that responses were significantly faster for targets following the self-representation than for targets following the stranger-representation, irrespective of whether the instances were represented by labels, *t*(29) = 8.18, *p* < .001, *d* = 1.49, or by shape-label pairs, *t*(29) = 3.99, *p* < .001, *d* = 0.73. However, the size of the cuing effect was significantly larger for cues represented by labels than for cues represented by pairs, *t*(29) = 2.99, *p* = .006, *d* = 0.55. That is, the difference in response time favouring responses to targets following self-representations over stranger-representations was greater when the self and stranger were represented by labels than when they were represented by shape-label pairs. Most importantly, however, no cuing effect was observed for the shape representation condition, *t*(29) = 0.97, *p* = .340, *d* = 0.18.

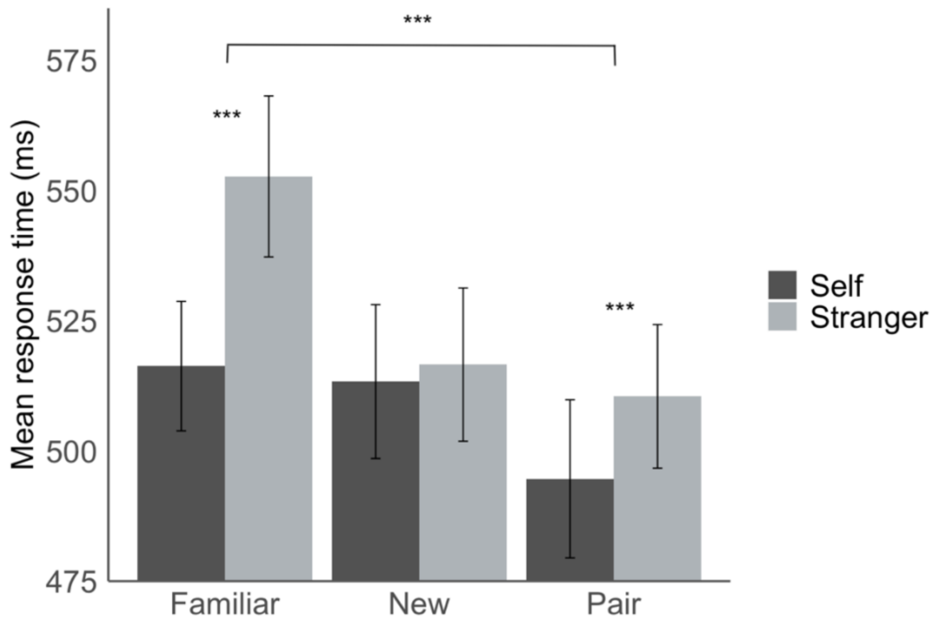

Figure 2.3 *Response times in the dot-probe task as a function of target location (self vs. stranger) and type of representation (familiar vs. new vs. pair). Error bars represent standard errors. *** p < .001.*

Error rates. Mean error rates (presented in Table **2.2**) were submitted to a 2 (target location: self vs. stranger) × 3 (type of representation: familiar vs. new vs. pair) MANOVA. A significant main effect of type of representation, $F(2, 58) = 5.36$, $p = .007$, $\eta_p^2 = .16$, indicated that responses to the different types of representations differed significantly in accuracy. The main effect of target location was not significant, $F(1, 29) = 0.04$, $p = .847$, $\eta_p^2 = .001$. The interaction of target location × type of representation, $F(2, 58) = 1.61$, $p = .209$, $\eta_p^2 = .05$, was also non-significant.

Table 2.2 *Mean error rates as a function of target location and type of representation in the dot-probe task*

Target Location	Type of Representation	Error rates (%)
Self	Familiar	2.6 (2.1)
	New	2.1 (1.6)
	Pair	2.3 (1.8)
Stranger	Familiar	3.3 (2.5)
	New	1.9 (1.6)
	Pair	2.0 (2.1)

Note. Standard deviation presented within parentheses.

Discussion

The current study aimed to shed light on the conditions under which self-relevance impacts the distribution of attention. Responses towards highly familiar self-associated stimuli like one's own name or face have previously been demonstrated to be faster than responses towards stimuli strongly linked to other persons like other's names or faces (Arnell et al., 1999; Brédart et al., 2006; Moray, 1959; Yang et al., 2013). Moreover, targets following familiar self-associated cues as opposed to other-associated cues also profit from the attentional prioritization induced by self-relevance (Alexopoulos et al., 2012; Wójcik et al., 2018), suggesting after-effects of attentional capture in the sense of attention holding. Based on the results obtained in a paradigm introduced by Sui et al. (2012), it has been suggested that self-association can guide attention even when it has only recently been established. In this paradigm, participants first associate different shapes to different persons, and then perform a matching task requiring the classification of shape-label pairs as matching or nonmatching with regards to the learned association. As has repeatedly been shown, participants are faster and more accurate in verifying self-associated shape-label pairs compared to other-associated pairs in this matching task (SPE; reviewed in Humphreys & Sui, 2015 and Sui & Rotshtein, 2019). Though it has been concluded from this finding that an attentional mechanism might contribute to the SPE (e.g., Falbén et al., 2019; Humphreys & Sui, 2015), the implementation of paradigms that have specifically been designed to investigate attentional mechanisms is essential to test the assumption that stimuli that have only recently become associated to the self indeed hold the potential to impact the distribution of attention. Still, there are only few studies that have directly tested the assumption that recently established self-associations can elicit attentional capture (e.g., Siebold et al., 2015; Wade & Vickery, 2019). It thus remains an open research question whether recently established self-association also hold the potential to elicit attention holding. We present the first study – to the best of our knowledge – to use the matching paradigm introduced by Sui et al. (2012) together with the dot probe task (MacLeod et al., 1986) in order to close this research gap. In detail, we compare (1) self- vs. stranger-associated cues and (2) highly familiar vs. recently self-vs. stranger-associated cues. We assess the cues' efficiency in enhancing the identification of a subsequent probe target (attention holding). To this end, participants were first asked to associate two geometric shapes to the self and a stranger. In the dot-probe task, the self and a stranger were either represented by the corresponding shapes (recently established self-associations), by the labels "I" and "stranger" (highly familiar self-association), or by shape-label pairs.

As expected, participants were generally faster and more accurate in identifying the probe target when it occurred at the location that had previously been occupied by self-associated stimuli than when it occurred at the location that had previously been occupied by stranger-associated stimuli. This indicates that self-associated stimuli captured attention, and that attention remained at the respective location for at least 100 ms (the duration of the SOA in our study). As a result, the identification of targets occurring shortly after self-associated cues as compared to stranger-associated cues was facilitated, demonstrating an after effect of the attentional prioritization induced by self-association. We interpret this to reflect that self-association can elicit attention holding. Importantly, the effect of self-association was modulated by the type of representation: It was more pronounced for the highly familiar cues than for recently established cues. Specifically, significant cuing effects were observed when the self and stranger were represented by the corresponding labels or by shape-label pairs but no significant cuing was observed when the instances were represented by the corresponding shapes (neither in RTs nor in error rates). This is in line with our hypotheses that highly familiar self- vs. other-associated cues are more efficient in eliciting attentional capture and attention holding than recently established cues. Note that shape-label pairs were no more efficient in eliciting cuing effects than labels only (i.e., we observed no significant differences regarding the size of the cuing effect in these conditions). Hence the presentation of the shape that has recently become associated to the self in addition to the familiar self-associated label did not increase the attentional prioritization of the self-associated compared to the other-associated stimuli under conditions of attentional competition.

Our finding that highly familiar self-associated stimuli elicit attentional capture and attention holding is well in line with previous studies showing attentional prioritization of one's own name, own personality traits (Alexopoulos et al., 2012; Bargh, 1982; Moray, 1959; Yang et al., 2013) or one's own face (Brédart et al., 2006; Wójcik et al., 2018). Furthermore, it extends this research by demonstrating that such prioritization also holds when the labels used are general constructs such as "self" and "stranger" that are not exclusive to one person. Actually, the broadness of the term "stranger" in comparison to "self" might even have enhanced the effect. However, this also applies to many studies demonstrating the SPE by using the matching task because the usage of these labels is very common in this paradigm. Accordingly, the question of how the specificity of the instances impacts the prioritization of recently established self- and other-associations is a more general issue requiring further research.

The current finding that recently self-associated as compared to stranger-associated shapes yielded no attentional advantage can also be related to some studies testing the efficiency of directional self- vs. stranger-associated cues in directing attention in endogenous cuing tasks (Sui et al., 2009; Zhao et al., 2015). In sum, these previous studies reported mixed results (Sui et al., 2009; Zhao et al., 2015). That is, from Sui et al. (2009), it can be concluded that in a Posner cuing task, self-associated arrows can serve to orient attention – but this effect seems to hold only under very specific conditions (see Zhao et al., 2015). Turning from the orientation of attention by directional cues to attentional capture and attention holding, Dalmaso et al. (2019) observed indicative evidence that saccades away from self-associated geometric shapes are initiated more slowly than saccades away from stranger-associated shapes – when the self/other distinction was task-relevant. Similarly, Wade and Vickery

(2018) observed faster detection of self- vs. stranger-associated geometric shapes in complex visual search tasks with displays including neutral and *either* self- *or* stranger-associated shapes. However, Siebold et al. (2015), who had presented neutral, self-, and stranger-associated shapes on the same visual search display, did not observe faster detection of self- as compared to stranger-associated shapes. Interestingly, Posner's cuing task and the oculomotor task used by Dalmaso et al. (2019) also include the presentation of only a self- *or* an other-associated cue on a given trial. In contrast, self- and stranger-associated cues are simultaneously presented in the paradigm we used (namely, the dot-probe task) – as in the visual task variant used by Siebold et al. (2015). That is, the latter variants test the potential of self-relevance to guide attention in contexts in which self- and stranger-associated stimuli have to be processed simultaneously –that is, to contexts in which self- and stranger-associated stimuli compete for attentional resources. Specifically, in our paradigm, the self-associated shape might reasonably be assumed to be more socially salient but still the manipulation also induces some degree of social salience to the stranger-associated shape (i.e., it does not remain a neutral stimulus). Taken together, the results from the current study are in line with the conclusion suggested by Siebold et al. (2015), namely that attentional self-prioritization may not transfer to a biased competition task.

In reference to Lockhead (1966) and Sui and Humphreys (2015), we had reasoned that attentional self-prioritization might be larger when the self and the stranger are represented by shape-labels pairs than when they are represented by labels (or shapes) only. However, we observed no cuing effect for the shapes and the size of the cuing effect did not differ for shape-label pairs and labels, indicating that attentional capture of the self-associated label did not increase by the addition of the self-associated shape. This is not in line with the reasoning that redundancy gains (Lockhead, 1966) induced by the presentation of the shape-label pair as opposed to only the shape or label alone, would enhance the effect of self-relevance in the dot-probe task (see Sui & Humphreys, 2015). Given that we did not observe a cuing effect for the label alone, it is reasonable that we did not observe redundancy gains when pairing the label with the shape. Still, responses were generally faster for targets following shape-label pairs as compared to targets following shapes or labels. That is, we observed no evidence in support of the assumption that self-associated shape-label pairs might capture attention more efficiently than the self-associated shape or the self-associated label. However, it seems possible that the faster RTs for pairs compared to shapes or labels only reflect a beneficial effect of redundancy gains (in the sense of facilitated processing for both self- and stranger-related information when two cues referring to each instance are presented, instead of only one) that is independent from the prioritization of self-associated stimuli. Note that it remains an open issue whether redundancy gains might enhance cuing effects for pairs as compared to labels (or shapes) in endogenous cuing tasks requiring the processing of only either self- *or* other-associated stimuli at a time as in Sui et al. (2009).

In the matching task, we found the expected pattern of results both in RTs and sensitivity measures (Schäfer et al., 2015; Schäfer, Wesslein, et al., 2016; Sui et al., 2012; Sui & Humphreys, 2015a, 2015b), indicating that we succeeded in inducing a significant SPE. Our findings from the dot-probe task can and should thus be interpreted against this background. In the matching task, each trial comprises both a newly associated shape and a highly familiar label. On some trials, only self- *or* other-associated information is present (matching trials), on others both self- *and* other-associated information is present (nonmatching trials). The latter also holds for the dot-probe task in which self- and stranger-related information competes for attentional resources on each prime display. Yet, the SPE is usually measured on matching trials, where effects may – at least to some degree – hinge upon the presentation of shape-label pairs. Across studies, results on nonmatching trials are less systematic. In our study, we generally observe faster RTs on trials comprising the self-associated shape than on trials comprising the stranger-associated shape – both on matching and nonmatching trials (see Sui et al., 2012; though see Janczyk et al., 2019; Schäfer et al., 2016; Sui & Humphreys, 2015c). This indicates that information processing of the self-associated shape as recently established, compared to the stranger-associated shape, is actually benefitted in the matching task: trials comprising the self-associated shape and stranger-associated label elicit faster responses than those comprising the self-associated label and the stranger-associated shape (nonmatching trials); trials comprising the self-associated shape and label elicit faster responses than those comprising the stranger-associated shape and label (matching trials). Though our results indicate that the presentation of shapes that have only recently become associated to the self vs. a stranger is not sufficient to elicit attentional self-prioritization in the dot-probe task, the current study does not allow to preclude whether an attentional effect may underpin the advantage of the self-associated shape compared to the stranger-associated shape in the matching task. Since the shape and the label both need to be considered to enable classification of the pair in the matching task, whereas the shapes (i.e., the cues) are rather task-irrelevant in the dot-probe task, future research should investigate whether the relevance of the shapes determines whether or not their self-vs. other-relatedness impacts the distribution of attention.

In conclusion, our data yields insights into effects of self-relevance on attention holding in situations where self- and stranger-associated stimuli compete for attention. Our results show that self-associated labels strongly capture and hold attention, thus facilitating responses to targets following self-associated labels as compared to targets following stranger-associated labels. Further, our study shows that this effect does not hold when – instead of the familiar labels – shapes that have only recently been associated to the self vs. a stranger are used as cues. That is, attentional prioritization of self-associated stimuli may be more limited when they are presented simultaneously with stranger-associated stimuli than when self- and stranger-associated stimuli are presented without any other stimuli competing for attention (e.g., Sui et al., 2009). Our study extends the body of literature showing that self-relevance elicits attentional capture (Arnell et al., 1999; Wade & Vickery, 2018) and serves to orient attention (Zhao et al., 2015; Sui et al., 2009) by demonstrating further support for the assumption that it also enhances attention holding (see Alexopoulos et al., 2012; Dalmaso et al., 2019; Wòjcik et al., 2018). Summing up, our results provide evidence that established, familiar self-associated stimuli (such as the label “I” in our study) robustly elicit attention holding, whereas recently established self-associations may not be sufficient to induce such an attentional prioritization when the self-associated stimuli need to compete for attentional resources with other-associated stimuli.

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Declaration regarding § 5 Abs. 2 No. 8 of the PhD regulations of the Faculty of Science

- Share in collaborative publications/manuscripts -

The subsequent chapter (Chapter 3) consists of a manuscript currently in preparation for submission and which was co-authored by Dr. Christina Matschke and Dr. Ann-Katrin Wesslein. The proportional contributions to the manuscript are presented in the following table.

Manuscript 2

Author	Author position	Scientific ideas	Data generation	Analysis & interpretation	Paper writing
Gabriela Orellana-Corrales	first author	10%	90%	40%	40%
Christina Matschke	second author	0%	0%	20%	30%
Ann-Katrin Wesslein	third author	90%	10%	40%	30%

Title of paper:	Does Self-Associating a Geometric Shape Immediately Cause Attentional Prioritization? Comparing Familiar vs. Recently Self-Associated Stimuli in the Dot-Probe Task
Status in publication process:	In preparation for submission

Chapter 3: Self-Representations and the Temporal Dynamics of Attentional Capture

Does self-associating a geometric shape immediately cause attentional prioritization? Comparing familiar vs. recently self-associated stimuli in the dot-probe task

One of the major challenges faced by our cognitive system is having to select what is most relevant for further processing out of the huge amounts of constantly incoming stimuli. The degree to which a stimulus is associated to the self represents a good cue indicating "relevance" to our cognitive systems. That is, self-associated stimuli have been found to be preferentially processed at different stages of cognitive information processing. For example, one's own name (Arnell et al., 1999; Moray, 1959; Yang et al., 2013) or face (Bortolon & Raffard, 2018; Brédart et al., 2006; Wójcik et al., 2018) tend to be quickly and accurately recognized – even in the absence of attention (e.g., Bargh, 1982; Moray, 1959).

In order to measure effects on information processing at different stages, experimental psychologists use different computerized tasks. As such, spatial cuing tasks represent one established paradigm to measure effects of self-relevance in information processing (Alexopoulos et al., 2012; Dalmaso et al., 2019; Sui et al., 2009; Wójcik et al., 2018; Zhao et al., 2015). These tasks consist of responding to targets which are presented at locations that are either cued by a stimulus of interest (valid trials) presented shortly before the target (i.e., with a short stimulus-onset asynchrony, SOA, ≤ 200 ms) or not (invalid trials). Research using such spatial cuing tasks has shown that salient stimuli facilitate responses on valid trials compared to invalid trials – an effect known as spatial cuing (e.g., Alexopoulos et al., 2012; Falbén et al., 2019; Posner, 1980). In detail, responses have been demonstrated to be faster towards targets presented on locations cued by one’s own name than to targets presented on locations cued by other names (Alexopoulos et al., 2012). Similarly, responses are generally faster towards targets presented on locations cued by a picture of one’s own face than to targets presented on locations cued by the picture of another face (Liu et al., 2016; Wójcik et al., 2018). Such results have been interpreted as a prioritized cognitive processing of self-associated stimuli vs. other-associated stimuli in attention. That is, due to their association to one’s self, one's own name and face are highly salient and are preferentially processed in cognition, thus leading to faster responding to targets cued by self-representations vs. other-representations.

Importantly, in the studies described so far, self-associated stimuli have always been represented by highly familiar items like one’s own name or face. Hence, the degree to which the observed effects are attributable to their relevance to the self or to their familiarity cannot be clearly established. In order to control for effects of familiarity, and thus attempting to measure the advantage of self-association more purely, Sui, He, and Humphreys (2012) introduced a matching-task paradigm which has become an established method to induce self-association. The procedure is as follows: First, participants are instructed to associate geometric shapes (e.g., a triangle, a circle, and a square) to the self, a close other, and an unknown or neutral other. This instruction is followed by a matching task comprising the presentation of random combinations of the geometric shapes and the word-labels representing the associated entities (i.e., “self”, “friend”, etc.; Sui et al., 2012). Participants must indicate whether each combination represents a matching or non-matching shape-label pair according to the initial instructions. Typically, results reflect an enhancement in performance towards the self: response times (RTs) are significantly faster when confirming the correct combination of the self-associated shape and label than when responding to any other shape-label combination (self-prioritization effect, SPE; see Humphreys & Sui, 2015; Sui & Rotshtein, 2019).

The SPE as observed in the matching task has been interpreted as evidence that a short association of some (previously arbitrary) stimulus to the self changes the way in which it is subsequently processed. That is, this stimulus, which had previously been neutral, is now prioritized due to its new association with the self (e.g., Humphreys & Sui, 2015; Janczyk et al., 2019; Sui et al., 2012). Crucially though, in the matching task, newly self- vs. other-associated shapes are always presented in combination with word-labels referencing the self vs. the other instances – with these labels representing highly familiar self- vs. other-associated items. Thus, in order to test the potential of recently established self- vs. other-associated stimuli to individually yield prioritization effects, the matching task has been combined with other cognitive tasks. For example, using a similar experimental induction of self-association as Sui and colleagues (2012), Sui et al. (2009) presented the newly self vs. other-associated arrows as cues in a variant of Posner's cuing task. In this task, the stimuli preceding the target were presented in the center of the screen pointing towards the target location, rather than appearing on the same location were the target would appear. Remarkably, they found that after the experimentally induced association of differently colored directional stimuli to the self vs. other instances, directional self-associated stimuli are more efficient in guiding attention than directional friend-associated stimuli (though see Zhao et al., 2015, for limitations of this effect). Likewise, in an oculomotor task, slower initiation of saccades towards a target positioned away from self- vs. other-associated shapes was observed (though only when the self/other distinction was task-relevant; Dalmaso et al., (2019). Then again, in visual search, the cuing of target locations by newly self-associated stimuli has been observed to enhance target detection in some studies (Wade & Vickery, 2018) but not in others (Siebold et al., 2015). That is, though it has been concluded from the SPE as observed in the matching task that the salience of a previously neutral geometric shape indeed increases through its association to the self, the specific evidence for this assumption is – to the best of our knowledge – quite scarce. Indeed, only few published studies have investigated whether the self-associated shape alone can elicit prioritization effects – and, to the best of our knowledge, evidence for a prioritization of the shape alone is quite scarce. A systematic comparison of the potential of familiar vs. new self-associated stimuli to impact information processing is lacking. In order to close this research gap, the current study aims to systematically compare how new and familiar self- vs. other-associated stimuli impact information processing.

Building on previous research, in our study we will combine the matching task with a spatial cuing task, namely the dot-probe task (MacLeod et al., 1986). The dot-probe task is an established method to measure salience and information processing (Y. P. Chen et al., 2002; Ehrman et al., 2002; Le Pelley et al., 2013; MacMahon et al., 2006; Werthmann et al., 2011). In this task, two prime stimuli differing in salience are simultaneously presented on opposite sides of the screen, followed by a probe target which participants are asked to locate as fast as possible by pressing one of two keys (one for each side). Importantly, the target can occur at either of the locations that had been occupied by the preceding prime stimuli. As processing is guided by salience, responses are facilitated when the target occurs on the side of the more salient stimulus when SOAs are short (Wójcik et al., 2018). The dot-probe task has previously been used to investigate the attentional prioritization of one's own face vs.

familiar and non-familiar others' faces, revealing that responses are facilitated by one's own face in comparison to other people's faces – thus resulting in faster RTs for targets following one's own vs. others' faces (Wójcik et al., 2018). However, this has not yet been demonstrated for newly self-associated stimuli. It therefore remains an open issue whether newly self-associated stimuli, as compared to newly other-associated stimuli, also speed responses if used as cues in a dot-probe task. In the current study, we will thus specifically compare the potential of both familiar and newly self- vs. stranger-associated stimuli to serve as cues in the dot-probe task. Specifically, self- and stranger-associated cues will be simultaneously presented to the participants, followed by the presentation of a to-be-located probe target randomly occurring either at the location previously occupied by the self- or stranger-associated cue.

