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Understanding self-prioritisation: the prioritisation of self-relevant stimuli and its relation to the individual self-esteem

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ABSTRACT

There is an ongoing debate about the way self-relevant stimuli guide us through everyday perception. A new measurement of self-relevance effects, the self-prioritisation effect (SPE), allows for an assessment of self-effects independent of material confounds as the effect of newly acquired self-relevance is tested. While revealing further insights in the way self-relevance influences cognition, the underlying processes of the SPE are not completely understood yet. In that regard, we conducted the following study to test whether the SPE is explained by a person's self-esteem or, in other words, by the amount someone considers her- or himself worthy or unworthy. In a sample of $N = 103$ healthy participants, no significant correlation of the SPE and the explicit self-esteem was found. A potential independence of the SPE of a rather complex aspect of the self, the self-esteem, is discussed in order to further understand the underlying processes of the SPE.

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Self; cognitive processing; self-prioritisation; self-esteem; independent components

Introduction

The "self" has been investigated in different fields of psychological research. In one field of research, many studies assessed the influences of self-relevant stimuli on cognitive processes often with a focus on the question how self-relevant stimuli guide us through everyday perception. In that regard, empirical studies revealed that self-relevant material guides attention in different paradigms of selective attention. For example, one of the basic findings is that participants cannot avoid an automatic allocation of attention towards an audio source in which one's own name is presented – even if they try to focus their attention in another direction (Moray, 1959). A similar effect was found with the written name in an attentional-blink paradigm (Shapiro, Caldwell, & Sorensen, 1997), confirming the automatic allocation of attention towards self-relevant stimuli. Furthermore, illustrative for lots of other studies with similar material, a significant interference was measured when a picture of the participant's own face was presented flanking a target stimulus (Devue & Bredart, 2008). Yet, null results in studies testing for prioritised access to awareness for self-related stimuli suggest a critical look at this interpretation (see, e.g. Noel, Blanke, Serino, & Salomon, 2017). Still, the finding that one's own name, other than non-self-relevant names, is not inhibited after it was presented as a distractor in a target-identification task (Frings, 2006) contradicts typical negative-priming effects (Neill, 1977; for a review, see Frings, Schneider, & Fox, 2015) and thereby supports the "self-is-special-hypothesis".

Effects of self-relevant stimuli go beyond such a perceptual or attention-based influence. For example, the self-reference effect describes the higher recall rate for items previously encoded in relation to the self in comparison to the recall rate for items previously encoded according to their semantic meaning (Rogers, Kuiper, & Kirker, 1977). Similarly, the mere-ownership effect in the sense of Cunningham, Turk, Macdonald, and Neil Macrae (2008) describes the impact of ownership on memory. In detail, recognition was improved for stimuli, which were labelled to be owned by oneself, compared to the recognition of stimuli, which were labelled to be owned by someone else (Cunningham et al., 2008).

Even neurological studies indicate a general differentiation between self and non-self in that particular brain areas are commonly associated with self-

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referential cognition, whereas other areas are more commonly associated with other-referential cognition (for a recent review, see, e.g. Wagner, Haxby, & Heatherton, 2012; for the assessment of event-related potentials, see, e.g. Miyakoshi, Nomura, & Ohira, 2007; Zhou et al., 2010). A rather fundamental differentiation of "self" and "non-self" in stimulus processing is also suggested by feature-based approaches to the self (Hommel, 2019).

Self-prioritisation in the matching task

A recent measurement of self-relevance effects revealed a partly different view on the influence of self-relevance on stimulus processing. In detail, in a simple paradigm, formerly neutral stimuli are associated with either the self or with non-self-relevant others. A self-prioritisation effect (SPE) emerges in that responses are significantly faster and more accurate in self-associated trials compared to non-self-associated trials (see, e.g. Schäfer, Wentura, & Frings, 2015; Stein, Siebold, & van Zoest, 2016; Sui, He, & Humphreys, 2012). Thus, formerly neutral material is associated with the self and responses on these new self-relevant associations are compared to responses on non-self-relevant associations. This is important because previously used self-relevant material, like, for example, the participant's own name or a picture of the participant's face, is highly overlearned as well as outstandingly familiar, which does not hold true for the non-self-relevant material. Due to this obvious confound of self-relevance and the extent of learning as well as the familiarity, any reported effects might be explained by the extent of learning and familiarity rather than by the self-relevance. Consequently, the burden of previous quasi-experimental assessments was solved by testing newly formed self-associations.

