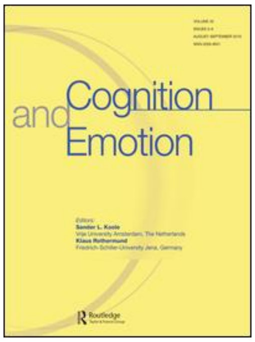

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# Affective compatibility with the self modulates the self-prioritisation effect

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# Affective compatibility with the self modulates the self-prioritisation effect

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**ABSTRACT**
The "self" shapes the way in which we process the world around us. It makes sense then, that self-related information is reliably prioritised over non self-related information in cognition. How might other factors such as self-compatibility shape the way self-relevant information is prioritised? The present work asks whether affective consistency between the self and arbitrarily self-associated stimuli influences the degree to which self-prioritisation can be observed. To this end, participants were asked to associate themselves with either a positive or a negative concept and to then indicate if a given stimulus (Experiment 1: Emotional faces; Experiment 2: Luminance cues) and an identity label matched. If affective consistency is key to self-prioritisation, negative constructs should dampen self-prioritisation and positive constructs should boost self-prioritisation because the self is universally construed as positive. Indeed, the results of the two experiments indicate that participants who made the negative association had more difficulty confirming whether the stimulus and the label matched than those who made the positive association. The implications of this finding are discussed in terms of "self" theories that span various levels of information processing. The data reveal that self-referential information processing goes beyond a default elevation of priority to the self.

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The self provides context for navigating the world in which we live; it shapes our understanding of other people, our place in society and it guides our behaviour (Markus & Wurf, 1987; Wheeler et al., 2007). In terms of information processing, the self provides structure and coherence allowing us to make sense of what really matters in what could be an over-stimulating world (Conway & Pleydell-Pearce, 2000). Indeed, it is not an uncommon feeling to engage with incoming information that is self-relevant and disengage from information that is not. The present work asks how the processing of self-associated or self-relevant information changes depending on the degree of compatibility with the self, particularly in relation to affective valence.

## The context of self

The phenomenon of self-prioritisation (rapid self-relevant processing) has been investigated at all stages of cognitive processing from perception and attention (Macrae et al., 2018; Stein et al., 2016) all the way through to judgement and decision-making biases (Constable, Welsh, et al., 2019; Golubickis et al., 2018). Although there is a range of research that provides experimental evidence of self-prioritisation at many stages of processing, one of the most well-researched areas is memory (Symons & Johnson, 1997). In a task similar to the one used to the present study (adapted from Sui et al., 2012), the temporal source of the self-prioritisation effect was localised to central stages of processing

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(Janczyk et al., 2019). Furthermore, neural evidence suggests that self-relevant stimuli benefit from facilitated access to long-term semantic networks (Chen et al., 2011; Muñoz et al., 2019; Woźniak et al., 2018; Xu et al., 2017).

To provide further background, self-memory structures are presumed to provide an elaborate semantic network within which new conceptually compatible information can be readily embedded (Conway, 2005; Conway & Pleydell-Pearce, 2000; Symons & Johnson, 1997). Information associated with the self consequently enjoys a robust position within memory structures because self-information potentiates stronger and more vast memory traces within the self-semantic network (Derry & Kuiper, 1981). Thus, self-associated information may be more readily accessed and verified (Constable, Rajsic, et al., 2019; Constable & Knoblich, 2020). A connectionist approach extends this concept. It suggests that any information that potentiates strong and vast links (such as compatible information) allows for that information to be retrieved more readily because the likelihood of activating the relevant information through presented cues is higher (Greenwald et al., 2002). Consequently, any identity association that a participant is required to make should be facilitated by compatibility with the self and inhibited by incompatibility with the self. Further, the degree of representativeness of the cue should influence how readily the information is retrieved.

## The self is positive

Individuals typically have a positive self-regard. This finding is so pervasive that it could be considered a universal (Cai et al., 2009; Schmitt & Allik, 2005; Yamaguchi et al., 2007), although the characteristics that contribute to a positive sense of self differ across cultures (Matsumoto, 2007). Beyond self-evaluation, the cognitive system also seems to organise itself to support a positive self-concept. Healthy adults demonstrate a general positivity bias but also greater interconnectedness of positive over negative content within memory structures, whereas depressed individuals integrate both positive and negative content (Dozois & Dobson, 2001).

The link between the self and preferential decision-making biases is also well established. Humans prefer and value objects they own over identical objects they do not own, referred to as the mere-ownership effect (Beggan, 1992) and endowment effect (Thaler, 1980), respectively. Extending this link to speeded judgements, Golubickis and colleagues (2019) demonstrated that stimulus desirability influenced processing speed in an ownership categorisation task. Responses to self-owned posters were faster for posters rated as desirable relative to posters rated as less desirable, whereas for friend-owned posters the opposite was true. Similarly, Hu and colleagues (2020) demonstrated a self-positivity-bias in a shape-label matching task. Participants were required to respond to shapes that had been assigned to the good part of themselves, the bad part of themselves, the good part of an unknown other and the bad part of an unknown other. Participants demonstrated a larger self-prioritisation effect for the "good" self than the "bad" self (Hu et al., 2020). The present studies will explore self-prioritisation more generally from a connectionist point of view using affective valence to test theoretical questions concerning target-to-self compatibility (valence with self). The second study will extend the notion of target-to-self compatibility to determine whether highly abstract links between the self and a concept might bring about the same effects as very direct compatibility mappings between self and stimulus.