As already mentioned, in the matching task, stimulus verification performance is enhanced for matching self-associated shape-label pairs compared to matching other-associated shape-label pairs (reflecting the SPE). Often, the words "I", "friend" and "stranger" have been used as labels here (Janczyk et al., 2019; Macrae et al., 2017; Reuther & Chakravarthi, 2017; Sui et al., 2012; Sui & Humphreys, 2015b). These labels are highly familiar and should thus be strongly associated to the respective instances. Indeed, it has been observed that the label "self" can enhance performance in a perceptual priming task vs. the label "stranger" (Tacikowski & Ehrsson, 2016). In comparison, shapes (e.g., a triangle, a circle) become only shortly associated to the instances in the course of the experiment. In the current study, participants will first associate geometric shapes to the labels "I" and "stranger". We will then implement either the familiar labels, the recently associated shapes or shape-label pairs as cues in the dot-probe task in order to compare their effectiveness. If newly established self-associations have the same potential to guide attention as highly familiar self-associations, then the size of the effectiveness of the cues should not differ as a function of their representation format (labels vs. shapes vs. pairs). If, however, familiarity plays a role for prioritization under conditions of attentional competition, then the size of the cuing effect should be larger for the labels/pairs compared to the shapes. We acknowledge that the evidence indicating an advantage for the information processing of highly familiar self-associated stimuli like one's own face, one's own name and own personality traits as opposed to corresponding other-associated stimuli is compelling (Alexopoulos et al., 2012; Bargh, 1982; Yang et al., 2013), whereas the evidence indicating a potential advantage for the information processing of recently self-associated shapes is mixed (Dalmaso et al., 2019; Siebold et al., 2015; Sui et al., 2009; Wade & Vickery, 2018; Zhao et al., 2015). Therefore, we assume that the attentional benefit of the self- compared to the stranger-associated cues in the dot-probe task is more pronounced when the labels ("I" and "stranger") are presented compared to when the self and the stranger are represented by the shapes.

Note that, in the matching task, the size of the SPE increases when two self-associated shapes are presented on matching self-associated shape-label trials compared to when one self-associated shape is presented (Sui & Humphreys, 2015b). Similarly, in the current study, the simultaneous presentation of two self-associated stimuli – namely, the self-associated shape and the self-associated label – might lead to a greater processing advantage compared to the presentation of only the self-associated shape or only the self-associated label (see Lockhead, 1966, for the general concept of redundancy gains). That is, self-associated shape-label pairs might thus serve as more efficient cues in the dot-probe task than the self-associated shape or the self-associated label only.

In summary, in the span of two experiments we will use the dot-probe task to investigate for the first time whether prioritization effects elicited by the association of a stimulus to the self, as previously reported to be reflected in spatial cuing effects (Alexopoulos et al., 2012; Wójcik et al., 2018), can be elicited by newly self-associated stimuli under conditions of attentional competition. That is, after using the typical SPE manipulation consisting of associating geometric shapes to the self and a stranger, we will present stimuli representing both instances as cues in a dot-probe task in order to measure the attentional capture of self-associated vs. stranger-associated stimuli. With a short SOA of 100 ms (Study 1), we expect that responses to a target will be faster when it occurs at the location previously occupied by self-associated stimuli as opposed to that previously occupied by stranger-associated stimuli. In addition, we will manipulate the way in which the self and stranger are represented (shape vs. label vs. shape-label pair), expecting the beneficial effect of self- vs. stranger-associated cues to be more pronounced when the familiar label is present than when it is not. Moreover, we will test (1) whether self-associated stimuli also influence responses to targets when only the self- vs. stranger-associated shapes (as established during the initial association phase of each experiment) are used as cues and (2) whether the effect of self-association on responding is stronger for shape-label pairs than for the label only. As, to the best of our knowledge, the available body of research for both familiar and new self- vs. other-associated stimuli is restricted to the investigation of the stimuli's potential to modulate responses when SOAs are short, Study 2 will use a longer SOA (1000 ms). For longer SOAs in spatial cuing tasks, responses to targets at locations cued by salient stimuli are usually delayed vs. responses to targets at uncued locations (SOA ≥ 300 ms; Klein, 2000). This effect is known as inhibition of return (Posner et al., 1985; Posner & Cohen, 1984). In Study 2, we set out to test for the first time whether self-associated stimuli cause higher inhibition of return than stranger-associated stimuli. Moreover, we will again compare three different representation formats (shapes vs. labels vs. pairs). We expect stronger inhibition of return for familiar stimuli than for new stimuli, and we expect stronger inhibition of return for the self- vs. stranger-associated stimuli, especially for familiar stimuli. The results of these studies will provide insights on the potential of recently established as compared to highly familiar self- vs. other-associations to impact responses to cued targets (in a context of attentional competition).

Study 1

In Study 1, we aimed to measure the effect of self-association on responses in the dot-probe task as reflected by a cuing effect. We expected responses to the target to be faster when the target follows self- vs. stranger-associated stimuli. Furthermore, we expected such difference to be impacted by the familiarity of the type of representation used for the self and stranger (i.e., stronger cuing effects for familiar than for newly established self vs. other representations).

Method

Participants. A priori power calculations were made using G*Power (Faul et al., 2007) to establish a minimum sample size. In previous studies, the SPE has been reported as medium to large in effect size (dz > 0.81 in Sui et al., 2012 and $dz \geq 0.58$ in Schäfer et al., 2016) and previous studies using own face and other-face stimuli in a dot-probe task to measure attentional capture reported a large effect size for congruency between target location and self-associated stimuli ($\eta_p^2 = .19$ in Wójcik et al., 2018). Based on this, we expected a medium effect size of $f = .25$ (Cohen, 1988) for the effect of self-prioritization in the dot-probe task. For a repeated-measures ANOVA of mean RTs with one group, 6 measurements (2 [target location: self vs stranger] × 3 [type of representation: label vs. shape vs. pair]), α = .05, correlation among the measures = .50, and nonsphericity correction ε = 1, a minimum sample size of N = 28 is needed to detect an effect with a power effect of 1 – β = .95. A total of 38 participants (29 female, M_{age} = 23, SD_{age} = 4.53) were tested to allow for dropouts and exclusion of outlier responses. All participants had normal or corrected-to-normal vision and were able to complete the study in German. Data from four participants were excluded due to the average of their RTs falling within Tukey's (1977) definition of an outlier when compared to the sample distribution of all participants. Data cleansing was carried out separately for the matching task and the dot-probe task. The study was carried out according to the principles of the Declaration of Helsinki, on the basis of informed consent.

Design. The study consisted of a 2 (target location: self vs. stranger) × 3 (type of representation: label vs. shape vs. pair) within-participants design. The assignment of shapes to labels was randomized and counterbalanced throughout participants, and the target position was randomized and counterbalanced throughout trials.

Apparatus and Materials. The experiment was conducted on Acer Aspire E15 35-573G-54SK 15.6" laptops using standard computer mice, and it was run on E-Prime 2.0. All stimuli were presented in white colour against a black background and at a viewing distance of 50 cm. The visual geometric shapes were presented at a visual angle of approximately 5° × 5°. All verbal stimuli were represented in Courier New font size 18 at a visual angle of about 0.7°.

Procedure. At the beginning of the experiment, participants were asked to associate geometric shapes (triangle and square) to the labels "I" and "stranger" ("Ich" and "Fremder" in German) with the following instructions presented on the computer screen: "You are a [shape 1] and a stranger will be represented by a [shape 2]". The images of the shapes were not presented during this association phase. Participants were to press any key to continue with the experiment after familiarizing themselves with the instructions.

Following, participants completed 84 trials of the dot-probe task (see Figure **3.1**). Each trial began with a fixation cross in the centre of the screen (500 ms), followed by the stimuli representing the self and a stranger on opposite sides of the screen (left and right, located on 25% and 75% of the horizontal line of the screen and on 50% of the vertical line of the screen, 100 ms). Representations were either a label, a geometric shape, or a matching shape-label pair – with the order of presentation being randomized. Then, a target consisting of an asterisk (*) was presented on either the left or right side of the screen (on 25% or 75% of the horizontal line of the screen, respectively, and on 50% of the vertical line of the screen) until participants responded "d" or "k" to indicate whether the target was located on the left or right side of the screen, respectively. The location of the target (left or right) was randomized between trials. On half of the trials, the target occurred at the location of the self-associated cue (these are "valid" trials in our paradigm), on the other half, it occurred at the location previously occupied by the stranger-associated cue ("invalid" trials). A 1000 ms pause, consisting of a black screen, proceeded before the next trial started.

Finally, the matching task was presented in order to test whether the self- and stranger-association of geometric shapes as introduced at the beginning of the experiment caused the SPE as established in the literature (Sui et al., 2012). Each trial began with a black screen (500 ms) followed by a fixation cross (500 ms). A pair consisting of a shape with a label underneath it was then presented and remained on the screen until the participant responded, or for a maximum of 1,500 ms. There were two possible responses: Participants had to press "d" to indicate that the shape-label pair matched the mapping learned during the association phase and "k" to indicate that it did not match the learned mapping. Participants received feedback if their response was incorrect or exceeded 1,500 ms ("incorrect", "please respond faster"). Initially, four trials were administered as a practice phase, followed by 128 experimental trials of the matching task.

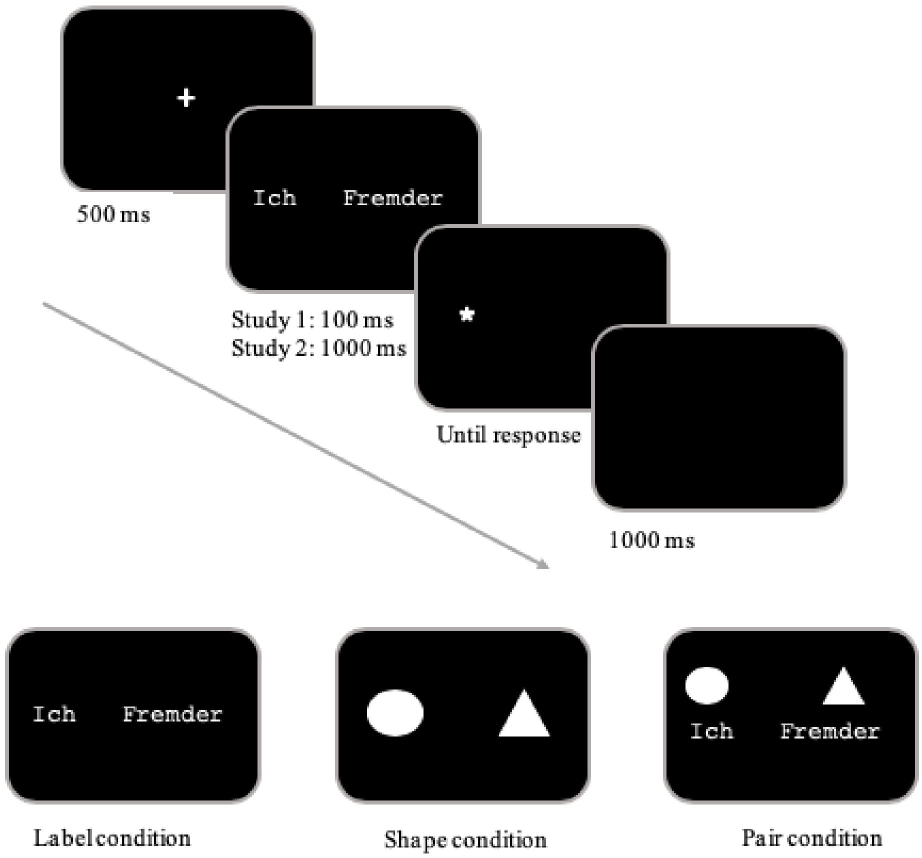

Figure 3.1 *Schematic depiction of one trial of the dot-probe task (upper graph) and example displays demonstrating how the display differed as a function of the type of representation (label vs. shape vs. pair; lower graph)*

Participants were then thanked, debriefed, and compensated with 4 euros. Students of the Department of Psychology at the University of Tübingen could opt to receive class credit.

Results

For all statistical analyses, a significance level of $\alpha = .05$ was specified. For RT analyses, only correct responses with RTs above 100 ms and below one and a half interquartile ranges above the third quartile of the overall individual RT distribution were used (see Tukey, 1977). Exclusions of trials were performed separately for the matching task and the dot-probe task.

Matching Task

As a manipulation check, we first analysed performance in the matching task considering either RTs or the signal detection index *d'* as a measure of accuracy.

Average RTs. The RT data (see Figure **3.2** for a summary depiction) were subjected to a 2 (shape: self-associated vs. stranger-associated) × 2 (trial type: matching vs. non-matching) within-participants MANOVA (see O'Brien and Kaiser, 1985, for the use of MANOVA to analyse repeated-measure designs). The main effects of shape, $F(1, 33) = 52.48$, $p < .001$, $\eta_p^2 = .61$, and trial type, $F(1, 33) = 15.00$, $p < .001$, $\eta_p^2 = .31$, were both significant. The interaction of shape and trial type, $F(1, 33) = 18.99$, $p < .001$, $\eta_p^2 = .37$, was also significant. To follow up on this interaction effect, RTs from matching trials were submitted to a one-factorial (shape: self-associated vs. stranger-associated) within-participants MANOVA to specifically analyse the SPE. The analysis revealed a significant main effect, $F(1, 33) = 50.73$, $p < .001$, $\eta_p^2 = .61$, indicating a significant SPE in the RT data. That is, responses were faster for matching self-associated shape-label pairs ($M = 685.82$, $SD = 170.73$) than for matching stranger-associated shape-label pairs ($M = 874.00$, $SD = 218.46$). The RTs from non-matching trials were submitted to the same analysis, also revealing a significant main effect, $F(1, 33) = 7.68$, $p = .009$, $\eta_p^2 = .19$. This indicates that responses were faster for non-matching trials comprising the self-associated shape (and other-associated label), ($M = 806.88$, $SD = 157.98$), compared to those comprising the stranger-associated shape (and self-associated label), (*M* = 858.12, *SD* = 215.27). Hence, the significant interaction effect is attributable to a larger RT-benefit for self- as compared to other-associated shapes on matching trials compared to non-matching trials.

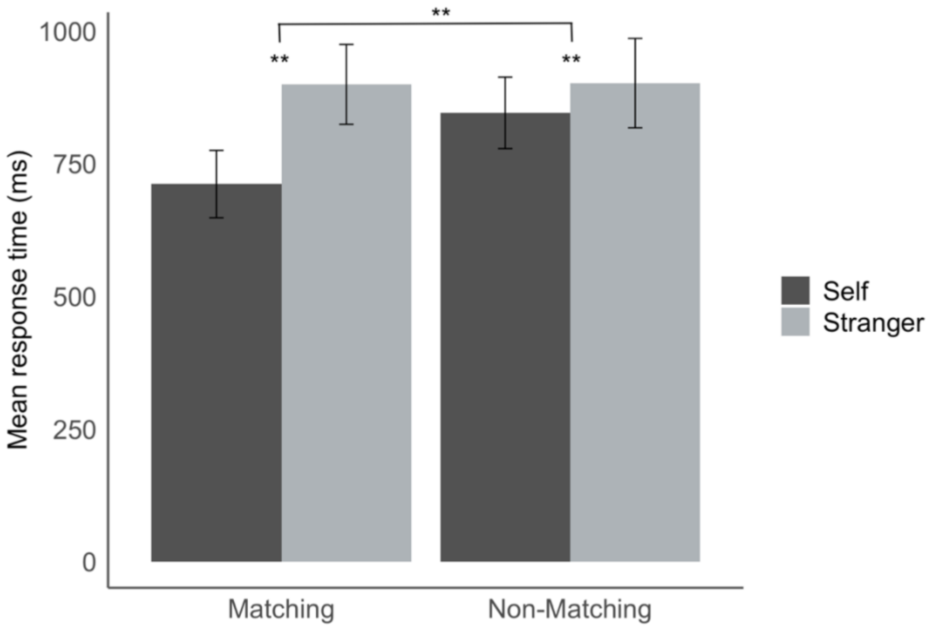

Figure 3.2 *Mean response time in the matching task in Study 1 as a function of shape (self-associated vs. stranger-associated) and trial type (matching vs. non-matching). Error bars represent standard errors. *** p < .001, ** p <.01*

Sensitivity measure d'. Signal detection sensitivity indices for each shape condition were used to analyse error rates (Schäfer et al., 2015, 2016; Sui et al., 2012). To this end, we defined responses in the following way: in matching trials, correct responses were considered hits and incorrect responses were considered misses; in non-matching trials, correct responses were considered correct rejections, and incorrect responses were considered false alarms. The loglinear approach was used to account for cases with 100% hits or 0% false alarms, meaning that 0.5 was added to the number of hits and the number of false alarms, and 1 was added to the number of signal trials and the number of noise trials before calculating the rates for hits and false alarms (see Hautus, 1995; Stanislaw & Todorov, 1999). We then computed *d'*, the measure of sensitivity, and submitted it to a one-factorial (shape: self-associated vs. stranger-associated) MANOVA. A significant main effect of shape was observed, $F(1, 33) = 28.95$, $p < .001$, $\eta_p^2 = .47$, indicating a higher sensitivity for self- than for stranger-associated shapes (i.e., a significant SPE in the sensitivity measure; see Table 3.1).

Table 3.1 *Mean sensitivity measure d' as a function of shape (self-associated vs. stranger-associated) in the matching task in study 1*

Shape	*d'*
Self-associated	2.95 (1.13)
Stranger-associated	2.22 (1.13)

Note. Standard deviation presented within parentheses

In sum, the analyses regarding the matching task revealed that, at the end of the experiment – after performing the dot-probe task – participants showed a significant SPE, showing that our manipulation to induce a self- and other-association of simple geometric shapes was successful.

Dot-probe task

Average RTs. Average RTs in the dot-probe task were subjected to a 2 (target location: self vs. stranger) × 3 (type of representation: label vs. shape vs. pair) within-participants MANOVA. A significant main effect of target location was observed, $F(1, 33) = 16.97$, $p < .001$, $\eta_p^2 = .34$, indicating that responses were faster when the target was presented at the location previously occupied by the self-representation ($M = 347.73$, $SD = 36.18$) than when the target was presented at the location previously occupied by the stranger-representation (M =

363.11, *SD* = 38.01). Furthermore, a significant main effect of type of representation was observed, $F(2, 66) = 97.86$, $p < .001$, $\eta_p^2 =.75$. Follow-up analyses revealed that mean RTs were significantly slower for targets following the self- and other-associated stimuli as represented by labels (*M* = 377.49, *SD* = 34.63) than for targets following the self- and other-associated stimuli as represented by shapes (*M* = 348.63, *SD* = 36.18) , $t(33) = 10.21$, $p <.001$, $d = 0.81$. Further, mean RTs were significantly slower for targets following cues represented by shapes (*M* = 348.63, *SD* = 36.18) than targets following cues represented by pairs (*M* = 340.15, *SD* = 39.17), $t(33) = 2.837$, $p =.008$, $d = 0.49$. The interaction of target location × type of representation, $F(2, 66) = 4.45$, $p = .015$, $\eta_p^2 = .12$, was also significant. To follow-up on this interaction, pairwise *t*-tests were conducted. These post-hoc analyses revealed that responses were significantly faster for targets following the self-representation than for targets following the stranger-representation, irrespective of whether the instances were represented by labels, $t(33) = 4.49$, $p < .001$, $d = 0.52$, or by shape-label pairs, $t(33) = 3.01$, $p = .005$, $d = 0.77$ (see Figure **3.3**). However, the size of the cuing effect did not differ significantly for cues represented by labels and pairs, $t(33) = 0.55$, $p = .584$, $d = 0.14$. Crucially, no significant cuing effect was observed for the shape representation condition, $t(33) = 1.71$, $p = .098$, $d = 0.29$.That is, in comparison to the shape representation condition, the cuing effect was significantly larger when the self and the stranger were represented by labels, $t(33) = 3.02$, $p = .005$, $d = 0.64$, or by shape-label pairs, $t(33) = 1.99$, $p = .055$, $d = 0.44$.

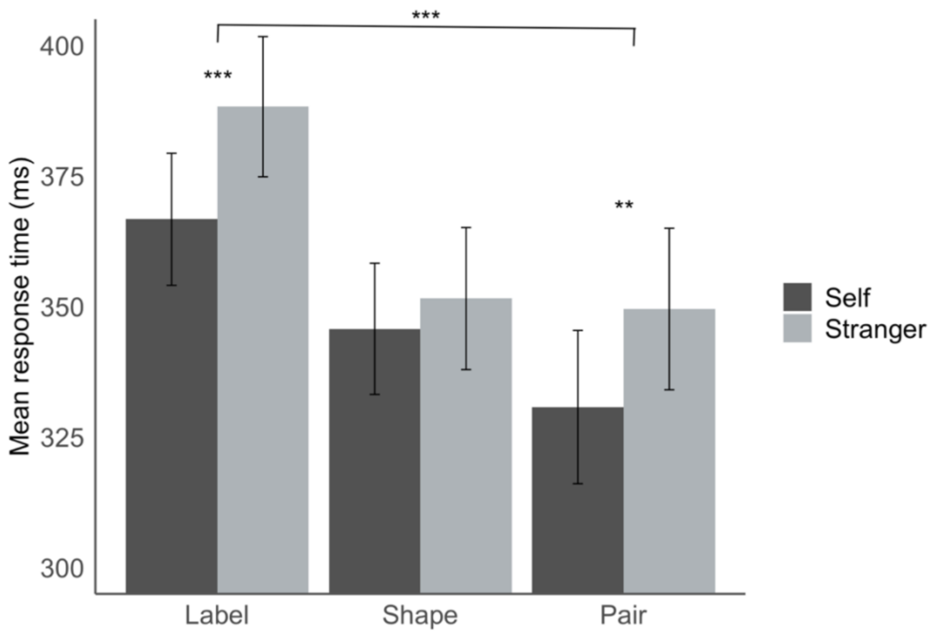

Figure 3.3 *Mean response times in the dot-probe task in Study 1 as a function of target location (self vs. stranger) and type of representation (label vs. shape vs. pair). Error bars represent standard errors. *** p < .001, ** p <.01.*

Error rates. Mean error rates were submitted to a 2 (target location: self vs. stranger) × 3 (type of representation: label vs. shape vs. pair) MANOVA (for descriptive statistics, see Table **3.2**). A significant main effect of target location, $F(1, 33) = 11.38$, $p = .002$, $\eta_p^2 = .26$, was observed, indicating that responses were more accurate when responding to targets presented on the position previously occupied by the self-representation ($M = 0.44$, $SD = 1.19$) than when responding to targets presented on the position previously occupied by the stranger-representation ($M = 0.87$, $SD = 1.13$). Additionally, a significant main effect of type of representation, $F(2, 66) = 12.42$, $p < .001$, $\eta_p^2 = .27$, indicated that responses to the different types of representations differed significantly in accuracy. The interaction of target location × type of representation, $F(2, 66) = 8.41$, $p = .001$, $\eta_p^2 = .20$, was also significant. Post-hoc analyses revealed that responses were significantly more accurate for targets occurring at the location previously occupied by the self-representation ($M = 0.59$, $SD = 1.28$) than for targets occurring at the location previously occupied by the stranger-representation (*M* = 1.47, *SD* = 1.76) when they were represented by labels, $t(33) = 3.23$, $p = .003$, $d = 0.56$, or by shape-label pairs (*M* = 0.29, *SD* = 1.06 for self-representations and *M* = 0.88, *SD* = 1.43 for stranger representations), $t(33) = 4.00$, $p < .001$, $d = 0.70$. Yet, no such cuing effect was observed when the self and stranger had been represented by the corresponding shapes, $t(33) = -1.14$, $p = .263$, $d = 0.20$ (*M* = 0.44, *SD* = 1.44 for self-representations and *M* = 0.26, *SD* = 0.75 for stranger representations). The cuing effect in error rates did not differ significantly for targets following the self- and stranger-stimuli as represented by labels and those following self-and strangers stimuli as represented by pairs, $t(33) = 1.09$, $p = .282$, $d = 0.17$. Yet, the cuing effect was smaller when the self and the stranger were represented by shapes than when labels, $t(33) = 1.76$, $p = .001$, $d = 0.23$, or shape-label pairs were used, $t(33) = 3.42$, $p = .002$, $d = 0.95$.