As mentioned above, research with this matching paradigm revealed a different view on the influence of self-relevance on stimulus processing. Whereas previous research suggested that self-referential information leads to perceptual prioritisation similar to prioritisation based on physical stimulus salience, the analysis of effects of newly generated self-associations contradicts a purely perceptual or attention-based effect. Indeed, evidence has been published in terms of a perceptual advantage of self-relevant material on the one hand, but also in terms of a non-perceptual learning advantage of self-relevant material on the other hand. In that regard, testing for a perceptual advantage of self-relevant stimuli, Sui et al. (2012) presented all stimuli in the matching task with reduced contrast and found that self-relevant stimuli did not suffer (in the sense of increased response times) from visual degradation while non-self-relevant stimuli suffered significantly. A further study revealed evidence for a privileged access to awareness for self-relevant stimulus combinations (i.e. the continuous-flash-suppression method; Macrae, Visokomogilski, Golubickis, Cunningham, & Sahraie, 2017; but see a contesting finding in Stein et al., 2016). Additionally, effects of self-associated stimuli as distractors in a global-local task were reported to be comparable to effects of highly salient distractors (Sui, Liu, Mevorach, & Humphreys, 2013). Contradicting these findings, several studies have been published, which report findings speaking against a perceptual advantage or in favour of a learning advantage of self-relevant stimuli. In that regard, note that the SPE was no longer significant when the learning of the non-self-relevant associations was supported by particular feedback (Fuentes, Sui, Estévez, & Humphreys, 2015), and that a second study using the continuous-flash-suppression method did not find any privileged access to awareness for self-relevant stimuli (Stein et al., 2016). A similar, non-perceptual interpretation comes from a study in which self-relevant stimuli were presented in the well-established psychological-refractory-period paradigm and response times indicated a source of the SPE in the *central* processing stage, rather than in a perceptual stage of stimulus processing (Janczyk, Humphreys, & Sui, 2018). Reuther and Chakravarthi (2017) conclude from their studies that evidence can be explained both, in terms of memory differences and perceptual effects. This conclusion is based on one study in which memory strength was kept constant for all learned associations and the SPE was still significant and on one study in which an artificially induced memory advantage caused similar prioritisation effects like self-relevance even if there was no self-relevant condition.

Thus, the underlying processes causing the prioritisation of self-relevant associations in the matching paradigm are still debated. One approach to assess the underlying processes of the SPE and to understand the way self-relevance influences cognitive processes, is the identification of influencing factors. Regarding that, evidence came from a study in which the induction of negative mood, either via listening to negative music or via

reading self-related negative mood statements, lowered the SPE (Sui, Ohrling, & Humphreys, 2016), suggesting that the SPE is influenced by current mood. Beyond that, several studies were conducted to assess whether the SPE might be explained by a prioritisation of positive stimuli, assuming that self-relevant stimuli are inherently rewarding (Sui et al., 2012). The results of these studies, which compared effects of self- and reward-associations, depicted a distinct and a common process of self and reward (Sui & Humphreys, 2015a; see also Sui, Enock, Ralph, & Humphreys, 2015; Sui et al., 2012), suggesting that the SPE might partly be explained by the rewarding component of self. An influence of the concreteness of the used labels in the matching task was concluded because an accentuation (via explicit instructions) of particular labels caused prioritisation (in terms of a congruency effect, which was conducted similar to the typical SPE) but only when the accentuated label was a concrete label ("frog" vs. "stranger"). Moreover, the name of the researcher, which administered the study (and who was present in the room) also caused prioritisation when it was presented as one of the labels (Wade & Vickery, 2017). The authors conclude that the SPE in the matching paradigm might partly be explained by the concreteness if the self-relevant label (however, for a contesting finding, see Sui et al., 2012, Exp. 3A; Woźniak & Knoblich, 2019, for the assumption that the SPE is independent of linguistic features). A similar conclusion holds true when the self-relevant label is the only pronoun between several nouns, suggesting that grammatical distinctiveness boosts prioritisation in the matching paradigm as well (Schäfer, Wentura, & Frings, 2017). Nevertheless, one study demonstrated that the SPE also occurred when the matching task was conducted without labels (i.e. using fully unfamiliar stimuli; Woźniak & Knoblich, 2019). This finding indicates that the SPE does not necessarily rely on the presence of familiar labels, which again might be an indication that the SPE is independent of linguistic features of the labels. Above that, inconsistent findings are reported about the influence of perceived personal distance to strange people. Namely, in one study, the SPE was smaller for individuals who indicated a close personal distance to strangers (Sui & Humphreys, 2015a), but in a second study, the indicated personal distance failed to show any correlation with the SPE (Sui & Humphreys, 2017). Similarly, an influence of the cultural differences on the SPE were found for Caucasian in comparison with Asian people (Jiang et al., 2019) in that the SPE was larger for presumably individualistic people (i.e. Caucasian). However, the interpretation of this effect might be difficult due to a confound of stimulus size and group (Asian people had larger stimuli than Caucasian; note that Sui & Humphreys, 2015b, found that the SPE increases for larger stimuli) and an inconclusive manipulation check (Caucasian people scored higher on collectivism than on individualism here).

Besides all these possible influences on the SPE, a further potential candidate to explain variance of the SPE might be someone's subjectively evaluated self-esteem. Since the SPE measures a prioritisation of self-relevant stimulus combinations against other-relevant combinations, one might assume that this self-prioritisation depends on how valuable people consider themselves – how much they care about themselves in contrast to others. A standard and most typical test to measure a person's self-esteem is the Rosenberg self-esteem scale (RSES; Rosenberg, 1989; for an actual review, see Donnellan, Trzesniewski, & Robins, 2015). The RSES was conducted and validated to measure the explicit global self-esteem. Ten statements are presented and participants are asked to indicate how much they agree to each statement (for further information about the scale, see the material and apparatus section and the appendix). The theoretical explanation of the scale defines self-esteem as peoples' attitude about themselves, in particular, whether they have a favourable or unfavourable opinion of themselves and whether they consider themselves worthy or unworthy (Rosenberg, 1989). Given this definition, we suggest that the individual self-esteem might be a further candidate to assess in order to find out about the SPE's influencing factors. This suggestion fits to the observation that the SPE partially hinges on the prioritisation of positive valence, in particular because self-relevant stimuli are inherently rewarding (Sui & Humphreys, 2015a). Moreover, it matches other studies which report correlations between complex and reportable traits (like depression) and low-level processing of stimulus-valence (see, e.g. Frings, Wentura, & Holtz, 2007).

The present study: assessing the connection between self-prioritisation and self-esteem

As a further assessment of a potential influencing factor of the SPE and thus to get further insights into the underlying processes of the SPE, we set

out to examine the connection between two – potentially connected – effects of the self: the SPE on the one hand and the explicit self-esteem on the other hand. Especially, when considering the inherent rewarding component of self-relevance, a connection between the prioritisation of self-relevant material (measured with the SPE) and a high self-esteem (measured with the RSES) can be assumed which should be measurable in a significant *positive* correlation of the two measures. This assumption of a positive correlation would be supported by the finding that the SPE can be predicted by the neural activation in a brain area, which is associated with social attention in general (Sui, Rotshtein, & Humphreys, 2013; but see Schäfer & Frings, 2019). Additionally, a positive correlation would be supported by the fact that self-esteem is defined as being essentially based on any relevant information from the social surrounding about one's self (Rosenberg, 1989).

Contrary to the postulation of a positive correlation, a null correlation could explain the diversity of findings concerning effects of the self because self-prioritisation and self-esteem might be interpreted in terms of two components affecting cognitive processes on different levels. A popular philosophical and (neuro-) psychological conceptualisation of the self (Gallagher, 2000) emphasises these two components as it postulates, on the one hand, a basic component influencing stimulus processing via a simple distinction between self and non-self and, on the other hand, a more elaborate component, which integrates information from different sources to define a complex self. Similar to that, in a latest theoretical look at the self (and non-self others), a literal, immediate perception of oneself is clearly differentiated from a knowledge about oneself, capturing aspects from past and future as well as opinions from oneself and others (Hommel, 2019). Thereby, this differentiation emphasised that the SPE (as an immediate differentiation between oneself and others) should be distinguishable from the individual self-esteem (as an elaborate opinion about oneself). Furthermore, the assumption of an independence of separate self-components is supported by a framework postulated by Sui and colleagues which assumes that some effects of self-relevance are purely perceptual and associated with sensory-driven brain areas, whereas other effects of the self influence higher-order processes like memory and attribution (Sui et al., 2013; see also Humphreys & Sui, 2016).

Thus, we expected to find either a positive correlation between the SPE and the self-esteem or a null correlation. The latter would suggest that the SPE is indeed an effect working unrelated to more complex aspects of the self, whereas the former would suggest that the SPE is connected to self-esteem possibly due to the rewarding character of self-relevant information.

Method

Participants

103 students from the University of Trier (90 female) took part in the study receiving course credit. Median age was 20 years (ranging from 18 to 39) and all participants had normal or corrected-to-normal vision. We tested the participants in a series of three experiments in which we measured the SPE and surveyed each participant's explicit self-esteem with the Rosenberg scale. Note that each of the experiments tested questions beyond the correlation of the standard SPE and self-esteem. Yet none of the participants took part in more than one of the experiments, the data of the experiments are not published elsewhere, and the SPE and self-esteem measures we compare here were identical so that we present the experiments as one study here.[1] With $N = 103$, the power is $1\text{-}\beta = .95$ ($\alpha = .05$, one-tailed) to detect a correlation of $r = .31$. Even a smaller correlation of $r = .24$ can be detected with a power of $1\text{-}\beta = .80$ ($\alpha = .05$, one-tailed). Power calculations were done with GPower (version 3.1.9.2; Faul, Erdfelder, Lang, & Buchner, 2007).

Design

We used a 2 (matching condition: *matching* vs. *non-matching*) × 3 (shape association: *self* vs. *familiar other* vs. *neutral instance*) repeated-measures

[1]The three experimental groups were identical with regard to apparatus and procedure. The only differences were in the number of association conditions (and in the number of participants). Specifically, the first and third experimental group (left and right section of Figure 2, respectively) were identical using the German words "Ich", "Mutter", and "Bekannter". In the second experimental group (middle section of Figure 2), two neutral labels were used (i.e. the German words "Ich", "Mutter", "Bekannter", and "Nichts", resulting in four association conditions instead of three, see below). Moreover, in the first experimental group, $N = 32$ participants were included in the analysis, in the second $N = 36$ and in the third $N = 35$. However, while the SPE in RTs varied between the experimental groups, $F(2, 100) = 3.71$, $p < .028$, $\eta_p^2 = .07$, indicating a larger SPE in the first than in the second group, all SPEs differed significantly from zero, all $ts < 4.12$, all $ps < .001$, all $ds > .68$.

design for the assessment of the SPE. The assignment of label and shape was balanced across participants following a Latin-square design.