Table 3.2 *Mean error rates as a function of target location (self vs. stranger) and type of representation (label vs. shape vs. pair) in the dot-probe task in Study 1*

Target Location	Type of Representation	Error rates (%)
Self	Label	0.6 (1.2)
	Shape	0.4 (1.4)
	Pair	0.3 (1.0)
Stranger	Label	1.5 (1.7)
	Shape	0.3 (0.8)
	Pair	0.8 (2.4)

Note. Standard deviation presented within parentheses

Discussion

Study 1 aimed at a direct comparison of the effect of new self-representations vs. familiar self-representations vs. pair self-representations on the distribution of attention. To this end, participants performed a version of the dot-probe task: They were first simultaneously presented with self- and stranger-related information on opposite sides of the screen (represented by newly self-/other-associated geometric shapes, by the familiar labels

"I" and "stranger" or by shape-label pairs). Then an asterisk occurred following either the self- or the stranger-representations and the participant's task was to identify the location of this target. After the dot-probe task, participants performed a shape-label matching task to test whether participants indeed associated the geometric shapes to the self vs. a stranger as they had learned at the beginning of the experiment. Regarding this matching task, we replicated the effects observed in former studies both RTs and sensitivity measures (Humphreys & Sui, 2015; Schäfer et al., 2015; Schäfer, Wesslein, et al., 2016; Sui et al., 2012), indicating that we succeeded in inducing a significant SPE. In the dot-probe task, responses towards targets following self-representations were faster than those towards targets following stranger-representations when these instances were represented by labels or shape-label pairs. That is, we observed a significant cuing effect for self-associated labels and pairs. The size of the effect did not differ between these two representation conditions. Importantly though, no such cuing effect was observed for self-associated shape representations. In other words, the newly self-associated shapes did not suffice to impact the distribution of attention in the dot-probe task in a similar way as the familiar self-label.

In order to test whether this finding generalizes from cuing to inhibition of return, Study 2 tests the effect in a second dot-probe task experiment.

Study 2

In Study 2, we aimed to extend the results from Study 1 by measuring the effect of self-association on responses in the dot-probe task as reflected by inhibition of return. Inhibition of return describes the finding that responses are typically delayed in spatial cuing tasks when the target occurs on the side of the more salient cue when SOAs are long (Theeuwes & Van der Stigchel, 2006; D. G. Watson & Humphreys, 2000). Hence, with long

SOAs of 1000 ms, we expect faster responses to a target when it occurs on the location previously occupied by stranger-associated stimuli (i.e., reduced inhibition of return) as opposed to the previously occupied by self-associated stimuli. This difference should be more pronounced for familiar self- vs. stranger-representations than for newly self- vs. stranger-associated representations. Still, generally, we also expect stronger inhibition of return for familiar than for newly associated representations.

Method

Study 2 followed the exact procedure of Study 1, with the exception that the SOA between the cue stimuli and the target was 1000 ms in the dot-probe task (instead of 100 ms).

A priori power calculations were made to establish a minimum sample size. Based on Study 1, we moderately chose an expected medium effect size of f = .25 (Cohen, 1988) for the effect of attentional self-prioritization in the dot-probe task. For a repeated-measures ANOVA of mean RTs with one group, 6 measurements (2 [target location: self vs stranger] × 3 [type of representation: label vs. shape vs. pair]), α = .05, correlation among the measures = .50, and nonsphericity correction ε = 1, a minimum sample size of N = 28 is needed to detect an effect with a power effect of $1 - \beta$ = .95 (Faul et al., 2007). A total of 33 participants (26 female, M_{age} = 23, SD_{age} = 4.85) completed the study. Data from two participants were excluded because their mean RTs in the dot-probe task were categorized within Tukey's (1977) definition of an extreme outlier when compared to the sample distribution.

Results

For all statistical analyses, a significance level of α = .05 was specified. Data cleansing was done as in Study 1.

Matching Task

Average RTs. The RT data (see Figure **3.4** for a summary depiction) were subjected to a 2 (shape: self-associated vs. stranger-associated) × 2 (trial type: matching vs. non-matching) within-participants MANOVA (O'Brien & Kaiser, 1985, for the use of MANOVA to analyze repeated-measure designs). The main effects of shape, $F(1, 30) = 40.58$, $p < .001$, $\eta_p^2 = .58$, and matching condition, $F(1, 30) = 6.02$, $p = .020$, $\eta_p^2 = .17$, were both significant. The interaction of shape × matching condition, $F(1, 30) = 6.42$, $p = .017$, $\eta_p^2 = .18$, was also significant. As a follow up to said interaction effect, we submitted RTs from matching trials to a one-factorial (shape: self-associated vs. stranger-associated) within-participants MANOVA. The within-participant factor of shape revealed a significant effect, $F(1, 30) = 29.72$, $p < .001$, $\eta_p^2 = .50$, indicating a significant SPE in the RT data. That is, responses were faster for matching self-associated shape-label pairs ($M = 765.45$, $SD = 211.50$) than for matching stranger-associated shape-label pairs ($M = 934.10$, $SD = 256.74$). Submitting RTs from non-matching trials to the same analysis revealed a non-statistically-significant result, $F(1, 30) = 2.67$, $p = .113$, $\eta_p^2 = .08$, indicating that responses in non-matching trials did not significantly differ between trials in which the self-associated shape was presented (simultaneously with the stranger-associated label) and trials in which the stranger-associated shape was presented (simultaneously with the self-associated label).

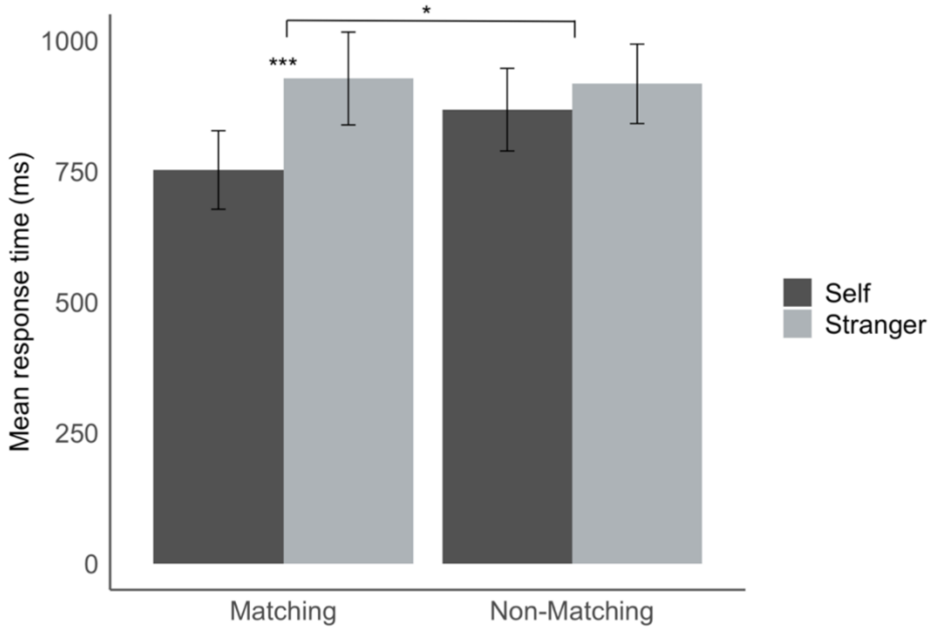

Figure 3.4 *Mean response time in the matching task in Study 2 as a function of shape (self-associated vs. stranger-associated) and trial type (matching vs. non-matching). Error bars represent standard errors. *** p < .001, * p < .05*

Sensitivity measure d'. Measures of sensitivity *d'* were computed as described in Study 1 and submitted to a one-factorial (shape: self-associated vs. stranger-associated) MANOVA. A significant main effect of shape was observed, $F(1, 30) = 13.95$, $p = .001$, $\eta_p^2 = .32$, indicating a higher sensitivity for self- than for stranger-associated shapes (i.e., a significant SPE in the sensitivity measure; see Table **3.3**).

To summarize, the analyses regarding the matching task revealed that, at the end of the experiment – after performing the dot-probe task – participants showed a significant SPE, showing that our manipulation to induce a self- and other-association of simple geometric shapes was successful.

Table 3.3 *Mean sensitivity measure d' as a function of shape (self-associated vs. stranger-associated) in the matching task in Study 2*

Shape	*d'*
Self-associated	3.03 (1.87)
Stranger-associated	2.41 (1.75)

Note. Standard deviation presented within parentheses

Dot-probe task

Average RTs. Average RTs from the dot-probe task were analyzed by means of a 2 (target location: self vs. stranger) × 3 (type of representation: label vs. shape vs. pair) within-participants MANOVA (see Figure **3.5**). The main effect of target location, $F(1, 30) = 1.93$, $p = .175$, $\eta_p^2 = .06$, was nonsignificant. However, the analysis revealed a significant main effect of type of representation, $F(2, 60) = 51.47$, $p < .001$, $\eta_p^2 = .63$. In detail, Helmert contrasts revealed that mean RTs were slower ($M = 416.27$, $SD = 44.17$) when the self/stranger were represented by labels than the mean of both other representation types ($M = 388.50$, $SD = 53.23$ for shapes, $M = 385.82$, $SD = 54.57$ for shape-label pairs), $p < .001$, reflecting that label representations generally yielded higher inhibition of return (for both self- and stranger-associated stimuli) than shapes and shape-label pairs. Mean RTs did not differ significantly for targets following cues represented by shapes or shape-label pairs, $p = .401$. The interaction between the factors of type of representation and target location was again statistically nonsignificant, $F(2, 60) = 1.42$, $p = .249$, $\eta_p^2 = .05$.

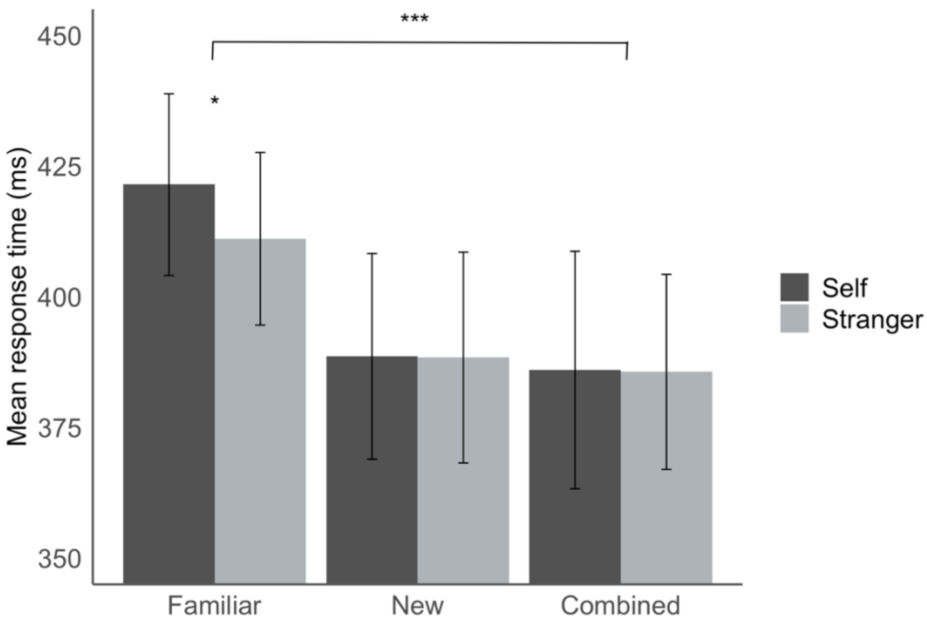

Figure 3.5 *Mean response times in the dot-probe task in Study 2 as a function of target location (self vs. stranger) and type of representation (label vs. shape vs. pair). Error bars represent standard errors. *** p < .001, * p <.05.*

Still, following the analysis of Study 1, we tested – separately for each type of representation – whether the target detection speed differed as a function of its location (following the self-associated stimuli vs. following the stranger-associated stimuli). When labels were used, responses were significantly faster for targets occurring at the previous "stranger"-position (M = 411.10, SD = 44.99) than for those occurring at the position previously occupied by the label "self" (M = 421.45, SD = 47.38), $t(30)$ = 2.13, p = .042, d = 0.38. No such difference was observed for shapes (M = 388.61, SD = 53.62 for targets following self-representations and M = 388.39, SD = 54.94 for targets following stranger-representations), $t(30)$ = .06, p = .953, d = 0.02, or shape-label pairs (M = 386.00, SD = 61.89 for targets following self-representations and M = 385.65, SD = 50.86 for targets following stranger representations), $t(30)$ = .07, p = .949, d = 0.01. Hence, in line with the pattern of results observed in Study 1, we again observed evidence that the distribution of attention is only impacted by familiar self-related stimuli, not by recently established self-associated stimuli (or pair representations).

Error rates. Mean error rates were submitted to a 2 (target location: self vs. stranger) × 3 (type of representation: label vs. shape vs. pair) MANOVA. No significant effects of target location, $F(1, 30) = 1.00$, $p = .325$, $\eta_p^2 = .03$, or type of representation, $F(2, 60) = 2.44$, $p = .096$, $\eta_p^2 = .08$, were observed. The target location × type of representation interaction was also not significant, $F(2, 60) = 3.21$, $p = .097$, $\eta_p^2 = .10$. Table **3.4** represents mean error rates as a function of the target location and type of representation.

Table 3.4 *Mean error rates as a function of target location (self vs. stranger) and type of representation (label vs. shape vs. pair) in the dot-probe task in Study 2*

Target Location	Type of Representation	Error rates (%)
Self	Label	0.0 (0.2)
	Shape	0.1 (0.3)
	Pair	0.0 (0.0)
Stranger	Label	0.2 (0.4)
	Shape	0.0 (0.0)
	Pair	0.0 (0.2)

Note. Standard deviation presented within parentheses

Discussion

Building on Study 1, in Study 2 we set out to test whether newly self- vs. other-associated stimuli are less likely to impact the distribution of attention as measured in a dot-probe task than familiar self- vs. other-representations. Importantly, we increased the SOA between the presentation of the cue (i.e., self- and stranger-related information presented simultaneously on opposite sides of the screen) and the to-be-located target (an asterisk following either the self- or the stranger-related information). Thus, if self-associated stimuli impact attention, this would now delay responding in the sense of inhibition of return. First, we checked whether participants had associated specific geometric shapes to themselves and a stranger as instructed at the beginning of our study. Showing support that our manipulation was indeed successful, a significant SPE was observed both in RTs and sensitivity measures. Turning to the dot-probe task, as expected, we observed slower responses for targets cued by self-representation than for targets cued by stranger-representation when the self and the stranger were represented by familiar stimuli. That is, we observed significant inhibition of return for familiar self-representations. However, again as in Study 1, no such slowing of responses was observed for targets following recently self- vs. stranger-associated stimuli. This demonstrates that despite the observation of a significant SPE in the matching task, the presentation of the self- and stranger-associated shapes in the dot-probe task did not impact the distribution of attention in the same way as the presentation of self- and stranger-associated familiar stimuli. Surprisingly, in view of the findings in Study 1, the shape-label pairs did not produce significant inhibition of return, either.

General discussion

One's own name or other self-associated stimuli are likely to capture our attention (e.g., Moray, 1959). Even a recently self-associated stimulus that had previously been neutral can serve as a more efficient cue to direct attention than a recently other-associated stimulus (e.g., Dalmaso et al., 2019; Sui et al., 2009; Wade & Vickery, 2018). Relatedly, pairs of familiar and recently established self-representations are verified as "matching" more quickly and more accurately than pairs of familiar and recently established other-representations (e.g., Sui et al., 2012). Still, a systematic comparison of the potential of familiar vs. recently established self- vs. other-representations to impact attention is lacking. In the current study, our first aim was thus to investigate attentional prioritization as elicited by familiar vs. new self-representations vs. pairs of familiar and new self-representations, in comparison to familiar vs. new other-representations, under conditions of attentional competition. To this end, we compared the size of cuing effects elicited by highly familiar self-associated stimuli (i.e., the label "I"), newly self-associated geometric shapes, and shape-label pairs in a dot-probe task. Our second aim was to investigate whether attentional prioritization effects as elicited by highly familiar as compared to newly self-associated stimuli would follow established temporal patterns – in which case the beneficial effect of self-associated cues on RTs for targets following these cues at short SOAs (100 ms) would flip at longer SOAs (1000 ms). In order to check whether they had indeed associated the geometric shapes to themselves, we asked participants to complete the matching task as established by Sui et al. (2012) after having completed the dot-probe task.

As expected, when using a short SOA in the dot-probe task (Study 1), participants were faster and more accurate in locating the probe target when it occurred at the location that had previously been occupied by the self-representation than when it occurred at the location that had previously been occupied by the stranger-representation. Again as expected, this RT difference in detecting targets following self- vs. stranger-associated cues was significant when the familiar labels were present. This might indicate that in a situation of attentional competition between familiar self- and stranger-related stimuli, the self-associated stimulus captures attention and holds attention to its location. As a result, the detection of targets occurring at this location shortly after the familiar self-associated cues (as compared to targets occurring at the location of the familiar stranger-associated cues) is facilitated. In other words: For highly familiar stimuli, self-association elicits a spatial cuing effect. In line with this conclusion, significant cuing effects were also observed when the self and stranger were represented by the corresponding shape-label pairs. Yet, intriguingly, no significant spatial cuing effect was observed when the self and the stranger were represented by the corresponding shapes (neither in RTs nor in error rates). Nonetheless, we observed the typical pattern of results for RTs and sensitivity measures in the matching task (Humphreys & Sui, 2015), indicating a significant SPE, so it can be assumed that the geometric shapes were adequate stimuli to use as newly established representations for the self and a stranger in the dot-probe task. The observed pattern of results is in line with our hypotheses that highly familiar self--associated cues are more efficient in eliciting attentional prioritization than recently established self-associated cues. Note that shape-label pairs were no more efficient in eliciting cuing effects than labels only. Hence the presentation of the shape that has recently become associated to the self in addition to the familiar self-associated label did not increase the prioritization of the self-associated compared to the other-associated stimuli.

When using a long SOA in the dot-probe task (Study 2), as expected, participants' responses were slower when responding to targets following familiar self- and stranger representations than for targets following recently learned self- and stranger-representations. Still, we observed no *general* RT difference in detecting targets following self- vs. stranger-associated cues. Neither for new self- vs. other-representations nor for combinations of new and familiar representations did RTs differ as a function of whether the target followed the self- or the stranger-representation. Nonetheless, responses towards those targets presented at the location previously occupied by the familiar self-associated cue were faster than those towards targets presented at the location previously occupied by the familiar stranger-associated cue, reflecting inhibition of return (Lupiáñez et al., 2006). Thus, in line with our expectation, the beneficial effect of self- vs. other-associated stimuli on the distribution of attention (Study 1) turned into a disadvantage for a large SOA (Study 2). We conclude from this finding that, upon the simultaneous presentation of familiar self- and stranger-associated stimuli, the self-associated stimulus is prioritized in information processing. In other words, we provide original evidence that familiar self-associated stimuli hold a stronger potential to modulate early information processing under conditions of attentional competition than recently self-associated stimuli, as reflected by both spatial cuing and inhibition of return.

Our findings regarding familiar self-associated stimuli extend prior research demonstrating the attentional capture of familiar self-relevant information (Arnell et al., 1999; Bargh, 1982; Brédart et al., 2006; Wójcik et al., 2018; Yang et al., 2013), highlighting that such effects also transfer into other early information processing phenomena such as inhibition of return (see Klein, 2000). Further, they are well in line with previous studies showing that one's own name, own personality traits (Alexopoulos et al., 2012; Bargh, 1982; Moray 1959; Yang et al., 2013) and one’s own face (Brédart et al., 2006; Wójcik et al., 2018) capture attention more easily than corresponding other-related stimuli. Still, noticeably, the current studies extend this research by demonstrating that such prioritization also holds when the labels used are general constructs such as “self” and “stranger” that are not exclusive to one person (as suggested by Tacikowski & Ehrsson, 2016). Actually, the broadness of the term “stranger” in comparison to “self” might even have enhanced the effect. However, this also applies to many studies demonstrating the SPE by using the matching task because the usage of these labels is very common in this paradigm. Accordingly, the question of how the specificity of the instances impacts the prioritization of recently established self- and other-associations is a more general issue requiring further research.

The current finding that newly self-associated shapes as compared to stranger-associated shapes yielded no benefit in responding when SOA is short, nor inhibition of return when the SOA is long, can be related to some studies testing the efficiency of directional self- vs. stranger-associated cues in directing attention in endogenous cuing tasks (Sui et al., 2009; Zhao et al., 2015). However, these previous studies indeed reported mixed results (Sui et al., 2009; Zhao et al., 2015). That is, from Sui et al. (2009), it can be concluded that in a Posner cuing task, self-associated arrows can serve to orient attention (though see Zhao et al., 2015). Turning from the orientation of attention by directional cues to attentional capture and attention holding, Dalmaso et al. (2019) observed indicative evidence that saccades away from self-associated geometric shapes were initiated more slowly than saccades away from stranger-associated shapes. Similarly, Wade and Vickery (2018) observed faster detection of self- vs. stranger-associated geometric shapes in complex visual search tasks with displays including neutral and *either* self- *or* stranger-associated shapes. However, Siebold et al. (2015), who had presented neutral, self-, and stranger-associated shapes on the same visual search display, did not observe faster detection of self- as compared to stranger-associated shapes. Interestingly, Posner's cuing task and the oculomotor task used by Dalmaso et al. (2019) also include the presentation of only a self- *or* an other-associated cue on a given trial. In contrast, self- and stranger-associated cues are simultaneously presented in the paradigm we used (namely, the dot-probe task). Considering that the cognitive processes underpinning the SPE are not yet been completely clear, it is important to consider these methodological differences when interpreting the data. Our study extends previous research on the potential of self-relevance to guide information processing in endogenous cuing tasks to contexts in which self- and stranger-associated stimuli have to be processed simultaneously (as in the study by Siebold et al., 2015) –that is, to contexts in which self- and stranger-associated stimuli compete for cognitive resources. Although the self-associated shape is assumed to be more socially salient, the manipulation also induces some degree of social salience to the stranger-associated shape (i.e., it does not remain a neutral stimulus). Taken together our results and those observed by Siebold et al. (2015) suggest that – though attentional effects of recently established self- vs. stranger-associated stimuli have been observed when self-associated stimuli were presented among neutral stimuli (see Dalmaso et al., 2019; Sui et al., 2009; Wade & Vickery, 2018) – they don't yield attentional prioritization in a biased competition task.

Referring to Lockhead (1966) and Sui and Humphreys (2015), we had reasoned that attentional self-prioritization might be larger when the self and the stranger are represented by shape-labels pairs than when they are represented by labels (or shapes) only due to the simultaneous presentation of two self-/stranger-associated cues. However, the size of the cuing effect did not differ for shape-label pairs and labels in Study 1, indicating that attentional capture of the self-associated label did not increase by the addition of the self-associated shape. This is not in line with the reasoning that redundancy gains (Lockhead, 1966) induced by the presentation of the shape-label pair as opposed to only the shape or label alone, would enhance the effect of self-relevance in the dot-probe task (see Sui & Humphreys, 2015a). Still, responses were generally faster for targets following shape-label pairs as compared to targets following shapes or labels with a short SOA. That is, we observed no evidence in support of the assumption that self-associated shape-label pairs might be more highly benefitted in information processing than the self-associated shape or the self-associated label. However, it seems possible that the faster RTs for the pairs compared to the shapes or labels reflect a beneficial effect of redundancy gains (in the sense of facilitated processing for both self- and stranger-related information when two cues referring to each instance are presented, instead of only one) that is independent from the prioritization of self-associated stimuli. Note that it remains an open issue whether redundancy gains might enhance cuing effects for pairs as compared to labels (or shapes) in endogenous cuing tasks requiring the processing of only either self- *or* other-associated stimuli at a time as in Sui et al. (2009). Nevertheless, our data do not reflect an enhancement of the benefit towards the self in information processing when presenting two self-associated cues in conditions of attentional competition.

In Study 2, we found no difference in RTs towards targets following self-associated shape-label pairs than stranger-associated pairs with a long SOA, although an RT difference was observed for familiar self- and stranger-representations. This might, however, be attributable to our experimental set-up: Whereas the possible location of targets was exactly the same as the location of the preceding cues when the self and the stranger were represented by shapes or labels only (i.e., centered at 25% / 75% of the horizontal and at 50% of the vertical line of the screen), the target was presented *in between* the locations of both components of the cue in the pair-condition. It remains an open question whether inhibition of return hinges more strongly upon the repetition of the exact location from the cue to the target than spatial cuing effects. At least, this might be why RTs towards targets following self-associated pairs did not differ significantly from those following other-associated pairs. Moreover, the larger size of the shape in comparison to the label and the set-up of presenting the shape above the label may have led to a larger impact of the shape as a cue in the pair condition, thus diminishing the potential of the familiar self-representation to elicit inhibition of return. In general, further research is needed to clarify the degree to which these features of our experimental set-up impacted on the observed results for the potential of shape-label combinations to induce cuing and inhibition of return.

In the matching task, we found the expected pattern of results both in RTs and sensitivity measures (Schäfer et al., 2015; Schäfer, Wesslein, et al., 2016; Sui et al., 2012; Sui & Humphreys, 2015b, 2015c), indicating that we succeeded in inducing a significant SPE. In the matching task, each trial comprises both a newly associated shape and a highly familiar label. On some trials, only self- *or* other-associated information is present (matching trials), on others both self- *and* other-associated information is present (non-matching trials). The latter also holds for the dot-probe task in which self- and stranger-related information competes for attentional resources on each prime display. Yet, the SPE is usually measured on matching trials, where effects may – at least to some degree – hinge upon the presentation of shape-label pairs. Across studies, results on non-matching trials are less systematic. In Study 1, we generally observe faster RTs on trials comprising the self-associated shape than on trials comprising the stranger-associated shape – both on matching and non-matching trials (see Sui et al., 2012; though see Janczyk et al., 2019; Schäfer et al., 2016; Sui & Humphreys, 2015a). This indicates that information processing of the self-associated shape as recently established, compared to the stranger-associated shape, is actually benefitted in the matching task: trials comprising the self-associated shape and stranger-associated label elicit faster responses than those comprising the self-associated label and the stranger-associated shape (non-matching trials); trials comprising the self-associated shape and label elicit faster responses than those comprising the stranger-associated shape and label (matching trials). Though our results indicate that the presentation of shapes that have only recently become associated to the self vs. a stranger is not sufficient to elicit attentional self-prioritization in the dot-probe task, the current study does not allow to preclude whether an attentional effect may underpin the advantage of the self-associated shape compared to the stranger-associated shape in the matching task. Yet, we can conclude that there is no advantage of the self-associated shape compared to the stranger-associated shape when it comes to attention. Since the shape and the label both need to be considered to enable classification of the pair in the matching task, whereas the shapes (i.e., the cues) are rather task-irrelevant in the dot-probe task, future research should investigate whether the relevance of the shapes determines whether or not their self-vs. other-relatedness impacts the distribution of attention.

It may be criticized that our use of the dot-probe task as a target-location task does not allow us to conclude the level at which responses are being affected. We acknowledge that the differential speed of responses towards targets following self- as opposed to those following stranger-associated familiar cues might either represent an attentional benefit or some kind of response priming by self-relevance. Still, jointly our Studies 1 and 2 show that the observed effect follows the temporal dynamics of attention as established – namely that cuing is observed at a short SOA whereas inhibition of return is observed at a long SOA. Nonetheless, further research is needed to clarify whether there might be a difference in the potential of familiar vs. recently established self-associated cues to elicit response priming which could contribute to our results.

In conclusion, our data yields insights into effects of self-relevance on information processing. That is, familiar self-associated stimuli have the potential to influence early information processing and produce both a cuing effect and inhibition of return. For newly self- vs. other-associated stimuli, we observed no such effects. Summing up, our results provide evidence that established, familiar self-associated stimuli robustly elicit effects in early attentional processing, whereas recently established self-associations may not be sufficient to induce such an attentional prioritization effect when self-associated stimuli need to compete for attentional resources with other-associated stimuli.

Declaration regarding § 5 Abs. 2 No. 8 of the PhD regulations of the Faculty of Science

- Share in collaborative publications/manuscripts -

The subsequent chapter (Chapter 4) consists of a manuscript which is currently under review for publication and which was co-authored by Dr. Christina Matschke and Dr. Ann-Katrin Wesslein. The proportional contributions to the manuscript are presented in the following table.

Manuscript 3

Author	Author position	Scientific ideas	Data generation	Analysis & interpretation	Paper writing
Gabriela Orellana-Corrales	first author	40%	100%	60%	40%
Christina Matschke	second author	20%	0%	20%	20%
Ann-Katrin Wesslein	third author	40%	0%	20%	40%

Title of paper:	Does the impact of self-association on attention depend on the familiarity of stimuli? A comparison of familiar vs. new letter combinations
Status in publication process:	Under review

Chapter 4: Disentangling the Roles of Familiarity and Self-Association

Does the impact of self-association on attention depend on the familiarity of stimuli? A comparison of familiar vs. new letter combinations

In aid of filtering the overwhelming amount of environmental stimulation, self-relevance plays a role in deciding which information to prioritize. However, there is no clear definition yet of what type of information can become associated to the self and thus benefit from such preferential processing. Research has found that self-associated words can easily capture attention in comparison to words associated to others, or neutral words (Alexopoulos et al., 2012; Tacikowski & Ehrsson, 2016; Yang et al., 2013). Although there is some evidence suggesting that this effect may also hold in absence of familiarity, measures of the impact of new self-associated stimuli on attention have yielded mixed results (Dalmaso et al., 2019; Siebold et al., 2015; Sui et al., 2009; Wade & Vickery, 2018; Zhao et al., 2015). Furthermore, the direct comparison of the potential of familiar vs. new self-associated stimuli to impact the distribution of attention indicates that new self- vs. stranger associated stimuli do *not* guide attention with similar effectivity as familiar self- vs. stranger-associated stimuli (Orellana-Corrales et al., 2020a; Orellana-Corrales et al., 2020b; Siebold, et al., 2015; though see Dalmaso et al., 2019 and Wade & Vickery, 2018). Notably, however, research so far has exclusively compared newly self-associated *shapes* to familiar self-associated *words*. Thus, the use of different types of stimuli for each condition may hinder this comparison. In order to rule out this potential confound, the purpose of the current study is to investigate for the first time whether neutral letter combinations can be associated to the self and consequently impact attention.

As previously mentioned, familiar self-associated words impact attention. For example, one’s own name captures attention more easily than other names (Alexopoulos et al., 2012; Yang et al., 2013). Even generic words referring to one’s self (e.g. “I”) can impact visual information processing with greater ease than generic words referring to others (e.g. “other”), even though these are not personalized to one as an individual (Tacikowski & Ehrsson, 2016). However, such self-associated words are also highly familiar. Thus, it is not possible to conclude that their impact on attention is due solely to their association to the self without any influence of the high level of prior exposure to it.

In the last decade, researchers have attempted to test whether formerly neutral stimuli can also impact attention after becoming associated to the self regardless of not having any prior history of representing the self. Such studies have been based on the following paradigm: After participants associate three geometric shapes to the self, a close other, and a stranger, they are presented with random combinations of (1) a word referring to one these persons and (2) a geometric shape associated to one of them (Sui et al., 2012). Typically, studies following this paradigm observe the self-prioritization effect (SPE): An advantage in confirming matching combinations of self-associated shape-word pairs in comparison to the confirmation of matching shape-word pairs associated to a close other or stranger (Dalmaso et al., 2019; Schäfer, Wesslein, et al., 2016; Sui et al., 2012; Wade & Vickery, 2018). The SPE has been interpreted to reflect that new stimuli can be tagged to the self and impact attention due to their association to the self (Humphreys & Sui, 2015; Sui & Rotshtein, 2019). Related studies replicated the SPE using other pictorial stimuli such as coloured arrows (Sui et al., 2009), faces (S. Payne et al., 2017; Zhao et al., 2015), and diagonal lines (Wade & Vickery, 2018). Thus, the SPE appears to be a robust effect. However, its combination with cuing tasks in order to directly measure the impact of newly self-associated stimuli on the distribution of attention has produced mixed results (Dalmaso et al., 2019; Siebold et al., 2015; Sui et al., 2009; Wade & Vickery, 2018; Zhao et al., 2015).

Direct comparisons of the attentional impact of familiar self-association and newly established self-association show that newly self- vs. stranger-associated stimuli do not impact the distribution of attention as differentially as familiar self- vs. stranger-associated stimuli. When comparing the potential of familiar self-associated words vs. new self-associated shapes to impact attention in a dot-probe task, an effect of attentional prioritization of self-associated stimuli was observed only when such stimuli were familiar words (Orellana-Corrales, Matschke, & Wesslein, 2020b, 2020a). Specifically, self- vs. stranger-associated familiar words yielded an advantage in responding towards familiar self-associated words when stimulus onset asynchrony (SOA) was short (200 ms; Orellana-Corrales et al., 2020b; see Orellana-Corrales et al., 2020a for a reversion of this effect with a long SOA). Such effects are typical of salient stimuli which capture attention (see Klein, 2000). When compared to familiar words, however, new self- vs. stranger-associated pictorial stimuli did not yield such effects.

Importantly, studies testing the effects of new self- vs. other-associated stimuli on visual information processing have only used shapes – that is, pictorial stimuli – and have compared them to familiar self- vs. stranger-associated words. However, pictorial stimuli and words are intrinsically different. These two types of stimuli are processed at different speeds

(Shor, 1971) and differ in their cognitive impact even when used to represent the same concept (see Jenkins et al., 1967; Sperber et al., 1979). Thus, it can be criticized that the evidence available so far presents a confound in its comparisons in regard to the attentional impact of familiar and new self-associated stimuli.

In this study, we aim to address this potential confound by comparing familiar and newly self-associated *letter combinations* (i.e. words vs. non-words) with each other. We investigate whether newly established self- vs. stranger-association of letter combinations impacts attention in a way that mirrors the attentional impact of familiar self- vs. stranger-associated letter combinations. In line with prior research on the SPE reflecting a robust effect that is observable with a wide variety of stimuli (S. Payne et al., 2017; Schäfer, Wesslein, et al., 2016; Sui et al., 2012; Wade & Vickery, 2018), we expect that new letter strings will become associated to the self, and will therefore yield a significant SPE. Additionally, in line with prior research directly comparing the attentional capture of familiar and new self-representations (Orellana-Corrales, Matschke, & Wesslein, 2020b, 2020a), we expect to observe an attentional benefit towards self-associated letter combinations in comparison to stranger-associated letter combinations only when such stimuli are familiar (i.e., for words), but not when stimuli are newly associated (i.e., for non-words).

Method

The study was carried out according to the principles of the Declaration of Helsinki, on the basis of informed consent, and pre-registered in the Open Science Framework, https://osf.io/s68pm.

Participants. The minimum sample size required was established by performing a priori power calculations using G*Power software (Faul et al., 2007). The SPE has been reported as a medium to large effect in size in previous studies (*dz* = 0.81 in Sui et al., 2012 and dz $\geq$ 0.58 in Schäfer et al., 2016). Furthermore, previous studies using familiar and new self- vs. other-associated stimuli in a dot-probe task measuring attentional capture reported a medium to large effect size of the interaction between target location and type of representation (ƒ = .37 in Orellana-Corrales et al., 2020a and ƒ = .72 in Orellana-Corrales et al., 2020b). Based on these reports, we expected a medium effect size of ƒ = .25 (Cohen, 1988) for the interaction between target location and letter string in a dot-probe task. Thus, for a repeated-measures analysis of variance (ANOVA) with one group, 4 measurements (2 [target location: self vs. stranger] × 2 [letter string: word vs. non-word]), α = .05, correlation among measures = .50, and non-sphericity correction ε = 1, a minimum sample size of *N* = 28 is needed to detect an effect with a power of 1 − β = .99.

The study was completed by a total of 33 participants (23 female; M_{age} = 21, SD_{age} = 2.8) to allow for dropouts and exclusion of outlier responses. All participants had normal or corrected-to-normal vision and were able to complete the study in German. Before analysing the data, each participant's mean response time (RT) and error rate were compared to the sample distribution of mean RTs and error rates, respectively, separately for the dot-probe task and the matching task. In the matching task, the average RT of two participants fell within Tukey's definition of an outlier (Tukey, 1977), so their data was excluded from all analyses.

Procedure. Upon arrival to the laboratory, participants were greeted by an experimenter who shortly provided an overview of the study structure. All specific instructions that followed were presented on the computer screen.

At the beginning of the experiment, participants were asked to associate non-words to the words “I” and “stranger”. To this end, a non-word was presented above the word to which it should be associated. Each combination was presented four times for a duration of 3000 ms, alternating between the self-associated and stranger-associated pair.

Following, participants completed the dot-probe task (see Figure 4.1). The task began with 24 practice trials in which participants received feedback if their response was incorrect or exceeded 1, 500 ms (“incorrect”, “please respond faster”). The practice trials were followed by 240 experimental trials in which participants did not receive feedback on their performance. Each trial began with a fixation cross in the centre of the screen (500 ms), followed by two cues – one representing the self and one representing a stranger – positioned on opposite sides of the screen (left and right, located on 25% and 75% of the horizontal line of the screen, and on 50% of the vertical line of the screen). The cues were presented for 200 ms and they either consisted of the words “self” and “stranger”, or the associated non-words. The letter combinations varied from trial to trial in a randomized order. Following the presentation of the cues, a target consisting of either a “q” or a “p” was presented on either the left or right side of the screen (on 25% or 75 of the horizontal line of the screen, respectively, and on 50% of the vertical line of the screen). The target remained on the screen until participants responded by pressing either of the response keys “Q” or “P” to indicate which target was presented. The target (q or p) and its location (left or right) were randomized between trials. A 1000 ms pause which consisted of a black screen proceeded before the beginning of the next trial. Faster responses to targets following self-associated letter combinations indicate a greater potential for self-associated stimuli to capture attention than stranger-associated stimuli.

Finally, the matching task was presented. Each trial began with a black screen (500 ms) followed by a central fixation cross (500 ms). A pair consisting of a non-word and a word underneath was then presented and remained on the screen until the participant responded, or for a maximum duration of 1,500 ms. Participants were asked to indicate whether or not the presented pair matched the mapping learned during the association phase (i.e. they both represented the self or they both represented the stranger): Pressing “D” indicated that the presented pair was a matching pair and pressing “K” indicated that the presented pair was a non-matching pair. Participants received feedback if their response was incorrect or if it exceeded 1,500 ms (“incorrect”, “please respond faster”.) A practice phase consisting of four trials was administered at first, followed by 128 experimental trials to measure the SPE as established in the literature (Sui et al., 2012). Faster responses to matching self-associated pairs than stranger-associated pairs indicate a significant SPE.

After finalizing the matching task, participants were thanked and compensated with four euros. Students of the Department of Psychology at the University of Tübingen could alternatively opt to receive class credit for their participation.

Apparatus and Materials. The experiment was conducted on Acer Aspire E15 35-573G-54SK 15.6” laptops using standard computer mice, and it was run on E-Prime 2.0 (Schneider et al., 2002).

All stimuli as well as the instructions were presented in white colour against a black background and at a viewing distance of 50 cm. The stimuli and instructions were represented in Courier New font size 18 at a visual angle of about 0.7°.

Familiar representations consisted of the labels “I” and “stranger” (i.e., the corresponding German words “Ich” and “Fremder” were used). Non-words were associated to both these instances at the beginning of the experiment. The non-words used were letter combinations that phonologically resemble real German words but have no semantic meaning. They were based on materials used by Landkammer et al. (2019) and consisted of the following: sfartku, ambelde, teirnen, kes, muf, lor. Considering the difference in character-length of the German words used (three characters for “Ich” and seven characters for “Fremder”), we also used non-words consisting of three and seven characters. That is, for every participant, one of the words was assigned to a three-character non-word, while the other was assigned to a seven-character non-word. The assignment of non-words to words was randomized and counter-balanced across participants.

Design. Data regarding the SPE matching task consisted of a 2 (association: self vs. stranger) × 2 (trial type: matching vs. non-matching) within-participants design.

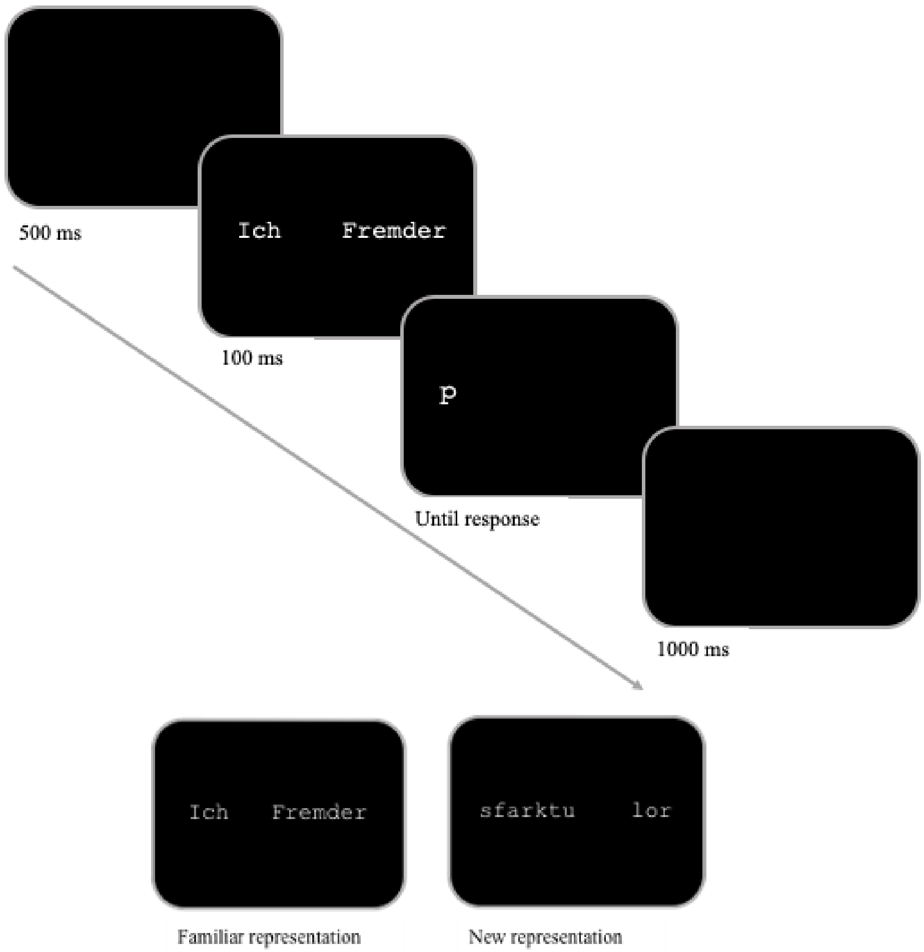

Figure 4.1 *Schematic depiction of one trial of the dot-probe task (upper graph) and example displays demonstrating how the display differed as a function of the type of representation (familiar vs. new; lower graph).*

Data regarding attentional prioritization in the dot-probe task consisted of a 2 (target location: self vs. stranger) × 3 (letter combination: word vs. non-word) within-participants design. The target location was randomized and counter-balanced throughout trials.

Results

For all statistical analyses, a significance level of α = .05 was specified. For RT analyses, only correct responses with RTs above 100 ms and below three interquartile ranges above the third quartile of the overall individual RT distribution were used (see Tukey, 1977). Exclusions of trials were performed separately for the matching task and the dot-probe task.

The datasets generated and analysed during the current study are available in the Open Science Framework, https://osf.io/4cwrv/.

Matching Task

Average RTs. The RT data (see Figure **4.2**) were subjected to a 2 (association: self-associated vs. stranger-associated) × 2 (trial type: matching vs. non-matching) within-participants multivariate analysis of variance (MANOVA; see O'Brien and Kaiser, 1985, for the use of the MANOVA to analyse repeated-measures designs[1]). A significant main effect of association was observed, $F(1, 30) = 26.65$, $p < .001$, $\eta_p^2 = .47$, indicating that responses were faster on trials comprising self-associated non-words than on trials comprising stranger-associated non-words. The effect of trial type was non-significant, $F(1, 30) = 0.53$, $p = .473$, $\eta_p^2 = .02$. However, a significant interaction between association and trial type was observed,

[1] Due to our power calculations being made for an ANOVA analysis, a parallel ANOVA analysis was run for all MANOVA analyses followingly reported. Both analyses yielded the same results.