Material and apparatus

We used standard PCs with TFT monitors that had a display resolution of 1,680 × 1,050 pixels, standard German QWERTZ keyboards and E-Prime 2.0 software. In all experiments, the self-relevant label was the German word *Ich* [I], the label for the familiar other was the German word *Mutter* [mother], and the label for the neutral instance was the German word *Bekannter* [acquaintance] or *Nichts* [none]. Each label was assigned with one of the following geometric shapes: circle, triangle, rectangle, square, or cross (resulting in three or four combinations depending on the experiment). Words were presented in black on white background and in Courier New, with a viewing distance of 60 cm resulting in a visual angle of about 0.48°. All stimuli were presented at the (horizontally) screen centre, the shape at a visual angle of 10.48° from the upper border of the screen, a fixation cross at 12.34° and the label at 14.72°. The geometric shapes were presented subtending approximately 2.7° × 2.7° visual angle.

According to the used psychometric scale, a revision of studies using the RSES revealed a reliability between .80 and .90 and a sufficient convergent and discriminant validity (Donnellan et al., 2015). The RSES applies to measure the *explicit* self-esteem via subjective agreement to items concerning a person's feeling about him- or herself. Thus, this construct is to differentiate from the *implicit* self-esteem, which is an automatic and preconscious self-evaluation (for the independence of these two components, see Donnellan et al., 2015). In the current study, we used the German version of the revised Rosenberg self-esteem scale (for further information, see von Collani & Herzberg, 2003). The internal reliability for this German version of the scale, tested with 285 German participants (mean age 33.7, ranging from 14 to 80 years), was Cronbachs $\alpha = .84$, indicating a high reliability of this scale (von Collani & Herzberg, 2003). The scale comprises ten items concerning a person's feeling about him- or herself (for the exact wording of the instructions and items see the appendix). Participants are asked to rate the extent to which the items fit their inner feelings in the current moment usually on a 4-point Likert scale from "0" to "3" (with "0" for "does not hold true at all", "1" for "does not hold true", "2" for "holds true", and "3" for "holds totally true"; see results section for details about the calculation of the score).

Procedure

Participants were tested individually in soundproofed rooms. They saw task instructions on the screen and heard a summary from the experimenter. In the first phase of the experiments, participants learned assignments of geometric shapes with different labels. Therefore, the to-be-learned assignments were presented on the display for 60 s in written form. For a particular participant, these assignments might read: "I am the square. The mother is the cross. An acquaintance is the circle." Participants were instructed that varying combinations of these shapes and labels will be presented on the screen and to judge these displayed combinations according to its correspondence to the initially learned assignments. Further, they were instructed to place the index finger of the left hand on the S-key to indicate non-matching combinations and the index finger of the right hand on the L-key to indicate matching combinations. Subsequently, the matching task was passed, in which the to-be-judged combinations were presented. Here, each trial started with a 500 ms presentation of a black screen, followed by a fixation cross for 500 ms, a combination of one label and one shape for 100 ms and another black screen until the participant responded or 1,500 ms had elapsed. One experimental session consisted of a practice phase and an experimental phase. The practice phase consisted of 48 trials and feedback appeared after each trial. The experimental phase consisted of three blocks with 48 trials (resulting in 144 trials). Here, a feedback display was present only when the participant did not respond within 1,500 ms. In both phases, each label was presented equally often and thereby half of the time with a matching and half of the time with a non-matching assignment. Trials were presented in random order.

After the matching task, each participant was instructed to answer the items of the German version of the revised RSES, which were sequentially presented on the screen. Responses were given by key press (A, S, D, and F) and the next slide only occurred when the previous item was answered. The experiment was carried out according to the principles of the Declaration of Helsinki, on the basis of informed consent.

Results

The RSES score

First, we recoded the score of the inverted items of the RSES. Therefore, for the items 2, 5, 6, 8, and 9 (see appendix), scores of "0" were recoded in "3", "1" in "2", "2" in "1", and "3" in "0". Second, we calculated a sum score of the ten items as the total score for each participant (note that there were no missing values for any item or participant). The analysis of this total score revealed a mean score of $M = 19.4$ (median score of 20) with a standard deviation of $SD = 4.9$. Regarding a minimum score of 0 and a maximum of 30, scores between 15 and 25 are within normal range for a non-clinical population (Rosenberg, 1965).