$F(1, 30) = 15.42$, $p < .001$, $\eta_p^2 = .34$. To follow up on this interaction effect, RTs from matching trials were submitted to a one-factorial (association: self-associated vs. stranger-associated) within-participants MANOVA. The analysis revealed a significant effect of association, $F(1, 30) = 33.89$, $p < .001$, $\eta_p^2 = .53$, indicating a significant SPE. That is, responses were faster for matching self-associated combinations (M = 615 ms, SD = 101 ms) than for matching stranger-associated combinations (M = 701 ms, SD = 149 ms). The RTs from non-matching trials were submitted to the same analysis, revealing a non-significant effect of association, $F(1, 30) = 1.11$, $p = .301$, $\eta_p^2 = .04$.

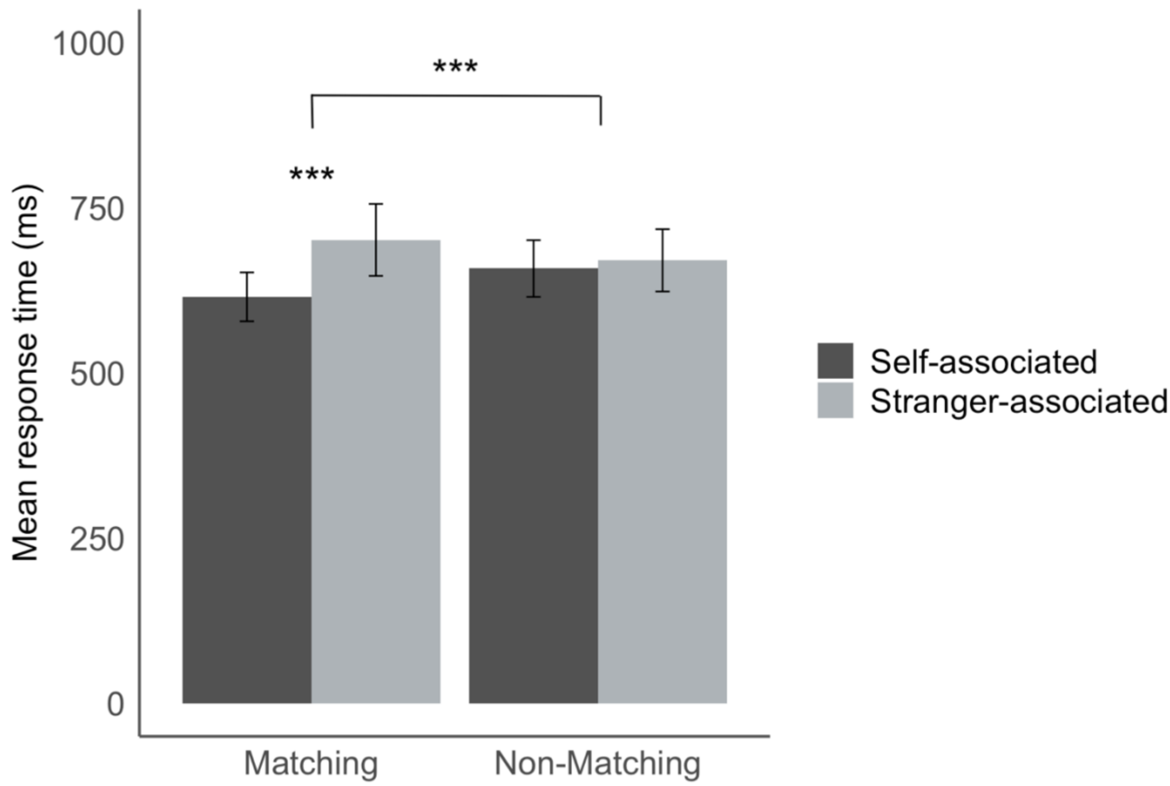

Figure 4.2 *Mean response time in the matching task as a function of association (self-associated vs. stranger-associated) and trial type (matching vs. non-matching). Error bars represent standard errors. *** p < .001.*

Sensitivity measure d'. Mean error rates are presented in Table **4.1**. Signal detection sensitivity measures (*d'*) for each association condition were used to analyse error rates (Schäfer et al., 2016; Sui et al., 2012). To this end, we defined responses in the following way: Hits were correct responses in matching trials, misses were incorrect responses in matching trials, rejections were correct responses in non-matching trials, and false alarms were incorrect responses in non-matching trials. The loglinear approach was used to account for cases with 100% hits or 0% false alarms, meaning that 0.5 was added to the number of hits and the number of false alarms, and 1 was added to the number of signal trials and the number of noise trials before calculating the rates for hits and false alarms (see Hautus, 1995; Stanislaw & Todorov, 1999). The sensitivity measures were submitted to a one-factorial (association: self-associated vs. stranger-associated) MANOVA. A significant main effect of association was observed, $F(1, 30) = 20.27$, $p < .001$, $\eta_p^2 = .40$, indicating a higher sensitivity for self-associated non-words than for stranger-associated non-words. In summary, the data reflects a significant SPE in measures of *d'*.

Table 4.1 *Mean error rates as a function of trial type and shape in the matching task*

Trial type	Shape	Error rates (%)
Matching	Self-associated	1.1 (1.5)
	Stranger-associated	3.1 (2.5)
Non-matching	Self-associated	1.0 (1.6)
	Stranger-associated	1.0 (1.2)

Note. Standard deviation presented within parentheses.

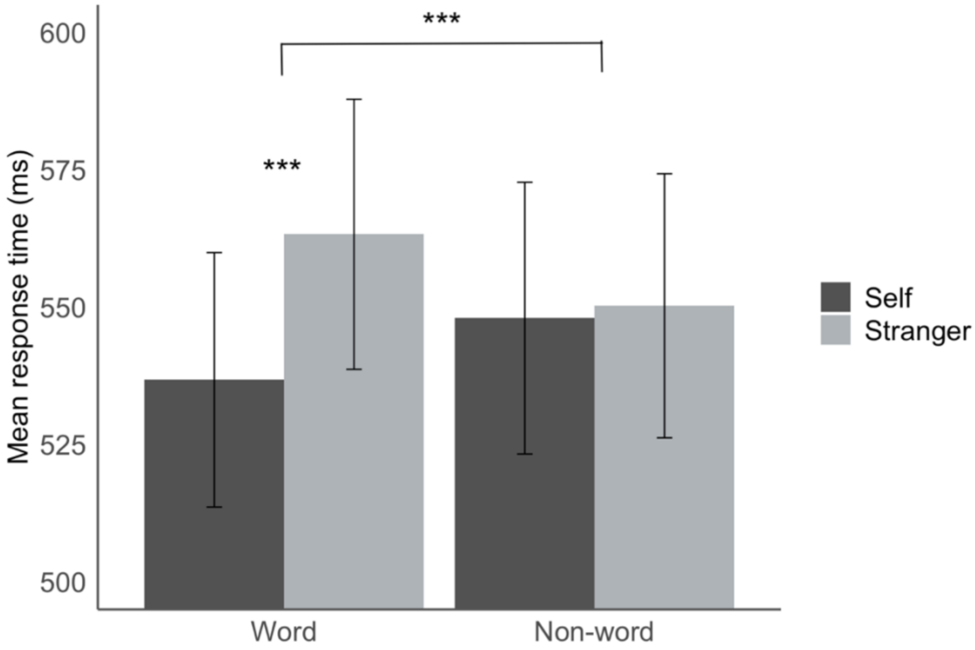

Figure 4.3 *Response times in the dot-probe task as a function of target location (self vs. stranger) and letter combination (word vs. non-word). Error bars represent standard errors.* *** *$p < .001$.*

Dot-probe task

Average RTs. Average RTs in the dot-probe task (see Figure **4.3**) were submitted to a 2 (target location: self vs. stranger) × 2 (letter combination: word vs. non-word) within-participants MANOVA. A significant main effect of target location was observed, $F(1, 30) = 17.49$, $p < .001$, $\eta_p^2 = .37$, indicating that responses were faster when the target was presented at the location previously occupied by a self-associated stimulus (M = 542 ms, SD = 63 ms) than when the target was presented at the location previously occupied by a stranger-associated stimulus (M = 557 ms, SD = 65 ms). The effect of letter combination was not significant, $F(1, 30) = 0.12$, $p = .731$, $\eta_p^2 = .004$. However, a significant interaction between target location and letter combination was observed, $F(1, 30) = 8.75$, $p = .006$, $\eta_p^2 = .22$. To follow-up on this interaction, post-hoc analyses were conducted. Pairwise *t*-tests revealed that, when the self and stranger were represented by words, responses were significantly faster for targets following the self-associated word (M = 537 ms, SD = 63 ms) than for targets following the stranger-associated word (M = 563 ms, SD = 67 ms), $t(30) = 6.23$, $p < .001$, dz = 1.12. However, as expected, no such cuing effect was observed for the non-word condition, $t(30) = 0.36$, $p = .720$, dz = 0.06.

Error rates. Mean error rates (Table **4.2**) were submitted to a 2 (target location: self vs. stranger) × 2 (letter combination: word vs. non-word) MANOVA. Neither the effects of target location, $F(1, 30) = 1.01$, $p = .324$, $\eta_p^2 = .03$, and letter combination, $F(1, 30) = 0.23$, p = .634, $\eta_p^2 = .01$, nor the interaction effect, $F(1, 30) = 0.32$, $p = .579$, $\eta_p^2 = .01$, were significant.

Table 4.2 *Mean error rates as a function of target location and type of representation in the dot-probe task*

Target Location	Letter combination	Error rates (%)
Self	Word	2.5 (1.9)
	Non-word	2.4 (2.1)
Stranger	Word	2.6 (2.3)
	Non-word	2.9 (2.1)

Note. Standard deviation presented within parentheses.

Discussion

The aim of this study was to investigate whether newly self vs. stranger-associated stimuli impact attention differently when both newly and familiar self-associated stimuli use the same representation modality (i.e., letter combinations). Prior research demonstrated that attention is held and captured by self-associated stimuli when familiar self- vs. stranger-associated letter strings are simultaneously presented (Orellana-Corrales et al., 2020a; Orellana-Corrales et al., 2020b). In comparison, no such effect of attentional capture and holding by self-associated stimuli was observed when new self- and stranger-associated geometric shapes are used (Orellana-Corrales et al., 2020a; Orellana-Corrales et al., 2020b). However, the exclusive use of pictorial stimuli instead of letter combinations in prior studies so far presents a potential confound that interferes with the comparison between these effects. Therefore, we aimed at ruling out this potential confound by investigating whether newly established self- vs. stranger-association of non-words impacts attention in a way that mirrors the attentional impact of familiar self- vs. stranger-associated words. To do so, we measured the distribution of attention to self- vs. stranger-associated words and non-words by using a dot-probe task in which participants had to identify a target which was randomly presented on either one side of the screen (left or right) after the simultaneous presentation of either words or non-words associated to self and stranger on opposite ends of the screen. Finally, participants performed a matching task in which they had to indicate whether random pairs of the words and non-words matched the initial association or not (i.e., measurement of the SPE). We expected to observe faster responses towards matching self-associated pairs of letter combinations than stranger-associated pairs (a significant SPE), thus confirming that the non-words were associated to the self and stranger. Furthermore, we expected to observe an attentional benefit towards self-associated letter combinations in comparison to stranger-associated letter combinations when these were familiar words. Based on previous research, however, we did not expect to find this effect for the non-words when comparing self-associated stimuli to stranger-associated stimuli.

In regard to the matching task, we observed that participants were faster and more accurate at confirming the matching combination of self-associated non-words and labels in comparison to any other combination of non-words and labels. This reflects a significant SPE, as established in the literature (Sui et al., 2012; Schäfer et al., 2016). In other words, our study successfully replicated the findings of the SPE literature and therefore demonstrates that non-words can become associated to the self and immediately impact performance in a matching task presenting combinations of non-words associated to the self and others, and the words referring to these persons. Importantly, this allows for the results in the dot-probe task to be interpreted within the framework of the SPE.

As expected, we observed that participants were faster at identifying the target when it was presented on the location previously occupied by self-associated words than when it was presented on the location previously occupied by stranger-associated words. This indicates that, under conditions of attentional competition (i.e., when self- and stranger-associated stimuli are presented simultaneously), self-associated letter combinations are prioritized in attention in comparison to stranger-associated letter combinations. That is, after the presentation of the word “I” (vs. “stranger”), attention was held at its location, enhancing responses towards the following target. However, no such difference was observed when non-words were used: Self-associated letter combinations did not yield an advantage in identifying targets in comparison to stranger-associated letter combinations when such letter combinations had been newly associated to the self and stranger. Taken together, our results indicate that the effect of attentional prioritization of the self is modulated by the type of representation used. In other words, the data shows that familiarity plays a role in the attentional impact of self- vs. stranger-associated stimuli.

The data replicates the results observed in previous studies comparing the attentional prioritization of familiar self- vs. stranger-associated word-stimuli and newly self- vs. stranger-associated pictorial stimuli. Specifically, both Orellana-Corrales et al. (2020a) and Orellana-Corrales et al. (2020b) observed an impact on responses towards self-associated stimuli over stranger-associated stimuli in a dot-probe task only using familiar word-stimuli, yet not when presenting newly self- and stranger-associated shapes alone. However, as studies had used words as familiar representations of "self" and "stranger", and geometric shapes as new representations, the role of the stimulus modality remained unclear. The current study extends these results by avoiding this potential confound and using the same modality of stimuli as both familiar and new representations. Namely, this study demonstrates that the difference observed in prior research between the attentional impact of familiar and new self-association are due to familiarity playing a role in yielding such impact, rather than because stimuli of a different modality were used.

Notably, some of the literature exploring the attentional impact of newly established self-association does report having observed an attentional benefit towards self-associated stimuli in comparison to other-associated stimuli (Dalmaso et al., 2019; Sui et al., 2009; Wade & Vickery, 2018; Zhao et al., 2015). However, these studies used different attentional tasks and thus the lack of systematization makes it difficult to compare the results observed in these studies. Considering the differences in methodology, it is interesting to note that our results are in line with those observed by Siebold et al. (2015), as it is the only study which, like ours, simultaneously presented the self- and other-associated stimuli. This may suggest that the attentional impact of self- vs. stranger-associated stimuli may depend on the visual context in which it is presented.

By building on previous research that has used the same task, this study stands on a solid base that allows for more precise inferences to be drawn from its results. However, it is necessary to further test the confound of different stimuli modalities in other cuing paradigms that have been previously used, such as variations Posner's cuing task (Dalmaso et al., 2019; Sui et al., 2009; Zhao et al., 2015).

In conclusion, our data shows that findings on the different impact of self- vs. stranger-associated familiar words vs new pictorial stimuli cannot be attributed to the use of different stimuli modalities. Rather, such findings also replicate when letter combinations are consistently used as both familiar and new representations of self and stranger. Thus, we extend the literature by testing the effect of familiar and new self-association by using the same stimulus modality (i.e. letter combinations) for the first time. Taken together, the results of this study highlight that familiarity constitutes an important boundary condition in the attentional impact of newly self-associated stimuli.

Chapter 5: General Discussion

The aim of this dissertation was to directly compare the impact of new self-representations to that of familiar self-representations (as opposed to the impact of new and familiar representations of a stranger). Stimuli that are associated to the self can capture attention (Alexopoulos et al., 2012; Bortolon & Raffard, 2018; Brédart et al., 2006), enhance cognitive processing (Bower & Gilligan, 1979; Brédart, 2016; Kim et al., 2018), and they can even impact attitudes (Boucher et al., 2009; Greenwald & Farnham, 2000) and behavior (Burkley et al., 2015; Tajfel, 1970). However, the conditions required for a stimulus to become associated to the self and yield such effects are still unclear. This is highly relevant in the context of today's ubiquitous use of the internet and digital media, as we interact with different environments in which we are represented in multiple ways. Such representations vary from the concrete and familiar, such as photographs of ourselves and our real name, to the very new and abstract, such as avatars or symbols. Understanding their impact on cognition, affect, and behavior, can shed light on the dynamics behind our use of technology and online behavior.

So far, many of the self-associated stimuli that have been demonstrated to produce such effects also have a long history of representing the self and are thus highly familiar – such as one's own name and face. In order to study self-association in absence of familiarity, a recent line of research has been studying the effects elicited by recently established self-association (Macrae et al., 2017; Schäfer, Wesslein, et al., 2016; Sui et al., 2012). Nevertheless, the evidence that has been collected so far regarding the impact of newly self-associated stimuli on information processing is limited and mixed. Furthermore, there are no direct comparisons of the effects yielded by newly self-associated stimuli and familiar self-associated stimuli. Thus, the three manuscripts included in this dissertation build on one another to detail the attentional impact of familiar and new self-association. In this chapter, I will discuss how the presented evidence relates to the existing literature, and its theoretical and practical implications, as well as strengths and limitations of the reported studies, and possible directions for future research.

General summary of findings

In order to facilitate a seamless integration of the empirical results, all of the studies in Chapters 2 - 4 used the same task to measure attentional effects of self- and stranger-representations in different familiarity conditions. Specifically, a dot-probe task was used in which self- and stranger-representations were simultaneously presented as cues on opposite ends of the screen (left and right), followed by a target which was randomly presented on either one side of the screen (i.e., left or right) and required a response. The attentional impact of each type of representation was measured by RTs to targets when they were preceded by a self-representation in comparison to when they were preceded by a stranger-representation. The use of this task across all experiments thus minimized the possible confounds between the observed results.

Throughout the studies reported, the attentional prioritization of self-representations over stranger-representations was compared when the familiarity of such representations varied. In detail, Chapter 2 aimed to measure whether a representation of the self can capture attention with greater ease than the representation of a stranger. Further, the type of representation used (familiar, new, or paired) was manipulated. Results indicated that self-associated representations yielded faster RTs towards targets than stranger-associated representations only when familiar representations were used. That is, when familiar representations were presented, self-representations captured attention and enhanced RTs to targets presented on the same location in comparison to stranger-representations. This difference between RTs to targets preceded by self- and stranger-representations was not observed when new representations were used. Notably, paired representations did yield a significant difference between RTs to targets preceded by a self- and stranger-representation. However, this attentional effect was interpreted to be caused solely by the familiar representation that was included within the paired representations – with no impact from the new representation – as will be discussed further in this section. Thus, Chapter 2 provided evidence that familiar self-representations impact attention as observed by a cuing effect, while new self-representations do not.

Followingly, Chapter 3 aimed to replicate and extend the results from Chapter 2 by manipulating the SOA. Namely, the aim was to compare whether the pattern in attentional capture of familiar, new, and mixed self- vs. stranger-representations – observed as a cuing effect with an SOA of 100 ms – was mirrored by a pattern of attentional impact observed as inhibition of return with an SOA of 1000 ms. By extending the length of the SOA, it was observed that only familiar representations yield a difference in RTs towards targets preceded by self vs. stranger-representations. In this case, RTs towards targets preceded by self-representations were slower than those preceded by stranger-representations. This was interpreted as a greater potential for self-representations to capture attention, which subsequently impaired RTs to stimuli presented on the same location after attention had drifted away from the cue due to the extended SOA. Notably, paired representations did not yield a significant difference between RTs to targets preceded by a self- and stranger-representation when the SOA was 1000 ms long. Taken together, Chapter 3 provided evidence that self-representations impact attention when such representations are familiar – as observed by a cuing effect and an effect of inhibition of return.

Finally, Chapter 4 again replicated the results from Chapter 2 regarding the effects of familiar and new self- and stranger-representations, yet this time by using the same stimulus modality for both familiar and new representations. That is, following prior literature, Chapters 2 and 3 had used words as familiar representations and shapes as new representations. However, the use of different stimuli modalities for the different types of representation entailed a potential confound which could possibly account for the different effects yielded by the different types of representations (i.e., verbal and pictorial). Thus, Chapter 4 used only verbal stimuli (words and nonwords) as familiar and new representations in order to control for this potential confound. This chapter provided evidence to support the claim that the difference in the effects yielded by familiar and new representations in the prior chapters were not due to the use of stimuli of different modalities for each type of representation. That is, it demonstrated that familiar self-representations impact attention as observed by a cuing effect while new self-representations do not – even when both representations use stimuli of the same modality.

Remarkably, a significant SPE was consistently observed in the matching task in all of the studies reported. Namely, the confirmation of matching self-associated pairings (composed either by a newly self-associated shape and a familiar label, or a newly self-associated non-word and a familiar label) was faster and more accurate than the confirmation of matching pairings that were associated to a stranger in the matching task. That is, the self-association of previously neutral stimuli impacted performance in the matching task.

Overall, this dissertation provides new specific insights regarding the conditions in which new stimuli are integrated into the self-concept as representations of the self. Specifically, it presents evidence that self-association alone may have a limited and temporary impact on certain stages of information processing but is insufficient to actually change the self-concept by integrating the recently self-associated element.

Attentional prioritization of self (vs. other) modulated by familiarity

As a whole, the evidence presented in this dissertation strongly supports that familiarity is a precondition for self-representations to impact attention. In all studies, a significant difference in the impact of self- vs. stranger-representations was observed when familiar representations were used, but not when new representations were used. Furthermore, the use of paired representations yielded mixed results.

The observed impact of familiar self-representations on attention across all chapters of this dissertation is congruent with prior research which has clearly established that familiar self-associated stimuli can easily capture attention (Alexopoulos et al., 2012; Tacikowski & Ehrsson, 2016). Specifically, words that represent one's self – such as one's name (Cherry, 1953; Moray, 1959; Tacikowski et al., 2011) and nationality (Tacikowski & Ehrsson, 2016) – can capture attention with greater ease than words referring to others. The word "self" in particular has not been used before in studies testing attention of self-associated stimuli, as was done in this dissertation. However, it has been used successfully in studies researching the impact of self-association in other dimensions such as implicit attitudes (Greenwald &

Farnham, 2000), because it is indeed a familiar word that semantically refers to the self. Thus, this dissertation provides further support to the claim that familiar words which represent the self can capture attention with greater ease that words referring to others.

Conversely, there may not be such a straight-forward interpretation regarding the lack of an observable effect of new self-representations. Research on the topic so far does not yet provide a clear distinction of the role which self-association plays in prioritizing attention. Generally, the attentional dynamics behind newly established self-association have so far demonstrated to be less robust than familiar self-association. For example, Sui et al. (2009) demonstrated that arrows presented in a self-associated color can orient attention towards targets with greater ease than arrows presented in a color associated to a friend. Furthermore, they observed that arrows presented in a self-associated color facilitated the localization of a target even if the location of the target was not cued by the arrow. The authors proposed that self-associated cues facilitate disengaging attention from the cued location which does not contain the target towards the uncued location containing the target. However, Zhao et al. (2015) replicated the results reported by Sui et al. (2009) with a "marginally significant" effect ($p = 0.07$) and they observed limitations in the degree to which self-association impacted attention due to the type of cues used and the type of target presented.

Relatedly, Dalmaso et al. (2018) demonstrated that newly self-associated shapes can capture and hold attention in comparison to stranger-associated shapes, consequently delaying anti-saccades away from them. Their results demonstrate that a newly self-associated stimulus can itself capture attention with greater ease than stimuli newly associated to others. Further adding to this claim, Wade and Vickery (2018) demonstrated that self-associated shapes can also capture attention from within a set of neutral shapes more efficiently than other-associated shapes presented within a set of neutral shapes. Taken together, these studies seem to suggest that newly self-associated stimuli can capture attention. However, both of these studies presented either only the self-associated stimulus or only the other-associated stimulus in each trial. In contrast, when presenting both a self- and stranger-associated diagonal line within a set of vertical lines, Siebold et al. (2015) observed no attentional advantage for the self-associated line. Hence, evidence from prior studies regarding the attentional impact of newly self-associated stimuli is mixed, even when using the same task with slight variations such as Wade and Vickery (2018) and Siebold et al. (2015) did in their studies. It is therefore important to consider the particularities of the task used in the studies of this dissertation and how they may influence the observed results.

One possible explanation for the difference between the results observed in this dissertation and those observed by Dalmaso et al. (2018) and Wade and Vickery (2018) regarding the attentional impact of newly established self-association is the setup in which the self- and other-associated stimuli are presented. Namely, the studies presented here measure the impact of attention when both stimuli are presented simultaneously rather than individually. It is important to consider that the manipulation used in studies researching newly established self-association entails that, in addition to making a previously neutral stimulus become salient by providing it with a new meaning and making it represent the self, the other-associated stimuli also become salient by being provided with a new meaning and making them represent an other (e.g. a friend or stranger). Thus, both the self-associated and other-associated stimuli differ in relevance between each other, but neither are exactly neutral. Hence, presenting both stimuli simultaneously is intrinsically different than presenting only one of them at a time (either alone or within sets of neutral stimuli) because it implies the processing of multiple salient stimuli at one time – albeit, multiple salient stimuli that differ in their degree of relevance – and can possibly yield different results. Indeed, Siebold et al. (2015) presented both stimuli simultaneously within a set of neutral stimuli and did not observe an advantage for the localization of self-associated stimuli vs. stranger-associated stimuli. Thus, it remains an open issue whether the context in which newly self-associated stimuli are presented has any influence on its attentional impact.

Indeed, there is currently no evidence on whether the attentional impact of newly self-associated stimuli is susceptible to the environment in which it is presented. However, research testing the influence of other stimuli in the environment could shed light on the relevance and attentional impact of newly self-associated stimuli. Furthermore, it would provide further insight into how it compares to the relevance and attentional impact of familiar stimuli. As a reference, familiar self-associated stimuli can robustly capture attention even when presented amongst other salient stimuli (e.g., Brédart et al., 2006; Moray, 1959). Such research could use the attentional tasks that have previously used, such as the dot-probe task or the visual-search task, and manipulate whether the self- and other-associated representations are presented as the sole salient stimulus (either alone or amongst neutral stimuli) or simultaneously. Results from such studies could clarify whether environmental stimuli represent a confound that affects the attentional impact of newly established self-association which may explain the mixed results observed in the literature. Beyond this clarification, such research would be important in demonstrating the impact of recently established self-association in a natural environment which typically includes multiple stimuli of varying relevance that compete for the allocation of cognitive resources – such as is the case in digital environments which simultaneously present multiple users.

One other particularity of the methodology used in the studies comprising this dissertation refers to the order in which the tasks were presented. Specifically, it may be criticized that the studies included in this dissertation divert from previous literature by separating the SPE methodology – measuring attention in between the manipulation and the matching task – which may have influenced the observed results. The reason why the methodology was used in this way was based on prior interpretations of the SPE presuming that the initial instruction asking participants to neutral stimuli to themselves and others is sufficient to yield the SPE as followingly measured in the matching task (Sui et al., 2012). According to this interpretation, the instruction should thus be sufficient to observe an effect of self-association on an attentional task which follows it. Therefore, the matching task was applied at the end of the study as a manipulation check in order to confirm that the associations were still active at that point and had thus been active throughout the entirety of the study. If the practice trials in the matching task were in fact necessary to observe the SPE, this would imply that indeed one must be more familiarized with self-associated stimuli in order for such stimuli to impact information processing. However, the evidence currently available is insufficient to support such claims. Indeed, the studies which have observed an attentional impact of newly established self-association did present the matching task before measuring the attentional impact of new self- and other-associated stimuli (Dalmaso et al., 2019; Sui et al., 2009; Wade & Vickery, 2018; Zhao et al., 2015). Nonetheless, a study observing no attentional impact of newly established self-association also presented the matching task before measuring the attentional impact of new self- and other-associated stimuli (Siebold et al., 2015). Thus, it seems unlikely that the order of the tasks had an impact on the effect (or lack thereof) of newly self-associated stimuli. Additional studies shifting the order in which the tasks are presented (that is, presenting the matching task before the attentional task) could provide further support to the results observed in this dissertation. However, there is currently no theoretical basis to substantiate the supposition of its interference.

To summarize, the results demonstrate that familiarity is a prerequisite for self-representations to impact attention. A particularity of the studies in this dissertation is that the task used presented both self- and stranger-representations at the same time. Importantly, this a characteristic which is shared with prior research that also observed no prioritization of newly self-associated stimuli in comparison to newly stranger-associated stimuli. In contrast, studies that have observed attentional prioritization of newly self-associated stimuli when compared to stranger-associated stimuli measured attentional capture when the self- and stranger-associated stimuli were presented with no other stimuli of relevance. This suggests that newly established self-association can yield a limited impact on information that does not hold when competing with other relevant stimuli for attentional resources and is thus not as strong as the impact yielded by familiar self-association. Furthermore, it is important that future research considers the relevance of the tasks used and the specifications of the experimental setting. Choosing tools that are specific for measuring precise stages of information processing and the susceptibilities of the effect to the specifications of tasks (e.g., timings, visual setting, and task order) are important to consider in the interpretation of results in order to define the conditions of the effects of self-association.

The role of newly self-associated stimuli in paired representations

The use of paired representations – which combine familiar and new representations – in Chapters 2 and 3 provides further insight into the role that familiarity plays in the attentional impact of self-association. Self-associated paired representations were observed to yield a cuing effect. Namely, participants responded faster towards targets preceded by a self-associated shape-label pair than towards targets preceded by a stranger-associated shape-label pair when the SOA was short (100 ms). However, when the SOA was long (1000 ms), self-associated paired representations did not yield an effect of inhibition of return as would be expected of salient stimuli, and as did familiar representations. Thus, it is not immediately clear what the impact is of combining familiar and new self-associated stimuli.

The way in which the paired representation is perceived is one consideration that may play a part in the observed effects. Namely, the literature suggests two possibilities: the pairing may be perceived either as two individual representations presented simultaneously (Sui & Humphreys, 2015), or as the conjunction of two representations forming one single representation (Schäfer, Frings, et al., 2016). In regard to the former, the studies by Sui and Humphreys (2015) and Sui et al. (2015) demonstrated that the presentation of multiple self-referential stimuli had a "redundancy effect" which enhanced the SPE. That is, presenting two self-referential stimuli yielded a higher SPE than presenting only one self-referential stimulus. Following this, it could be expected that paired representations could have a higher attentional impact because they consist of two self-associated representations (namely, the label and shape). However, the size of the attentional effect of paired representations did not differ from that of familiar representations. In other words, combining a familiar self-associated label with a newly self-associated shape did not cause a change in the impact yielded by the familiar self-associated label alone. Thus, the presentation of two self-representations (one familiar and one new) did not yield redundancy gains, reflecting that the shape and label may not have been perceived as two individual representations of the self.

It could therefore be alternatively considered that the paired representation was integrated and perceived as one single stimulus, as described by Schäfer, Frings, et al (2016) when using stimuli defined by two characteristics in the matching task. Specifically, by asking participants to associate stimuli to themselves which were defined by their shape and color (rather than shape only), Schäfer and her colleagues observed that the SPE was observable only for those stimuli which complied with both characteristics. That is, partial matches (shape only or color only) were not prioritized in responding in a matching task. Their results demonstrated that stimuli are associated to the self as a whole, rather than its features being associated to the self. Thus, as a single, integrated stimulus, paired representations should not yield redundancy effects. However, in the context of the studies in this dissertation, this should also mean that partial representations – that is, the shape alone or label alone – should not yield an advantage to the self and this is not the case. Although the paired representations indeed did not yield redundancy effects, it is not the case that partial representations didn't yield an effect. Namely, familiar labels did reflect an advantage for the self vs. a stranger. Therefore, it also seems like paired representations were not perceived as a single, conjunct representation.

It rather seems as though the lack of redundancy effects – that is, the paired representation not being perceived as two individual self-representations presented simultaneously – is due to the shape not being perceived as a self-representation in the first place. After all, newly self- and stranger-associated shapes did not yield an advantage in RTs towards targets preceded by self-representations vs. stranger-representations. Therefore, it seems like the effect of attentional prioritization of self vs. stranger when represented by the pairing of a newly associated shape and a familiar label was caused solely by the familiar label. For this reason, the size of the effect of paired representations did not differ from the size of the effect of familiar representations.

Relatedly, prior research regarding the impact of the size of stimuli on the SPE may further substantiate that newly established self-representations do not play a role on the impact of paired representations. Namely, by manipulating the size of stimuli associated to the self, a friend, and a stranger in the matching task, Sui and Humphreys (2015) demonstrated that increasing the size of self-associated stimuli increases the SPE. That is, larger self-associated shapes yielded faster RTs towards self-associated shape-label pairs in the matching task. In the dot-probe task used in this dissertation, shape stimuli where of a larger size than verbal stimuli, yet they did not yield a greater impact. Although they were both of the same length, shape stimuli were of a greater height than verbal stimuli and thus occupied a larger area. Furthermore, paired representations occupied the greatest area because of their combination of both the label and shape. Thus, it would be expected that shapes would have a greater attentional impact than labels, and that paired representations would have the greatest attentional impact out of all three types of representations. It could be assumed that this is a suggestion that newly self-associated shapes are not integrated into the self-concept and therefore do not impact attention. However, it remains possible that the larger shape size did not yield an effect simply because it is an effect that is strictly limited to the SPE and does not transfer to attentional processes.

In sum, paired representations entail diverse dynamics that may make them too complex to use as a stimulus representing some degree of familiarity. However, the results observed regarding the paired representation generally provide supporting evidence that, indeed, familiarity is a precondition for the attentional impact of self-representations.

Self-representations of different modalities

In order to follow the methodology of prior research, Chapters 2 and 3 used labels as familiar representations and geometric shapes as new representations of the self and a stranger. However, this inherited the potential confound that the different types of representation consisted of stimuli of different modalities – namely, verbal and pictorial. The use of stimuli of different modalities for the different types of representations thus makes it unclear whether the difference in the effect yielded by each type of representation is due solely to their familiarity, or whether the stimulus modality also played a part. This confound was eliminated in Chapter 4 by using verbal stimuli as both familiar and new representations. The results replicated those observed in Chapters 2 and 3: a cuing effect benefitting self-representations was observed when familiar stimuli were used, but not when new stimuli were used. Hence, Chapter 4 demonstrates that the different effects observed for each type of representation (familiar and new) are not due to the types of stimuli being of a different modality – namely, verbal and pictorial.

Prior literature relating to the use of different stimuli modalities to is limited. The only studies that had previously induced self- and other-association to neutral stimuli of the same modality as familiar self- and other-associated stimuli are those using arbitrary faces (S. Payne et al., 2017). Namely, both studies by S. Payne et al., (2017) and Wózniak et al. (2018) demonstrated that arbitrary faces which have just become associated to the self can impact performance in cognitive tasks, just as one's own face also impacts performance in cognitive tasks (Bola et al., 2020; Liu et al., 2016; Tacikowski & Nowicka, 2010). However, there is not yet any direct comparison of the effects yielded by familiar and newly self- vs. other-associated faces. Additionally, the results observed in Chapter 4 are congruent with the results observed by Zhao et al. (2015) when inducing self- and other-association of colored arrows and illustrated faces that gazed to the left or right and presented them as cues for neighboring targets. In detail, the authors observed that both stimulus modalities demonstrated an advantage for self-associated stimuli to orient attention towards targets (with the type of target presenting a limitation to their effects). That is, both this dissertation and the studies by Zhao et al. (2015) demonstrate that different stimulus modalities do not change the effect of self-association.

Still, further research focusing on both the use of familiar and new stimuli of the same modality and the effects of different stimuli modalities on the impact of self-association is needed. For example, it would be interesting to compare the effects of using familiar and new shapes to represent the self and stranger. While the studies included in this dissertation controlled for the effect of different stimulus modalities by using verbal stimuli as both new and familiar representations, such comparisons would be interesting to explore with stimuli of other modalities.

Nevertheless, there is one visible effect in the data pattern in this dissertation that may be due to the difference in stimulus modality. Even though the new representations do not impact the attentional prioritization of self-associated stimuli, they do lead to generally faster RTs. That is, new representations led to faster RTs towards targets than familiar representations, and paired representations led to faster RTs than familiar and new representations alone (with no impact regarding the difference between self- and stranger-representations). This effect is in line with prior research demonstrating that different stimuli modalities are processed differently. In detail, Shor (1971) observed that pictorial stimuli are processed at a faster speed than verbal stimuli. Thus, the results observed across the studies in this dissertation suggest that different stimuli modalities may generally influence RTs, but do not impact the size of the effect of self-association. In other words, the use of stimuli of different modalities do not seem to influence the impact of self-association.

To summarize, the use of the same stimulus modality for both familiar and representations confirmed that familiarity is relevant in the attentional impact of self-association. Namely, the difference in the effects yielded by familiar and new representations does not seem to be due to previously having used verbal stimuli as familiar representations and pictorial stimuli as new representations. Although the different type of stimuli did impact overall speed, they had no influence over the effect of self-association.

Other stages of information processing in newly established self-association

Remarkably, all studies included in this dissertation replicated the SPE. Research has demonstrated that the SPE is a highly robust effect which can be observed with a wide variety of stimuli (Macrae et al., 2017; S. Payne et al., 2017; Schäfer, Wesslein, et al., 2016; Sui et al., 2012). In addition to providing further evidence sustaining the SPE, this dissertation demonstrates that neutral verbal stimuli (nonwords) can also yield an SPE. However, this result also raises questions about what the matching task measures, and the underlying mechanisms of the SPE.

Importantly, as mentioned earlier, the matching task used to measure the SPE presents a limitation in its methodology that may limit the interpretation of its results. Namely, the newly self-associated stimuli are always presented alongside familiar labels referring to the self or others. Results do typically show that RTs are enhanced when responding to matching combinations of the self-associated shape and the “self” label, but not when responding to the self-associated shape paired with a different label, or the “self” label paired with a different shape. Thus, the results reflect that the shape has somewhat acquired self-relevance, but they thwart interpretations of the effect being generated by the newly self-associated stimulus itself.

Recently, Wózniak and Knoblich (2019) ran a study controlling for this confound by having participants associate avatars consisting of faces to themselves and others as well as symbols that would represent the labels referring to the self and others. Thus, they presented a matching task which consisted solely of neutral, newly self- and other-associated stimuli and still observed a significant SPE. Thus, the robustness of the SPE seems to still hold and it reflects some sort of tagging of the new stimuli to the self. This seems to call back reports about redundancy effects – yielded by the presentation of two newly self-associated stimuli – enhancing the SPE. Namely, it seems curious that two newly self-associated stimuli (with no familiar self-representations) can induce the SPE, yet none of the studies in this dissertation observed an attentional impact of newly self-associated stimuli. As stated before, more research is clearly needed in order to define what exactly is measured by the SPE and the stage of information processing that it impacts. However, the discrepancy between results in the SPE literature and the studies in this dissertation seem to highlight that the matching task and the dot-probe task measure different cognitive processes and that the SPE is limited to impacting a particular stage of processing that is not captured by the dot-probe task.

Varying interpretations of the SPE have pinpointed the involvement of different stages in information processing in this effect. However, recent research has suggested that the SPE occurs at a conceptual level and that it implicates later stages of information processing (Schäfer et al., 2015). In particular, evidence from a process refractory period paradigm excluded that the SPE occurs at an early or late stage of information processing, thus excluding attention and narrowing down that it occurs in memory (Janczyk et al., 2019). Furthermore, Yin et al. (2019) demonstrated that the self-association of colors enhanced responses to probes in a match-to-sample working memory task, suggesting that newly established self-association consists of internal representations sustained in working memory. Such evidence may provide some insight as to why the SPE was observed, but not an attentional effect. Namely, it reflects that the dot-probe task and matching task measure distinct cognitive processes. Thus, further research using multiple tasks that measure the same cognitive process would be useful to assertively define the stages of information processing that are impacted by newly established self-association.

However, considering that familiar self-associated stimuli can impact cognition at multiple stages of information processing (Alexopoulos et al., 2012; Bower & Gilligan, 1979; Brédart, 2016), such results may already hint at general differences between familiar and newly established self-association. Namely, they suggest that self-association has a limited impact when it has recently been established, and that the increase of its impact may relate to processes that occur later on, based on the exposure to the newly self-associated element and the overall experience of the relationship with that element.

Affective and behavioral impact of self-association

Beyond impacting cognition, it has been demonstrated that self-associated stimuli can also impact affect and behavior (Greenwald & Farnham, 2000; Oeberst & Matschke, 2017; Tajfel, 1970). Generally, the self and self-associated elements are evaluated more positively and yield positive behaviors that benefit the self-associated element. For example, self-associated stimuli such as one's own name and nationality are categorized as positive with greater ease than other-associated stimuli in an IAT (Greenwald & Farnham, 2000). Similarly, the self and self-associated others are preferentially benefitted when allocating resources between the self (or self-associated) and an other (Aron et al., 1991; Tajfel, 1970; Tajfel et al., 1971). However, the research studying these dynamics has typically used stimuli that are highly familiar such as one's own name, one's own community, and possessions. One exception is the use of the minimal group paradigm in which participants are arbitrarily assigned to arbitrary groups, after which they immediately reflect attitudinal and behavioral biases favoring the group they were assigned to (Tajfel, 1970; Tajfel et al., 1971). Nevertheless, it may be argued that while the specific group is indeed new, participants are familiar with the concept of a group and its dynamics. Hence, it is not entirely an unfamiliar stimulus. Testing these effects with neutral stimuli would allow to better understand the process by which new stimuli are integrated into the self-concept and the role played by mere initial self-association.

Namely, considering that the self-concept is susceptible to the influence of multiple dimensions that range from the internal to the external, extending the research in this dissertation from the cognitive towards the affective and behavioral seems necessary to define the interplay of bottom-up and top-down dynamics that are at play in the construction of the self-concept. That is, the study of the affective and behavioral impact of newly established self-association is relevant to understand the conditions through which a simple association to the self develops into a new integrated element of the self-concept that impacts judgements and behavior.

Preliminary testing of the affective and behavioral impact of newly established self-association

In order to explore the affective and behavioral impact of newly established self-association, Orellana-Corrales, Matschke, Schäfer, et al. (2020) ran two pilot studies testing the affective and behavioral effects of newly established self-association. In detail, the first study consisted of associating geometric shapes to the self and the category "furniture" and followingly performing a Self-Esteem IAT (Greenwald & Farnham, 2000). The task presented familiar and new representations of the self and furniture. It was expected that valence measures for self-representations would be higher than for furniture-representations, and that this difference would be greater for familiar representations than for new representations.

The RT data from the Self-Esteem IAT were subjected to a 2 (association: self vs. furniture) x 2 (mapping: congruent vs. incongruent) x 2 (representation: familiar vs. new) within-participants MANOVA. A significant interaction effect of association x representation was observed, F = (1, 56) = 13.86, p < .001, η_p^2 = .198, while all other effects were non-significant. To follow up on this effect, mean RTs from target trials (those presenting self and furniture stimuli to be categorized, rather than affective stimuli) were submitted to a one-factorial (representations: familiar vs. new) within-participants MANOVA. The analysis revealed a non-significant main effect of association, F = (1, 57) = 1.14, p = .291, η_p^2 = .020, and a significant interaction effect of association x representation, F = (1, 57) = 6.35, p = .015, η_p^2 = .100. That is, RTs were generally faster when categorizing self-associated stimuli (M = 944.22 ms, SD = 329.03) than furniture-associated stimuli (M = 912.85, SD = 312.81) when familiar representations were presented. In other words, the type of representation modulated the prioritization of responses yielded by self-associated stimuli vs. furniture-associated stimuli. Thus, the data from the Self-Esteem IAT reflect that familiar self-representations benefit from a positive attitudinal bias while new self-representations do not.

In the second study, a resource allocation task was applied after associating geometric shapes to the self and a stranger. The task represented the self and a stranger as matching or non-matching pairs of a familiar label and recently associated shape (as usually presented in the matching task) and asked participants to allocate a total of 100 points between both representations. It was expected that results would elucidate the role of familiarity in yielding affective effects. Specifically, we expected that matching pairs would yield the greatest difference in point allocation benefitting the self-associated shape-label pair due to its clear signaling of self-relevance. In regard to the non-matching representations, three possible outcomes were considered which would reflect the role of familiarity in yielding behavioral effects. The first possibility is that allocation would benefit the representation including the self-associated label because the label "self" is an explicit reference to the self and, as a familiar representation, is more closely associated to the self. This would reflect that the behavioral effect is produced by the label alone and is thus dependent on familiarity. The second possibility is that allocation would be closer to equivalence between the two representations because they both include self-associated stimuli (namely, one would include the self-associated label while the other would include the self-associated shape).

A between-participant comparison of the relative benefit in resource allocation to the self vs. a stranger when the self and stranger were represented by matching (M = 1.5, SD = 2.41) and non-matching (M = 1.46, SD = 2.46) shape-label pairs indicated a non-significant difference, $t(54)$ = .06, p = .954, dz = 0.02. That is, neither matching nor non-matching representations produced a benefit in point allocation towards self-associated stimuli. In other words, there was no behavioral benefit towards the self regardless of the familiarity of representations.

Importantly, the studies were under-powered and thus the data do not allow for in-depth analysis of the results. However, they may signal that there is still more to uncover regarding the impact of newly established self-association. Thus, further research regarding the affective and behavioral impact of newly established self-association is necessary to have a cohesive understanding of how new stimuli are integrated into the self-concept and consequently impact behavior, and attention.