The SPE

Only correct responses with mean RTs above 100 ms and below 1.5 interquartile ranges above the third quartile of the overall RT distribution (Tukey, 1977) were used for the RT analysis, thereby eliminating too fast and too slow responses to focus on valid responses only. Note that, averaged across participants, 75.7% of the trials were selected for RT analysis; 19.5% of the trials were excluded because of erroneous responses and 4.8% due to the RT-outlier criteria. Table 1 shows mean RTs and error rates in the 2 (matching condition: *matching* vs. *non-matching*) × 3 (shape association: *self* vs. *familiar other* vs. *neutral instance*) design. We calculated non-matching trials with regard to the label. Consequently, for example, all trials with the self-relevant label and one of the non-self-associated shapes were accumulated in the self-associated non-matching condition (and accordingly for the other non-matching conditions).

A 2 (matching condition: *matching* vs. *non-matching*) × 3 (association: *I* vs. *mother* vs. *acquaintance/none*) repeated-measures MANOVA (for the use of MANOVA analyzing repeated-measures designs, see O'Brien & Kaiser, 1985) with mean RTs as the dependent variable revealed two significant main effects. The significant main effects indicated faster responses in matching than in non-matching trials, $F(1, 102) = 153.40$, $p < .001$, $\eta_p^2 = .60$, and in the self-relevant than in the neutral condition, $F(2, 101) = 50.20$, $p < .001$, $\eta_p^2 = .50$. A significant interaction, $F(2, 101) = 102.59$, $p < .001$, $\eta_p^2 = .67$, suggested that the overall data pattern completely fitted the typical effects in the paradigm (see Sui et al., 2012). Furthermore, prioritisation effects are usually analysed in matching trials, because matching and non-matching trials involve different processes and prioritisation has most reliably been demonstrated in matching trials (see, e.g. Humphreys & Sui, 2016). A one-factorial, repeated-measures MANOVA in the matching condition with mean RTs and the factor association (*I* vs. *mother* vs. *acquaintance/none*) depicted a significant main effect, $F(2, 101) = 56.30$, $p < .001$, $\eta_p^2 = .53$. Within this analysis, the two simple contrasts corresponded to the comparison of the self-associated condition with the mother-associated condition and with the neutral condition, respectively. The first and the second simple contrast were significant, indicating that responses in the self-associated condition were faster than responses in the mother-associated, $F(1, 102) = 26.91$, $p < .001$, $\eta_p^2 = .21$, as well as in the neutral-associated condition, $F(1, 102) = 113.62$, $p < .001$, $\eta_p^2 = .53$. Thus, the self-associate condition is prioritised against the "mother"-condition, indicating that the prioritisation of self goes beyond the prioritisation of a familiar other.

Because the SPE is defined as faster and more accurate responses in self-associated matching trials compared to other-associated matching trials (for a definition, see Sui et al., 2012), we computed the SPE for each participant as the difference between the RT in matching trials with the self-relevant label (i.e. the label "I") and the average of the RTs in the non-self-relevant matching trials (i.e. those with the familiar other or the neutral label). The SPE was significant, $t(102) = 9.03$, $p < .001$, $d = .88$, indicating faster responses in self-associated matching trials compared to other-associated matching trials (Figure 1) with the effect size depicting a large

Table 1. Mean RTs (in ms) and error rates (in %) as a function of matching condition and association as well as the sensitivity measure *d'* as function of association. Standard deviations are in parentheses.

	RTs		Errors		d'
Association	Matching	Non-Matching	Matching	Non-Matching	
I	536 (130)	646 (147)	19.2 (24.6)	28.10 (25.9)	1.99 (1.2)
Mother	578 (135)	645 (154)	26.8 (21.7)	26.6 (22.6)	1.71 (1.1)
Acquaintance/None	618 (152)	659 (167)	30.8 (23.7)	24.6 (20.6)	1.69 (1.1)

effect according to Cohen's conventions for small, medium, and large effects (Cohen, 1988).

Accuracy was analysed computing signal-detection-sensitivity indices (*d'*) in order to consider the individual response criterion. Therefore, *d'* was calculated with regard to the label and correct responses in matching trials were considered hits, while erroneous responses in non-matching trials were considered false alarms. Following the log-linear approach to account for cases with 100% hits or 0% false alarms (see Hautus, 1995; Stanislaw & Todorov, 1999), we computed *d'* as the sensitivity measure. A one-factorial, repeated-measures MANOVA (*I* vs. *mother* vs. *acquaintance/none*) with *d'* as the dependent variable revealed a significant main effect, $F(2, 101) = 7.90$, $p = .001$, $\eta_p^2 = .14$. The analysis of simple contrasts indicated that responses in the self-associated condition were more accurate than responses in the mother-associated, $F(1, 102) = 12.57$, $p = .001$, $\eta_p^2 = .11$, as well as in the neutral-associated condition, $F(1, 102) = 12.86$, $p = .001$, $\eta_p^2 = .11$. The SPE as the difference between *d'* in the self-relevant condition and the averaged *d'* in the non-self-relevant conditions was also significant, $t(103) = 0.29$, $p < .001$, $d = .39$ (Figure 1).

Correlation analysis

In the here described sample, the reliabilities for the to-be-correlated variables were sufficiently high, $r = .50$ for the SPE in RTs, $r = .49$ for the SPE in error rates (both Spearman-Brown coefficients for the split-half reliability for first and second half of matching-task trials), and .86 for the self-esteem measure (Cronbach's α).

The correlation of the mean SPE in RTs with the mean self-esteem score was $r(101) = .002$, $p = .987$. In accordance with that, the correlation of the mean SPE in *d'* with the self-esteem score was $r(101) = .064$, $p = .520$. A correction for attenuation revealed a correlation coefficient of $r(101) = .003$ for the SPE in RTs and the self-esteem scale as well as a correlation coefficient of $r(101) = .099$ for the SPE in *d'* and the self-esteem scale, supporting the non-significant correlation of self-prioritisation and self-esteem. In order to care for potential differences between the formerly separate experimental groups, we calculated the correlation score in each of the three groups. Appropriately, in none of the groups the correlation of the self-esteem score with the mean SPE in RTs or the mean SPE in *d'* was significant, all $ps > .264$, $-.193 > rs < .204$, except that in one group the correlation of the SPE in *d'* and the self-esteem score was close to significant, but negative, $r(101) = -.321$, $p = .060$ (for the scatterplots of the null correlations, see Figure 2).

Additionally, a corresponding Bayes analysis was conducted using the Bayesian Correlation Pairs module of JASP (Love et al., 2015). The Bayes factor in favour of the null hypothesis was $BF_{01} = 7.884$ for the correlation with the SPE in RTs and $BF_{01} = 6.039$ for the correlation with the SPE in *d'*. According to the rules of thumb given by Jeffreys (1961; see also Wagenmakers, Wetzels, Borsboom, & van der Maas, 2011) both values indicate "substantial evidence" for the null hypothesis.

In sum, the correlation analyses suggest that the SPE in the matching task is unrelated to the explicit self-esteem of a person.

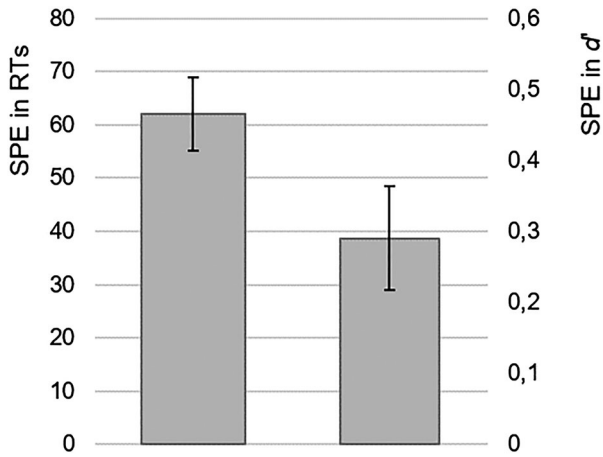

Figure 1. The SPE as performance difference between self- and other-relevant trials in ms and in *d'* (error bars depict the standard error of the mean [as the estimated standard deviation of the sample mean]).