The studies in Chapters 2 – 4 can highlight some possible future directions for research in this area. The empirical results in the reported studies suggest that simply associating a neutral stimulus to the self has a limited impact (*at most*) in information processing – as reflected by the SPE – but is insufficient to integrate the stimulus into the self-concept. Furthermore, as previously mentioned, the consideration of these results within the body of literature suggest that the environment in which stimuli are presented may play a significant role on whether these limited effects can be observed or not. While some studies have observed an attentional impact of newly self-associated stimuli, Siebold et al. (2015) and the studies in this dissertation did not observe an effect of attentional prioritization of self- vs. other-associated stimuli. An important difference between these studies is that those which observed an attentional impact of newly self-associated stimuli in comparison to other-associated stimuli measured attention to each type of stimuli by presenting them individually. In contrast, Siebold at al. (2015) and the studies in this dissertation presented both self- and other-associated stimuli at the same time. That is, they are presented in a context in which they compete for attentional resources. Relatedly, Orellana-Corrales, Matschke, Schäfer et al. (2020) also presented self- and stranger-associated stimuli simultaneously in the resource allocation task. Furthermore, this task is inherently a context of competition of resources. Thus, future studies may test behavioral bias towards the self and an other individually, in a context in which these do not compete for resources. These results may confirm whether merely associating a stimulus to the self can indeed have a (limited) impact which is not observable in more complex environments.

Importantly, Chapters 2 and 3 establish that paired representations may implicate more complex dynamics that are not so easily interpretable in terms of familiarity/unfamiliarity. Thus, future studies may also be better off using other types of representations that more clearly establish familiarity. Extending research in this direction is important to further elucidate the impact of recent self-association and the role that familiarity plays in the integration of stimuli into the self-concept.

To summarize, there is limited research regarding the affective and behavioral impact of recently established self-association. So far, it seems as though familiarity is necessary in order for self-associated stimuli to yield affective and behavioral bias. This suggests that new self-representations presented in digital media may not immediately impact evaluations and online behavior, though they hold the potential to do so with increased use and interaction.

Familiarity generally plays a role in our attitudes and behavior which results in biases favoring the familiar. Such is the case, for example, in brand loyalty and habits, in which individuals tend to seek out the familiar and may even feel uncomfortable with the unfamiliar. Further research is thus necessary and important in order to establish the conditions in which self-association impacts affect and behavior as well as to specify the role of familiarity in this process.

Integration of new stimuli into the self-concept

According to Deaux (1996), simply associating an element to the self is the initial requirement to integrate an element into the self/concept and that, in some cases, this self-association may suffice to integrate an element into the self-concept. As mentioned earlier, this can be exemplified by the automatic identification with a group to which a person is randomly assigned and its immediate activation of related behaviors favoring the in-group. The second requirement entails a process of consciously analyzing and accepting the element, and its characteristics, as part of the self. This would entail having deeper knowledge about the group and understanding, for example, its norms and how its perceived by others, and willingly accepting one’s membership to the group. Although the first requirement may already induce short-term changes, the second requirement is necessary in order for the self-concept to be restructured as to incorporate the new element and remain stable in the long term.

The SPE can indeed be interpreted as a reflection that a simple and arbitrary stimulus has been tagged to the self. However, it is debatable whether this is equivalent to having integrated said stimulus into the self-concept. Indeed, being assigned to a group or playing a particular role in a video game can immediately yield cognitive (Enock et al., 2018; Klimmt et al., 2009, 2010), attitudinal (Oeberst & Matschke, 2017), and behavioral effects (Oeberst & Matschke, 2017; Tajfel, 1970; Tajfel et al., 1971) reflecting the integration of the group or role into the self-concept. However, no matter how "new" a group or role may be, we already have an understanding of what a group or role is and what it entails. Furthermore, we understand them as elements that have the potential to have a long-term impact. In contrast, simple stimuli such as geometric shapes lack the depth that would demand further processing and that would require a restructuring of the self-concept and yield a long-term change. Simple stimuli also lack contextual cues that would make it salient elsewhere outside of the experimental task. Ultimately, they do not refer to the elements conforming the self-concept; namely, individual traits, relational roles, or social identities (Brewer & Gardner, 1996). Thus, it seems unlikely that the self-associations induced by the manipulation used in the SPE (and related) literature are integrated into the self-concept. Of course, the purpose of using such simple stimuli is to observe self-association more purely and in absence of familiarity or other confounding factors. Hence, this may reflect the complex dynamics that conform the self-concept and, more specifically, that although associating an element to the self may be an initial step towards integrating it into the self-concept, it may not always be sufficient for it to actually be integrated into the self-concept.

Indeed, the self-concept is a complex and multidimensional structure. As Deaux (1996) further theorized, it must remain flexible in order to adapt to environmental changes. While this does entail that it is vulnerable to environmental influences, the self-concept is also guided by internal motivations. Thus, the environment ascribes roles, defines role categories, and strengthens associations through repetitive behavior patterns. However, an individual may also voluntarily choose to integrate or eliminate and element into their self-concept and decide whether or not to endorse the roles ascribed by the environment. Hence, assigning a new self-representation is not necessarily sufficient for it to be integrated into the self-concept. Particularly because there are multiple sources that can influence the self-concept, it must also remain somewhat stable (Tajfel, 1981). Thus, the self-concept will not be re-structured to integrate every element that is merely associated to it. Rather, it relies on multiple dynamics in order to process the integration of a new element into the self-concept.

When considering the experimental context of the studies in this dissertation, there are two environmental influences present influencing the potential integration of the geometric shape into the self-concept which may account for the observed results. Namely, the experimental environment ascribes the association of the shape to the self through the association instruction at the beginning of the experiment, and then provides repetitive behavior patterns in regard to the association of the shape to the self by implementing a practice phase in the matching task, as well as providing feedback in the experimental phase of the matching task when errors are made. Importantly, an impact of newly established self-association was not observed in the dot-probe task – which included only ascribing the association as an environmental influence. In contrast, an impact of newly established self-association was observed in the matching task (the SPE) – which also included repetitive behavior patterns. Thus, the environmental influences that are present in each task supporting self-association may account for the difference in observed results. In other words, it reflects that increasing the environmental sources supporting the association of an element to the self can increase the impact of self-association.

Still, the individual motivation to integrate an element into the self-concept is also necessary (Deaux, 1996). These motivations include the need for consistency and social integrity (Becker & Tausch, 2014; Tajfel, 1981), a need for social inclusion and individuation (Brewer, 1991, 1993), and a desire to integrate the resources associated to an element (Aron et al., 1991). The experimental context of the dot-probe task is too simple to tap into dynamics (although this was, indeed, the reason why it was used), and may provide an explanation as to why no attentional impact of newly established self-association was observed. Namely, participants lacked reasons to want to integrate a geometric shape into the self-concept, as it did not present any particular benefit to them even within the experimental task outside of performance in the task. This recalls the research demonstrating that reward may increase the size of the SPE (Sui & Humphreys, 2015a, 2015b), which may support the idea that providing reasons that increase an individual's motivation to integrate an element to the self-concept is important for it to actually be integrated.

Furthermore, the effects of self-association are also dependent on context (Turner & Onorato, 1999). That is, identifications are expressed in environments in which they are relevant. When considering the experimental tasks used in the studies in this dissertation, they represent a very particular environment that offers limited conditions in which the self-association of a geometric shape is relevant. In other words, the association of the geometric shape has little relevance in other contexts outside of the experimental environment. Thus, while the association of the geometric shape to the self may remain active during the matching task measuring the SPE, this association will not be triggered by other scenarios in daily life. Further considering that such experimental tasks are unlikely to be performed numerous times – if even performed more than once – the possibility of the shape being integrated into the self-concept and causing a permanent shape in this cognitive structure is eliminated.

Clearly, the data presented in this dissertation is limited to the interpretation of specific aspects of the cognitive impact of self-association and refer only to the very initial process of establishing self-association. Thus, further research is necessary in order to bridge the gap between these aspects and the way in which self-association is established and developed in our everyday use of technology. In this regard, multiple possibilities are open for future directions of research in this area. For example, the impact of newly established self-association could be tested when new representations are chosen as opposed to assigned, as is usually the case in digital environments. Furthermore, the impact of newly established self-association could be tested when new representations are designed by participants – reflecting, for example, how usernames or handles (which may, but do not necessarily have to, be one's own name) are chosen. Also, considering that positive valence and reward are closely linked to the SPE (Stolte et al., 2017; Sui & Humphreys, 2015a, 2015b; Yankouskaya et al., 2018), it may be interesting to compare whether environments designed for different types of interactions (consider your user in online banking and your user in a videogame) have an effect on the impact of self-association. Overall, many elements that are involved in the integration of stimuli into the self-concept remain to be tested and offer interesting possibilities for future research.

Practical implications

Interpreting the results presented in this dissertation within the context of the literature, important suggestions for the design of user representations in digital environments – and the digital environments in which they are presented – can be derived. Namely, the initial presentation of a particular image as a new representation of the self is surely a necessary initial step towards it being integrated into the self-concept, yet it is insufficient to actually lead to the integration of it into the self-concept and produce a long-term association that can impact users' information processing and behaviors. This does not mean, however, that it lacks the potential to be integrated into the self. Providing elements of reward, and possibilities of social inclusion and individuation increase users' internal motivation to integrate self-representations into the self-concept. Furthermore, the digital environment must can influence the process of integrating the self-representation into the self-concept by providing clear definitions of the users' roles and provide consistency through repetitive (positive) behaviors and interactions. In other words, the design of digital self-representations and digital environments must cater to the multiple needs of users.

Considering the relevant role of familiarity, becoming familiar to users is an important tool to be used. The self-concept is a complex construct and, while conditions that enable internal motivations for the integration of elements into the self-concept can be offered, self-association cannot be simply induced. Designers have significantly more control over the environmental influences over self-association and thus a focus on increasing interactions with the user and becoming familiar can be an efficient approach to facilitate self-association.

Ultimately, the appropriate design of user representations will be dependent on the end goal of the digital service or environment. An obvious, easy solution that eliminates the process of inducing self-association representing users with their real name or a photograph of themselves. However, this may not be suitable for every digital environment, such as a videogame which aims to immerse a user into a specific universe, or platforms with open discussion forums where some users may want to maintain some degree of anonymity.

Limitations and future directions

Taking into account the multiple dynamics that come into play in the process of self-association, it is clear that its study requires the scientific efforts of many researchers from different fields. While this dissertation may represent a contribution to the body of research on self-association, its results are limited to a specific area of it. However, the limitations of this work can provide some orientation for future research in this topic.

While the use of the dot-probe task across studies in this dissertation facilitates the seamless integration and interpretation of its results, it does mean that the empirical results are bound to the constrictions of this specific task and the particular way in which it is used in these studies. As previously discussed, the research shows that even small adaptations of the same task seem to influence the observed effects of newly established self-association. Thus, it is important for future research to use tasks that can specifically measure a defined stage of information processing and, furthermore, that different tasks targeting the same stage of information processing are used. Diversifying the tasks that are used can enable the derivation of generalized conclusions.

This empirical focus of this dissertation builds on prior literature and focuses on the cognitive impact of newly established self-association, specifically on attention. However, a large body of research shows that self-association impacts cognition at different stages of information processing. Furthermore, the effects of self-association are not only cognitive – they extend to affect and behavior. Further research on other stages of cognitive information processing as well as the affective and behavioral dimensions are important in order to develop and integrative understanding of the conditions that foster self-association.

Conclusion

Self-association is a complex process involving multiple dynamics between the environment and the individual and cannot easily be induced. Thus, the numerous and varied self-representations that we regularly encounter in digital environments may be sustained in working memory while they are used (i.e., they remain active during the time in which an application is being used) but are not necessarily integrated into the self-concept. Rather, their potential to be integrated into the self-concept in the long-term and consequently impact information processing, attitudes, and behavior, will depend on their relevance, as well as the dynamics and experiences that follow the initial tagging to the self. Nevertheless, familiarity seems to play an important role in the potential for self-representations to impact information processing. Thus, due to the long history of exposure to our own name and face, familiar representations such as one's own name as a username and profile photos may generally remain the most efficient self-representations par excellence. Still, elements that foster self-association can be used and included in the design of digital representations of the self and digital environment in order to guide users in their manipulation of the environment and enhance their overall satisfaction with their experience in the digital environment.

References

Alexopoulos, T., Muller, D., Ric, F., & Marendaz, C. (2012). I, me, mine: Automatic attentional capture by self-related stimuli. *European Journal of Social Psychology*, *42*(6), 770–779. https://doi.org/10.1002/ejsp.1882

Amiot, C. E., de la Sablonnière, R., Terry, D. J., & Smith, J. R. (2007). Integration of social identities in the self: Toward a cognitive-developmental model. *Personality and Social Psychology Review*, *11*(4), 364–388. https://doi.org/10.1177/1088868307304091

Arnell, K. M., Shapiro, K. L., & Sorensen, R. E. (1999). Reduced repetition blindness for one's own name. *Visual Cognition*, *6*(6), 609–635. https://doi.org/10.1080/135062899394876

Aron, A., Aron, E. N., Tudor, M., & Nelson, G. (1991). Close relationships as including others in the self. *Journal of Personality and Social Psychology*, *60*(2), 241–253. https://doi.org/10.1037/0022-3514.60.2.241

Aron, A., McLaughlin-Volpe, T., Mashek, D., Lewandowski, G., Wright, S. C., & Aron, E. N. (2004). Including others in the self. *European Review of Social Psychology*, *15*(1), 101–132. https://doi.org/10.1080/10463280440000008

Bargh, J. A. (1982). Attention and automaticity in the processing of self-relevant information. *Journal of Personality and Social Psychology*, *43*(3), 425–436. https://doi.org/10.1037/0022-3514.43.3.425

Barresi, J., & Martin, R. (2011). History as prologue: Western theories of the self. In S. Gallagher (Ed.), *The Oxford Handbook of the Self*. Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199548019.003.0002

Becker, J. C., & Tausch, N. (2014). When group memberships are negative: The concept, measurement, and behavioral implications of psychological disidentification. *Self and Identity*, *13*(3), 294–321. https://doi.org/10.1080/15298868.2013.819991

Beggan, J. K. (1992). On the social nature of nonsocial perception: The mere ownership effect. *Journal of Personality and Social Psychology*, *62*(2), 229–237. https://doi.org/10.1037/0022-3514.62.2.229

Blass, E. M., Fillion, T. J., Rochat, P., Hoffmeyer, L. B., & et al. (1989). Sensorimotor and motivational determinants of hand^mouth coordination in 1-3-day-old human infants. *Developmental Psychology*, *25*(6), 963–975. https://doi.org/10.1037/0012-1649.25.6.963

Blume, C., del Giudice, R., Lechinger, J., Wislowska, M., Heib, D. P. J., Hoedlmoser, K., & Schabus, M. (2017). Preferential processing of emotionally and self-relevant stimuli persists in unconscious N2 sleep. *Brain and Language*, *167*, 72–82. https://doi.org/10.1016/j.bandl.2016.02.004

Bola, M., Paź, M., Doradzińska, Ł., & Nowicka, A. (2020). *The self-face automatically captures attention without consciousness* [Preprint]. Neuroscience. https://doi.org/10.1101/2020.01.22.915595

Bortolon, C., & Raffard, S. (2018). Self-face advantage over familiar and unfamiliar faces: A three-level meta-analytic approach. *Psychonomic Bulletin & Review*, *25*(4), 1287–1300. https://doi.org/10.3758/s13423-018-1487-9

Boucher, H. C., Kaiping Peng, Junqi Shi, & Lei Wang. (2009). Culture and implicit self-esteem: Chinese are “good” and “bad” at the same time. *Journal of Cross-Cultural Psychology*, *40*(1), 24–45. https://doi.org/10.1177/0022022108326195

Bower, G. H., & Gilligan, S. G. (1979). Remembering information related to one’s self. *Journal of Research in Personality*, *13*(4), 420–432. https://doi.org/10.1016/0092-6566(79)90005-9

Breakwell, G. M. (2015). *Coping with threatened identities*. Routledge.

Brédart, S. (2016). A self-reference effect on memory for people: We are particularly good at retrieving people named like us. *Frontiers in Psychology*, *7*. https://doi.org/10.3389/fpsyg.2016.01751

Brédart, S., Delchambre, M., & Laureys, S. (2006). One’s own face is hard to ignore. *Quarterly Journal of Experimental Psychology*, *59*(1), 46–52. https://doi.org/10.1080/17470210500343678

Brewer, M. B. (1979). In-group bias in the minimal intergroup situation: A cognitive-motivational analysis. *Psychological Bulletin*, *86*(2), 307–324. https://doi.org/10.1037/0033-2909.86.2.307

Brewer, M. B. (1991). The social self: On being the same and different at the same time. *Personality and Social Psychology Bulletin*, *17*(5), 475–482. https://doi.org/10.1177/0146167291175001

Brewer, M. B. (1993). Social identity, distinctiveness, and in-group homogeneity. *Social Cognition*, *11*(1), 150–164. https://doi.org/10.1521/soco.1993.11.1.150

Brewer, M. B., & Gardner, W. (1996). Who is this "We"? Levels of collective identity and self representations. *Journal of Personality and Social Psychology*, *71*(1), 83–93. https://doi.org/10.1037/0022-3514.71.1.83

Burkley, E., Curtis, J., Burkley, M., & Hatvany, T. (2015). Goal fusion: The integration of goals within the self-concept. *Self and Identity*, *14*(3), 348–368. https://doi.org/10.1080/15298868.2014.1000959

Butterworth, G. (1992). Origins of self-perception in infancy. *Psychological Inquiry*, *3*(2), 103–111. https://doi.org/10.1207/s15327965pli0302_1

Carlston, D. E., & Smith, E. R. (1996). Principles of mental representation. In E. E. Higgins & A. Kruglanski (Eds.), *Social psychology: Handbook of basic principles* (pp. 184–210).

Chen, Y. P., Ehlers, A., Clark, D. M., & Mansell, W. (2002). Patients with generalized social phobia direct their attention away from faces. *Behaviour Research and Therapy*, *40*(6), 677–687. https://doi.org/10.1016/S0005-7967(01)00086-9

Chen, Y.-A., & Huang, T.-R. (2017). Multistability of the brain network for self-other processing. *Scientific Reports*, *7*(1). https://doi.org/10.1038/srep43313

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

Christoff, K., Cosmelli, D., Legrand, D., & Thompson, E. (2011). Specifying the self for cognitive neuroscience. *Trends in Cognitive Sciences*, *15*(3), 104–112. https://doi.org/10.1016/j.tics.2011.01.001

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed). L. Erlbaum Associates.

Constable, M. D., Welsh, T. N., Huffman, G., & Pratt, J. (2018). I before U: Temporal order judgements reveal bias for self-owned objects. *Quarterly Journal of Experimental Psychology*, 174702181876201. https://doi.org/10.1177/1747021818762010

Cooper, W. E., & Ross, J. R. (1975). World order. *Papers from the Parasession on Functionalism*, 63–111.

Cunningham, S. J., & Turk, D. J. (2017). Editorial: A review of self-processing biases in cognition. *Quarterly Journal of Experimental Psychology*, *70*(6), 987–995. https://doi.org/10.1080/17470218.2016.1276609

Dalmaso, M., Castelli, L., & Galfano, G. (2019). Self-related shapes can hold the eyes. *Quarterly Journal of Experimental Psychology*, 174702181983966. https://doi.org/10.1177/1747021819839668

Deaux, K. (1996). Social identification. In E. T. Higgins & Kruglanski, A. W. (Eds.), *Social psychology: Handbook of basic principles* (pp. 777–798). Guilford Press.

Ehrman, R. N., Robbins, S. J., Bromwell, M. A., Lankford, M. E., Monterosso, J. R., & O'Brien, C. P. (2002). Comparing attentional bias to smoking cues in current smokers, former smokers, and non-smokers using a dot-probe task. *Drug and Alcohol Dependence*, *67*(2), 185–191. https://doi.org/10.1016/S0376-8716(02)00065-0

Enock, F., Sui, J., Hewstone, M., & Humphreys, G. W. (2018). Self and team prioritisation effects in perceptual matching: Evidence for a shared representation. *Acta Psychologica*, *182*, 107–118. https://doi.org/10.1016/j.actpsy.2017.11.011

Falbén, J. K., Golubickis, M., Balseryte, R., Persson, L. M., Tsamadi, D., Caughey, S., & Neil Macrae, C. (2019). How prioritized is self-prioritization during stimulus processing? *Visual Cognition*, 1–6. https://doi.org/10.1080/13506285.2019.1583708

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*(2), 175–191. https://doi.org/10.3758/BF03193146

Franconeri, S. L., Alvarez, G. A., & Cavanagh, P. (2013). Flexible cognitive resources: Competitive content maps for attention and memory. *Trends in Cognitive Sciences*, *17*(3), 134–141. https://doi.org/10.1016/j.tics.2013.01.010

Frischen, A., Bayliss, A. P., & Tipper, S. P. (2007). Gaze cueing of attention: Visual attention, social cognition, and individual differences. *Psychological Bulletin*, *133*(4), 694–724. https://doi.org/10.1037/0033-2909.133.4.694

Gallagher, S. (2013). A pattern theory of self. *Frontiers in Human Neuroscience*, *7*. https://doi.org/10.3389/fnhum.2013.00443

Gebauer, J. E., Riketta, M., Broemer, P., & Maio, G. R. (2008). "How much do you like your name?" An implicit measure of global self-esteem. *Journal of Experimental Social Psychology*, *44*(5), 1346–1354. https://doi.org/10.1016/j.jesp.2008.03.016

Greenwald, A. G., & Banaji, M. R. (1995). Implicit social cognition: Attitudes, self-esteem, and stereotypes. *Psychological Review*, *102*(1), 4–27. https://doi.org/10.1037/0033-295X.102.1.4

Greenwald, A. G., & Farnham, S. D. (2000). Using the Implicit Association Test to measure self-esteem and self-concept. *Journal of Personality and Social Psychology*, *79*(6), 1022–1038. https://doi.org/10.1037/0022-3514.79.6.1022

Hafter, E. R., Sarampalis, A., & Loui, P. (2007). Auditory attention and filters. In W. A. Yost, A. N. Popper, & R. R. Fay (Eds.), *Auditory Perception of Sound Sources* (Vol. 29, pp. 115–142). Springer US. https://doi.org/10.1007/978-0-387-71305-2_5

Hatvany, T., Burkley, E., & Curtis, J. (2018). Becoming part of me: Examining when objects, thoughts, goals, and people become fused with the self-concept. *Social and Personality Psychology Compass*, *12*(1), e12369. https://doi.org/10.1111/spc3.12369

Hautus, M. J. (1995). Corrections for extreme proportions and their biasing effects on estimated values ofd'. *Behavior Research Methods, Instruments, & Computers*, *27*(1), 46–51. https://doi.org/10.3758/BF03203619

Hawkins, H. L., Hillyard, S. A., Luck, S. J., Mouloua, M., Downing, C. J., & Woodward, D. P. (1990). Visual attention modulates signal detectability. *Journal of Experimental Psychology:*

Human Perception and Performance, *16*(4), 802–811. https://doi.org/10.1037/0096-1523.16.4.802

Höller, Y., Kronbichler, M., Bergmann, J., Crone, J. S., Ladurner, G., & Golaszewski, S. (2011). EEG frequency analysis of responses to the own-name stimulus. *Clinical Neurophysiology*, *122*(1), 99–106. https://doi.org/10.1016/j.clinph.2010.05.029

Humphreys, G. W., & Sui, J. (2015). Attentional control and the self: The self-attention network (SAN). *Cognitive Neuroscience*, *7*(1–4), 5–17. https://doi.org/10.1080/17588928.2015.1044427

Imhoff, R., Lange, J., & Germar, M. (2019). Identification and location tasks rely on different mental processes: A diffusion model account of validity effects in spatial cueing paradigms with emotional stimuli. *Cognition and Emotion*, *33*(2), 231–244. https://doi.org/10.1080/02699931.2018.1443433

James, W. (1890). *The principles of psychology* (Vol. 1). Cosimo Classics.