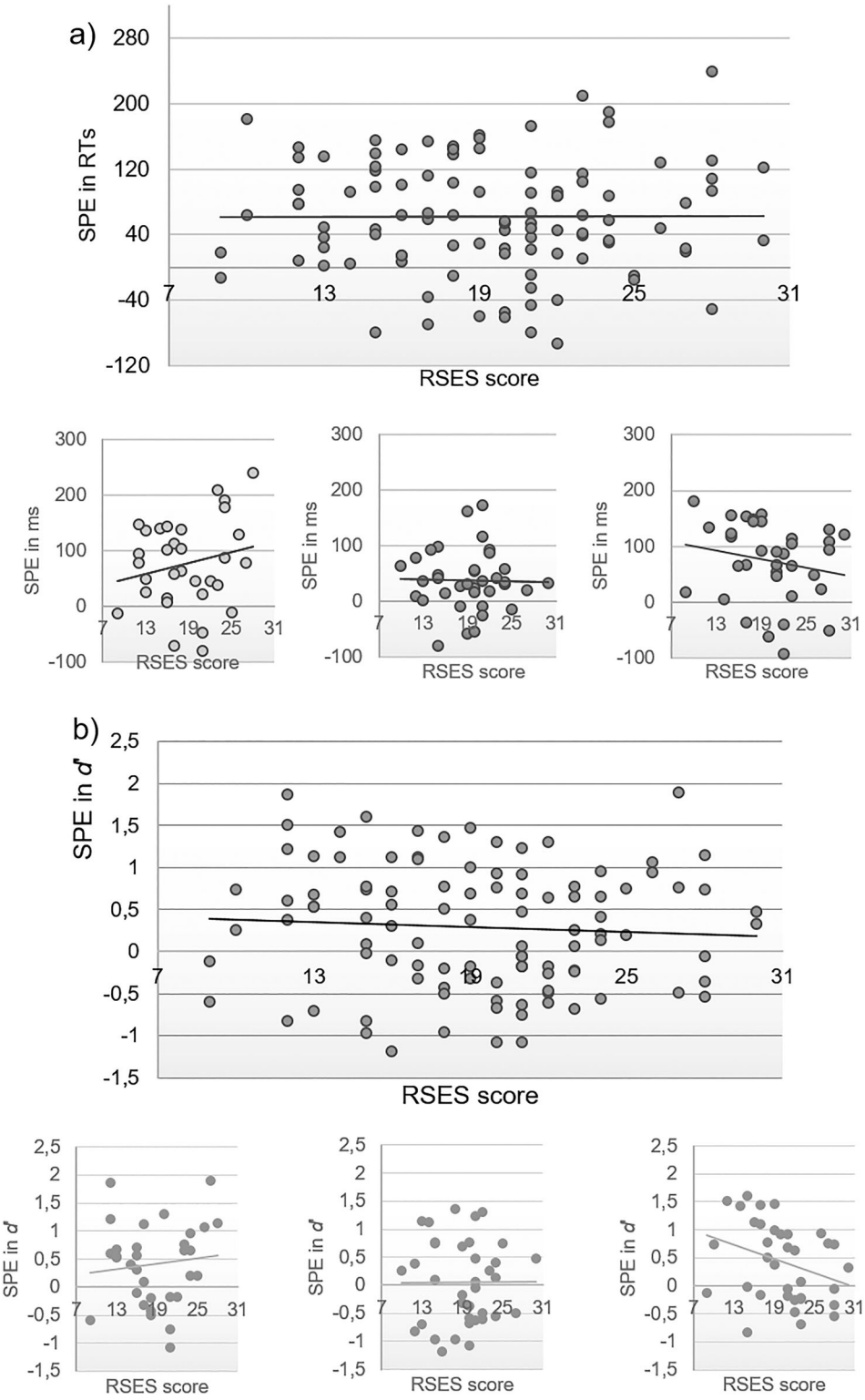

Figure 2. Scatterplots of the empirical SPE on the total self-esteem score (RSES score) of each participant in RTs (a) and *d'* (b) including the particular data pattern in the formerly separate experimental groups.

Discussion

In order to assess the underlying processes of the SPE further, we analysed the connection of self-prioritisation and peoples' opinion about themselves. In detail, we correlated the SPE with a typical measurement of self-esteem, the Rosenberg

self-esteem scale (Rosenberg, 1989). We found a large SPE in response times and in sensitivity (according to Cohen, 1988 and in comparison to typical effect sizes, for example, in Sui et al., 2012) as well as a typical median RSES score of a non-clinical sample. Remarkably, the results demonstrate robust null correlations of the SPE measures with the self-esteem score. Appropriately, separate analyses in the three experimental groups (which were presented as one study here) revealed that in none of the groups a positive correlation of SPE and self-esteem occurred. In fact, in neither of the groups a significant correlation was found.

The reported null correlations demonstrate that the amount of prioritisation of newly formed self-associations in a visual matching task is not related to the degree to which the participants were convinced of themselves. Although, of course, a significant correlation does not indicate a causal connection, the here reported absence of a correlation of SPE and self-esteem score suggests that the SPE in the matching task does not depend on a person's opinion about him- or herself. Thus, these two aspects of the self – the influence of self-relevance on a visual matching task on the one hand and the implicit opinion about oneself on the other hand – might represent two intendent components of the self.

Remarkably, the reported null correlations have been found between the SPE and the *explicit* self-esteem as measured by the RSES. In particular, the assumption that the SPE represents a process similar to the prioritisation of rewarding stimuli made it very plausible that the SPE is correlated with how someone explicitly thinks of his or her own worth. Nevertheless, when believing in an independence of the SPE of the explicit self-esteem (although any conclusions should of course be drawn with caution as they are, up to now, based on a single study), the question might be raised whether the SPE is associated with a person's *implicit* self-esteem. Given that the explicit self-esteem is defined as an "expressible attitude about oneself" (Rosenberg, 1989) and thereby differentiated from the "implicit self-esteem as an automatic and preconscious self-evaluation" (Donnellan et al., 2015), a correlation of the SPE with one of these two attributes would reveal different information about the origin of the SPE.

Either way, further studies could be conducted to test for correlations of the SPE with different potentially related constructs. Besides the implicit self-esteem, further self-related factors, like, for example, self-reflection (i.e. the ability to reflect on one's own attributes and preferences) or self-awareness (i.e. the ability to distinguish between self and other) could be assessed. Beyond correlations with self-related factors, correlations with more basic factors like, for example, working-memory capacity could also reveal further insights about the SPE (thereto, note that the attentional capture of one's own name has been shown to depend on a person's working-memory capacity; see Conway, Cowan, & Bunting, 2001). In a broader view, correlations of the SPE with particular other variables could occur differentially in clinical samples. By all means, future studies about correlations with the SPE should control for meanwhile described factors, which (might) influence the size of the SPE. In that regard, factors like memory advantages (Reuther & Chakravarthi, 2017), word concreteness (Wade & Vickery, 2017), or grammatical distinctiveness of the labels (Schäfer et al., 2017) should be controlled to reach a most reliable measurement of the SPE.

However, the interpretation of the SPE and the explicit self-esteem as two independent components of the self fits a common conceptualisation of the self by Gallagher (2000). As stated in the introduction, he postulates two – more or less separate – components of the self: a simple, basic distinction between self and non-self, which he calls the *minimal* self, and a more elaborate, higher-order integration of all available information to define the self, which he calls the *narrative* self (Gallagher, 2000). The conclusion that the SPE as a fast and implicit differentiation between self- and other-associations does not depend on a personal explicit opinion about the self, might indicate the explicit self-esteem as a component of the narrative self, whereas the SPE depicts a measure of the minimal self. Such an assignment of the SPE as a measure of the minimal self is justified by research about the stimulus-driven (see, e.g. Macrae et al., 2017; Sui et al., 2012; Sui et al., 2013) and automatic nature of the SPE (Sui, Sun, Peng, & Humphreys, 2014) as well as by findings which illustrate that the SPE is rather independent of the used word material and thereby not to explain by linguistic aspects (Sui et al., 2012; Woźniak & Knoblich, 2019).

Correspondingly, in a review of brain areas, which were shown to be associated with self-referential processing, a differentiation between stimulus-driven and higher-order effects of the self was postulated. Here, the SPE was categorised as an automatic and

implicit, stimulus-based effect (Northoff, 2016). Complementary, the self-esteem in the sense of Rosenberg is defined as an elaborative opinion about one's self including any available information (Rosenberg, 1989) so that the explicit and elaborative aspects of this trait are pointed out and thereby an assignment of the RSES to the narrative self suggests itself. If one were to develop this idea further, a significant correlation of the SPE with the *implicit* self-esteem as an automatic and preconscious self-evaluation could further emphasise the basic, minimal origin of the SPE.

Briefly, the individual self-esteem does not explain a significant part of variance of the SPE in our study. Nevertheless, or even because of this finding, the study's result might contribute to a deeper understanding of the SPE and of self-effects in general. In particular, the current results can be seen as first evidence that the SPE and the implicit self-esteem represent two independent factors. This independence of the SPE of the elaborate and expressible opinion about the self further supports the already postulated assumption of the SPE as a basic influence of a self/non-self-differentiation on stimulus processing, which is to differentiate from elaborate, rather social aspects of the self like the explicit self-esteem. Thereby, the current results support the idea that self-effects are divergent and impact cognition at different levels of processing.

Disclosure statement

No potential conflict of interest was reported by the authors.

Data availability statement

The raw data and a corresponding codebook can be found at http://dx.doi.org/10.23668/psycharchives.2642 (data) and http://dx.doi.org/10.23668/psycharchives.2643 (code).

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Appendix

Instruction:.
"Im Folgenden findest Du 10 Feststellungen, die beschreiben, wie jemand sich bezüglich seiner selbst fühlen kann. Bitte lies jede einzelne Feststellung sorgfältig durch, und schätze für diese Feststellung ein, wie sehr sie mit Deinen eigenen Gefühlen zu Dir selbst übereinstimmt – und zwar zum gegenwärtigen Zeitpunkt."
[engl.: Below is a list of statements dealing with your general feelings about yourself. Please indicate how strongly you agree or disagree with each statement.]
Items:

	mean	SD	Var
(1) Alles in allem bin ich mit mir selbst zufrieden. [On the whole, I am satisfied with myself.]	1.83	.729	.53
(2) Hin und wieder denke ich, dass ich gar nichts tauge. [At times, I think I am no good at all.]*	1.18	.894	.80
(3) Ich besitze eine Reihe guter Eigenschaften. [I feel that I have a number of good qualities.]	2.17	.585	.34
(4) Ich kann vieles genauso gut, wie die meisten anderen Menschen auch. [I am able to do things as well as most other people.]	2.02	.610	.37
(5) Ich fürchte, es gibt nicht viel, worauf ich stolz sein kann. [I feel I do not have much to be proud of.]*	.98	.686	.47
(6) Ich fühle mich von Zeit zu Zeit richtig nutzlos. [I certainly feel useless at times.]*	1.19	.817	.67
(7) Ich halte mich für einen wertvollen Menschen, jedenfalls bin ich nicht weniger wertvoll als andere auch. [I feel that I'm a person of worth, at least on an equal plane with others.]	2.31	.657	.43
(8) Ich wünschte, ich könnte vor mir selbst mehr Achtung haben. [I wish I could have more respect for myself.]*	1.47	.850	.72
(9) Alles in allem neige ich dazu, mich für einen Versager zu halten. [All in all, I am inclined to feel that I am a failure.]*	1.00	.804	.65
(10) Ich habe eine positive Einstellung zu mir selbst gefunden. [I take a positive attitude toward myself.]	1.85	.706	.50

* reversely worded item.