Janczyk, M., Humphreys, G. W., & Sui, J. (2019). The central locus of self-prioritisation. *Quarterly Journal of Experimental Psychology*, *72*(5), 1068–1083. https://doi.org/10.1177/1747021818778970

Jenkins, J. R., Neale, D. C., & Deno, S. L. (1967). Differential memory for picture and word stimuli. *Journal of Educational Psychology*, *58*(5), 303–307. https://doi.org/10.1037/h0025025

Kim, K., Jeon, Y. A., Banquer, A. M., & Rothschild, D. J. (2018). Conscious awareness of self-relevant information is necessary for an incidental self-memory advantage. *Consciousness and Cognition*, *65*, 228–239. https://doi.org/10.1016/j.concog.2018.09.004

Kitayama, S., & Karasawa, M. (1997). Implicit self-esteem in Japan: Name letters and birthday numbers. *Personality and Social Psychology Bulletin*, *23*(7), 736–742. https://doi.org/10.1177/0146167297237006

Kleiss, J. A., & Lane, D. M. (1986). Locus and persistence of capacity limitations in visual information processing. *Journal of Experimental Psychology: Human Perception and Performance*, *12*(2), 200–210. https://doi.org/10.1037/0096-1523.12.2.200

Klimmt, C., Hefner, D., & Vorderer, P. (2009). The video game experience as “true” identification: A theory of enjoyable alterations of players’ self-perception. *Communication Theory*, *19*(4), 351–373. https://doi.org/10.1111/j.1468-2885.2009.01347.x

Klimmt, C., Hefner, D., Vorderer, P., Roth, C., & Blake, C. (2010). Identification with video game characters as automatic shift of self-perceptions. *Media Psychology*, *13*(4), 323–338. https://doi.org/10.1080/15213269.2010.524911

Knapp, J. R., Smith, B. R., & Sprinkle, T. A. (2014). Clarifying the relational ties of organizational belonging: Understanding the roles of perceived insider status, psychological ownership, and organizational identification. *Journal of Leadership & Organizational Studies*, *21*(3), 273–285. https://doi.org/10.1177/1548051814529826

Koole, S. L., Dijksterhuis, A., & van Knippenberg, A. (2001). What's in a name: Implicit self-esteem and the automatic self. *Journal of Personality and Social Psychology*, *80*(4), 669–685. https://doi.org/10.1037/0022-3514.80.4.669

Landkammer, F., Winter, K., Thiel, A., & Sassenberg, K. (2019). Team sports off the field: Competing excludes cooperating for individual but not for team athletes. *Frontiers in Psychology*, *10*. https://doi.org/10.3389/fpsyg.2019.02470

Le Pelley, M. E., Vadillo, M., & Luque, D. (2013). Learned predictiveness influences rapid attentional capture: Evidence from the dot probe task. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *39*(6), 1888–1900. https://doi.org/10.1037/a0033700

Liu, M., He, X., Rotsthein, P., & Sui, J. (2016). Dynamically orienting your own face facilitates the automatic attraction of attention. *Cognitive Neuroscience*, *7*(1–4), 37–44. https://doi.org/10.1080/17588928.2015.1044428

Lockhead, G. R. (1966). Effects of dimensional redundancy on visual discrimination. *Journal of Experimental Psychology*, *72*(1), 95–104. https://doi.org/10.1037/h0023319

Lougheed, T. (2014). *Self-Consciousness and the Self-As-Subject* [Doctoral dissertation, Carleton University]. https://doi.org/10.22215/etd/2014-10476

Lupiáñez, J., Klein, R. M., & Bartolomeo, P. (2006). Inhibition of return: Twenty years after. *Cognitive Neuropsychology*, *23*(7), 1003–1014. https://doi.org/10.1080/02643290600588095

MacLeod, C., Mathews, A., & Tata, P. (1986). Attentional bias in emotional disorders. *Journal of Abnormal Psychology*, *95*(1), 15–20. https://doi.org/10.1037/0021-843X.95.1.15

MacMahon, K. M. A., Broomfield, N. M., & Espie, C. A. (2006). Attention bias for sleep-related stimuli in primary insomnia and delayed sleep phase syndrome using the dot-probe task. *Sleep*, *29*(11), 1420–1427. https://doi.org/10.1093/sleep/29.11.1420

Macrae, C. N., Visokomogilski, A., Golubickis, M., Cunningham, W. A., & Sahraie, A. (2017). Self-relevance prioritizes access to visual awareness. *Journal of Experimental Psychology: Human Perception and Performance*, *43*(3), 438–443. https://doi.org/10.1037/xhp0000361

Markus, H. (1977). Self-schemata and processing information about the self. *Journal of Personality and Social Psychology*, *35*(2), 63–78. https://doi.org/10.1037/0022-3514.35.2.63

Moray, N. (1959). Attention in dichotic listening: Affective cues and the influence of instructions. *Quarterly Journal of Experimental Psychology*, *11*(1), 56–60. https://doi.org/10.1080/17470215908416289

Muñoz, F., Casado, P., Hernández-Gutiérrez, D., Jiménez-Ortega, L., Fondevila, S., Espuny, J., Sánchez-García, J., & Martín-Loeches, M. (2020). Neural dynamics in the processing of personal objects as an Index of the brain representation of the self. *Brain Topography*, *33*(1), 86–100. https://doi.org/10.1007/s10548-019-00748-2

Murray, R. J., Debbané, M., Fox, P. T., Bzdok, D., & Eickhoff, S. B. (2015). Functional connectivity mapping of regions associated with self- and other-processing: Self & Other

Functional Connectivity Mapping. *Human Brain Mapping*, *36*(4), 1304–1324. https://doi.org/10.1002/hbm.22703

Murray, R. J., Schaer, M., & Debbané, M. (2012). Degrees of separation: A quantitative neuroimaging meta-analysis investigating self-specificity and shared neural activation between self- and other-reflection. *Neuroscience & Biobehavioral Reviews*, *36*(3), 1043–1059. https://doi.org/10.1016/j.neubiorev.2011.12.013

Nuttin, J. M. (1985). Narcissism beyond Gestalt and awareness: The name letter effect. *European Journal of Social Psychology*, *15*(3), 353–361. https://doi.org/10.1002/ejsp.2420150309

O'Brien, R. G., & Kaiser, M. K. (1985). MANOVA method for analyzing repeated measures designs: An extensive primer. *Psychological Bulletin*, *97*(2), 316–333. https://doi.org/10.1037/0033-2909.97.2.316

Oeberst, A., & Matschke, C. (2017). Word order and world order: Titles of intergroup conflicts may increase ethnocentrism by mentioning the in-group first. *Journal of Experimental Psychology: General*, *146*(5), 672–690. https://doi.org/10.1037/xge0000300

Orellana-Corrales, G., Matschke, C., Schäfer, S., & Wesslein, A.-K. (2020). *Once it's part of me, it's also positive: Affective prioritization of newly self-associated stimuli* [Manuscript in preparation for submission].

Orellana-Corrales, G., Matschke, C., & Wesslein, A.-K. (2020a). *Does self-associating a geometric shape immediately cause attentional prioritization? Comparing familiar vs.*

Recently self-associated stimuli in the dot-probe task [Manuscript under review for publication].

Orellana-Corrales, G., Matschke, C., & Wesslein, A.-K. (2020b). *(When) Do self-associated stimuli lead to attention holding? A comparison of highly familiar vs. Recently established self-representations* [Manuscript in preparation for submission].

Pannese, A., & Hirsch, J. (2011). Self-face enhances processing of immediately preceding invisible faces. *Neuropsychologia*, *49*(3), 564–573. https://doi.org/10.1016/j.neuropsychologia.2010.12.019

Payne, B., Lavan, N., Knight, S., & McGettigan, C. (2019). *Perceptual prioritisation of self-associated voices* [Preprint]. PsyArXiv. https://doi.org/10.31234/osf.io/xdw6t

Payne, S., Tsakiris, M., & Maister, L. (2017). Can the self become another? Investigating the effects of self-association with a new facial identity. *Quarterly Journal of Experimental Psychology*, *70*(6), 1085–1097. https://doi.org/10.1080/17470218.2015.1137329

Posner, M. I. (1980). Orienting of attention. *Quarterly Journal of Experimental Psychology*, *32*(1), 3–25. https://doi.org/10.1080/00335558008248231

Posner, M. I., & Cohen, Y. (1984). Components of visual orienting. *Attention and Performance*, *X*, 531–556.

Posner, M. I., Rafal, R. D., Choate, L. S., & Vaughan, J. (1985). Inhibition of return: Neural basis and function. *Cognitive Neuropsychology*, *2*(3), 211–228. https://doi.org/10.1080/02643298508252866

Rathbone, C. J., & Moulin, C. J. A. (2010). When's your birthday? The self-reference effect in retrieval of dates. *Applied Cognitive Psychology*, *24*(5), 737–743. https://doi.org/10.1002/acp.1657

Reuther, J., & Chakravarthi, R. (2017). Does self-prioritization affect perceptual processes? *Visual Cognition*, *25*(1–3), 381–398. https://doi.org/10.1080/13506285.2017.1323813

Rochat, P. (2011). What is it like to be a newborn? In *The Oxford Handbook of the Self*. Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199548019.003.0003

Rochat, P. (2019). Self-unity as ground zero of learning and development. *Frontiers in Psychology*, *10*. https://doi.org/10.3389/fpsyg.2019.00414

Schäfer, S., Frings, C., & Wentura, D. (2016). About the composition of self-relevance: Conjunctions not features are bound to the self. *Psychonomic Bulletin & Review*, *23*(3), 887–892. https://doi.org/10.3758/s13423-015-0953-x

Schäfer, S., Wentura, D., & Frings, C. (2015). Self-prioritization beyond perception. *Experimental Psychology*, *62*(6), 415–425. https://doi.org/10.1027/1618-3169/a000307

Schäfer, S., Wesslein, A.-K., Spence, C., Wentura, D., & Frings, C. (2016). Self-prioritization in vision, audition, and touch. *Experimental Brain Research*, *234*(8), 2141–2150. https://doi.org/10.1007/s00221-016-4616-6

Schneider, W., Eschman, A., & Zuccolotto, A. (2002). *E-Prime: User's guide* (2.0) [Computer software]. Psychology Software Incorporated.

Shaw, M. L., & Shaw, P. (1977). Optimal allocation of cognitive resources to spatial locations. *Journal of Experimental Psychology: Human Perception and Performance*, *3*(2), 201–211. https://doi.org/10.1037/0096-1523.3.2.201

Shor, R. E. (1971). Symbol processing speed differences and symbol interference effects in a variety of concept domains. *The Journal of General Psychology*, *85*(2), 187–205. https://doi.org/10.1080/00221309.1971.9920672

Siebold, A., Weaver, M. D., Donk, M., & van Zoest, W. (2015). Social salience does not transfer to oculomotor visual search. *Visual Cognition*, *23*(8), 989–1019. https://doi.org/10.1080/13506285.2015.1121946

Smith, E. R. (1996). What do connectionism and social psychology offer each other? *Journal of Personality and Social Psychology*, *70*(5), 893–912. https://doi.org/10.1037//0022-3514.70.5.893

Smith, E. R., Coats, S., & Walling, D. (1999). Overlapping mental representations of self, in-group, and partner: Further response time evidence and a connectionist model. *Personality and Social Psychology Bulletin*, *25*(7), 873–882. https://doi.org/10.1177/0146167299025007009

Smith, E. R., & Henry, S. (1996). An in-group cecomes part of the self: Response time evidence. *Personality and Social Psychology Bulletin*, *22*(6), 635–642. https://doi.org/10.1177/0146167296226008

Sperber, R. D., McCauley, C., Ragain, R. D., & Weil, C. M. (1979). Semantic priming effects on picture and word processing. *Memory & Cognition*, *7*(5), 339–345. https://doi.org/10.3758/BF03196937

Stanislaw, H., & Todorov, N. (1999). Calculation of signal detection theory measures. *Behavior Research Methods, Instruments, & Computers*, *31*(1), 137–149. https://doi.org/10.3758/BF03207704

Stein, T., Siebold, A., & van Zoest, W. (2016). Testing the idea of privileged awareness of self-relevant information. *Journal of Experimental Psychology: Human Perception and Performance*, *42*(3), 303–307. https://doi.org/10.1037/xhp0000197

Stolte, M., Humphreys, G., Yankouskaya, A., & Sui, J. (2017). Dissociating biases towards the self and positive emotion. *Quarterly Journal of Experimental Psychology*, *70*(6), 1011–1022. https://doi.org/10.1080/17470218.2015.1101477

Strawson, G. (1999). The self and the SESMET. *Journal of Consciousness Studies*, *6*(4), 99–135.

Sui, J., & Gu, X. (2017). Self as object: Emerging trends in self research. *Trends in Neurosciences*, *40*(11), 643–653. https://doi.org/10.1016/j.tins.2017.09.002

Sui, J., He, X., & Humphreys, G. W. (2012). Perceptual effects of social salience: Evidence from self-prioritization effects on perceptual matching. *Journal of Experimental Psychology: Human Perception and Performance*, *38*(5), 1105–1117. https://doi.org/10.1037/a0029792

Sui, J., & Humphreys, G. W. (2015a). Super-size me: Self biases increase to larger stimuli. *Psychonomic Bulletin & Review*, *22*(2), 550–558. https://doi.org/10.3758/s13423-014-0690-6

Sui, J., & Humphreys, G. W. (2015b). More of me! Distinguishing self and reward bias using redundancy gains. *Attention, Perception, & Psychophysics*, *77*(8), 2549–2561. https://doi.org/10.3758/s13414-015-0970-x

Sui, J., & Humphreys, G. W. (2015c). The integrative self: How self-reference integrates perception and memory. *Trends in Cognitive Sciences*, *19*(12), 719–728. https://doi.org/10.1016/j.tics.2015.08.015

Sui, J., Liu, C. H., Wang, L., & Han, S. (2009). Attentional orientation induced by temporarily established self-referential cues. *Quarterly Journal of Experimental Psychology*, *62*(5), 844–849. https://doi.org/10.1080/17470210802559393

Sui, J., & Rotshtein, P. (2019). Self-prioritization and the attentional systems. *Current Opinion in Psychology*, *29*, 148–152. https://doi.org/10.1016/j.copsyc.2019.02.010

Sui, J., Rotshtein, P., & Humphreys, G. W. (2013). Coupling social attention to the self forms a network for personal significance. *Proceedings of the National Academy of Sciences*, *110*(19), 7607–7612. https://doi.org/10.1073/pnas.1221862110

Tacikowski, P., Brechmann, A., Marchewka, A., Jednoróg, K., Dobrowolny, M., & Nowicka, A. (2011). Is it about the self or the significance? An fMRI study of self-name recognition. *Social Neuroscience*, *6*(1), 98–107. https://doi.org/10.1080/17470919.2010.490665

Tacikowski, P., & Ehrsson, H. H. (2016). Preferential processing of self-relevant stimuli occurs mainly at the perceptual and conscious stages of information processing. *Consciousness and Cognition*, *41*, 139–149. https://doi.org/10.1016/j.concog.2016.02.013

Tacikowski, P., & Nowicka, A. (2010). Allocation of attention to self-name and self-face: An ERP study. *Biological Psychology*, *84*(2), 318–324. https://doi.org/10.1016/j.biopsycho.2010.03.009

Tajfel, H. (1970). Experiments in intergroup discrimination. *Scientific American*, *223*(5), 96–102. https://doi.org/10.1038/scientificamerican1170-96

Tajfel, H. (1981). *Human groups and social categories: Studies in social psychology*. Cambridge University Press.

Tajfel, H., Billig, M. G., Bundy, R. P., & Flament, C. (1971). Social categorization and intergroup behaviour. *European Journal of Social Psychology*, *1*(2), 149–178. https://doi.org/10.1002/ejsp.2420010202

Theeuwes, J., & Van der Stigchel, S. (2006). Faces capture attention: Evidence from inhibition of return. *Visual Cognition*, *13*(6), 657–665. https://doi.org/10.1080/13506280500410949

Tong, F., & Nakayama, K. (1999). Robust representations for faces: Evidence from visual search. *Journal of Experimental Psychology: Human Perception and Performance*, *25*(4), 1016–1035. https://doi.org/10.1037/0096-1523.25.4.1016

Tropp, L. R., & Wright, S. C. (2001). Ingroup identification as the inclusion of ingroup in the self. *Personality and Social Psychology Bulletin*, *27*(5), 585–600. https://doi.org/10.1177/0146167201275007

Truong, G., Roberts, K. H., & Todd, R. M. (2017). I saw mine first: A prior-entry effect for newly acquired ownership. *Journal of Experimental Psychology: Human Perception and Performance*, *43*(1), 192–205. https://doi.org/10.1037/xhp0000295

Tukey, J. W. (1977). *Exploratory data analysis*. Addison-Wesley.

Turner, J. C., & Onorato, R. S. (1999). Social identity, personality, and the self-concept: A self-categorization perspective. In T. R. Tyler, R. M. Kramer, & O. P. John (Eds.), *The psychology of the social self* (pp. 11–46). Psychology Press.

Van Dyne, L., & Pierce, J. L. (2004). Psychological ownership and feelings of possession: Three field studies predicting employee attitudes and organizational citizenship behavior. *Journal of Organizational Behavior*, *25*(4), 439–459. https://doi.org/10.1002/job.249

Verghese, P. (2001). Visual search and attention. *Neuron*, *31*(4), 523–535. https://doi.org/10.1016/S0896-6273(01)00392-0

Vogeley, K., & Gallagher, S. (2011). Self in the brain. In S. Gallagher (Ed.), *The Oxford Handbook of the Self* (pp. 111–136). Oxford University Press. https://doi.org/10.1093/oxfordhb/9780199548019.003.0005

Wade, G. L., & Vickery, T. J. (2018). Target self-relevance speeds visual search responses but does not improve search efficiency. *Visual Cognition*, *26*(8), 563–582. https://doi.org/10.1080/13506285.2018.1520377

Wark, B., Lundstrom, B. N., & Fairhall, A. (2007). Sensory adaptation. *Current Opinion in Neurobiology*, *17*(4), 423–429. https://doi.org/10.1016/j.conb.2007.07.001

Watson, D. G., & Humphreys, G. W. (2000). Visual marking: Evidence for inhibition using a probe-dot detection paradigm. *Perception & Psychophysics*, *62*(3), 471–481. https://doi.org/10.3758/BF03212099

Watson, J. S. (1995). Self-orientation in early infancy: The general role of contingency and the specific case of reaching to the mouth. In P. Rochat (Ed.), *The self in infancy: Theory and research* (Vol. 112, pp. 375–393). Elsevier. https://doi.org/10.1016/S0166-4115(05)80020-2

Werthmann, J., Roefs, A., Nederkoorn, C., Mogg, K., Bradley, B. P., & Jansen, A. (2011). Can(not) take my eyes off it: Attention bias for food in overweight participants. *Health Psychology*, *30*(5), 561–569. https://doi.org/10.1037/a0024291

Wójcik, M. J., Nowicka, M. M., Kotlewska, I., & Nowicka, A. (2018). Self-face captures, holds, and biases attention. *Frontiers in Psychology*, *8*. https://doi.org/10.3389/fpsyg.2017.02371

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), 255–260. https://doi.org/10.1037/0278-7393.21.1.255

Woźniak, M. (2018). "I" and "Me": The self in the context of consciousness. *Frontiers in Psychology*, *9*. https://doi.org/10.3389/fpsyg.2018.01656

Woźniak, M., & Knoblich, G. (2019). Self-prioritization of fully unfamiliar stimuli. *Quarterly Journal of Experimental Psychology*, *72*(8), 2110–2120. https://doi.org/10.1177/1747021819832981

Woźniak, M., Kourtis, D., & Knoblich, G. (2018). Prioritization of arbitrary faces associated to self: An EEG study. *PLOS ONE*, *13*(1), e0190679. https://doi.org/10.1371/journal.pone.0190679

Yamada, Y., Kawabe, T., & Miura, K. (2012). One's own name distorts visual space. *Neuroscience Letters*, *531*(2), 96–98. https://doi.org/10.1016/j.neulet.2012.10.028

Yang, H., Wang, F., Gu, N., Gao, X., & Zhao, G. (2013). The cognitive advantage for one's own name is not simply familiarity: An eye-tracking study. *Psychonomic Bulletin & Review*, *20*(6), 1176–1180. https://doi.org/10.3758/s13423-013-0426-z

Yankouskaya, A., Bührle, R., Lugt, E., Stolte, M., & Sui, J. (2018). Intertwining personal and reward relevance: Evidence from the drift-diffusion model. *Psychological Research*. https://doi.org/10.1007/s00426-018-0979-6

Yin, S., Sui, J., Chiu, Y.-C., Chen, A., & Egner, T. (2019). Automatic prioritization of self-referential stimuli in working memory. *Psychological Science*, *30*(3), 415–423. https://doi.org/10.1177/0956797618818483

Zhao, S., Uono, S., Yoshimura, S., & Toichi, M. (2015). Self make-up: The influence of self-referential processing on attention orienting. *Scientific Reports*, *5*(1), 14169. https://doi.org/10.1038/srep14169

Zickfeld, J. H., & Schubert, T. W. (2016). Revisiting and extending a response latency measure of inclusion of the other in the self. *Comprehensive Results in Social Psychology*, *1*(1–3), 106–129. https://doi.org/10.1080/23743603.2017.1298356

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