## The present studies

Participants were asked to associate themselves with either a positively valenced category or a negatively valenced category. A connectionist view coupled with the universal positive self, predicts that self-prioritisation should be reduced for those who associate themselves with a negatively valenced category. This primary hypothesis was evaluated using an identity-based shape-label matching task first developed by Sui and colleagues (2012).

The shape-label matching task is a particularly popular means of investigating the cognitive representation of the self and associated information processing. Importantly, this shape-label matching task ensures that match and mismatch trials remain orthogonal to self and other trials,[1] and removes the potential confound of stimulus familiarity (e.g. own face/own name). Participants make arbitrary identity associations (usually with a shape) and then judge if a presented stimulus and label match or not. On match trials, where the shape and label do match, self-stimuli are responded to faster than non-self-stimuli. This effect is extremely pervasive and consistent. For example, it has been found when stimuli represent a self-collective (Constable, Elekes, et al., 2019; Enock et al., 2018; Moradi, Sui, et al., 2015; Moradi, Yankouskaya, et al., 2015), when stimuli are avatars (Payne et al., 2017; Woźniak et al., 2018), and for space (Strachan et al., 2020). The effect has also been demonstrated in multiple languages and cultures (e.g. Constable, Elekes, et al., 2019; Constable & Knoblich, 2020; Golubickis et al., 2019; Ivaz et al., 2019; Siebold et al., 2015; Yin et al., 2019) and it has been found beyond visual modalities (action: Frings & Wentura, 2014; audition and touch: Schäfer et al., 2016).

The design for the following two experiments remains the same while modifying the stimuli used. Here, participants are asked to associate themselves with a given stimulus category and a stranger to the opposing category (Associations: Happy/Sad, Light/Dark). For each stimulus category, there are two stimuli: one that is strongly representative of the concept, and another that is weakly representative of the concept (Strength: Strong/Weak). The experimental task requires participants to indicate if a simultaneously presented stimulus and label (Label: Self/Stranger) does or does not match (Trial Type: Match/Mismatch).

Because the self-concept is typically couched in positive terms, a negative concept associated with the self should be more difficult to embed within existing memory structures and subsequently more difficult to retrieve. Accordingly, it is expected that the self-prioritisation effect would be diminished in the negative association condition relative to the positive association condition. Further, this effect should be qualitatively modulated by the strength of the cue for retrieval. That is, the strength of representativeness of the cue should interact with valence (i.e. the degree of representativeness to the self). Specifically, a strongly positive cue should provide a boost to the self through conceptual consistency (existing self-prioritisation boost + boost from cue-to-universal-self consistency). On the other hand, a strongly negative cue creates a difficulty in retrieval through conflict with the universally positively construed self, thereby mitigating what remains of the self-prioritisation effect after an initially poorer association (existing self-prioritisation boost + loss from cue-to-universal-self conflict). Weakly representative stimuli (either mildly positive or mildly negative) do not represent an immediate conflict or high level of consistency with the universal self and, as such, should exhibit smaller modulations to self-prioritisation.

## Experiment 1 – emotional valence

Participants were either asked to associate themselves with either Happy or Sad stimuli. They were then asked to indicate if a happy or sad stimulus did or did not match a given label (Self or Stranger). Because humans typically have a positive self-concept and, world over, report that they experience positive affect two to three times more frequently than negative affect (Helliwell et al., 2019), it is hypothesised that negative associations will not be as well embedded within memory structures leading to a reduced self-prioritisation effect for participants in the sad condition overall. Further, it is expected that cue strength will qualitatively modulate the effect of association. Only strongly happy cues should provide a robust cue to the self, resulting in a large self-prioritisation effect. Strongly negative cues represent a conflict with the self and thus should not trigger access to the self-semantic network as readily. Weakly representative cues in this case are relatively neutral as cues to the self (mild happiness and mild sadness are frequent in day to day life) and of the associated category. Thus, weakly representative cues should not boost or interrupt the self-prioritisation effect to a large extent but, once identified, they may provide access to self-associations that were differentially represented during the initial encoding phase.

## Methods

*Participants*. No a priori power estimate was used to justify sample size given the exploratory nature of this initial experiment. A target of fifty-six participants was selected to double the sample size of conventional within-subject investigations of the self-prioritisation effect. This number also allowed for the appropriate counterbalancing of response keys. See the Methods of Experiment 2 for the results of a power simulation based on the observed data of this experiment. Fifty-six adults ($M = 24.36$, $SD = 4.25$) volunteered to participate in the study in exchange for supermarket vouchers (1500 HUF). Twenty-eight were male and twenty-eight were female. All had normal or corrected to normal vision and could speak English.

*Stimuli and apparatus*. Two females and two males were randomly selected as stimuli from the FACES database (Ebner et al., 2010; Holland et al., 2019). Video morphs from neutral to happy[2] and neutral to sad[3] were used. Stills representing the extremes of the morph (happy and sad) were taken as "Strong" representations of the emotion. Stills from the 600 ms point of the video morph were taken as "Weak" representations of the emotion. Participants only saw stimuli that matched their gender. The background colour was grey and set to 169 cd/m$^2$. All text was black. Stimuli were presented on a computer running Windows 10 and a screen with a spatial resolution of 1920X1080 and a refresh rate of 60 Hz. All text was presented in English.

## Procedure

*Stimulus assignment and training*. Participants were instructed that they would be represented by either the "Happy" or the "Sad" stimuli and a stranger would be represented by the other type of stimuli (between-subjects manipulation). Participants then performed a brief training session (4 trials) to ensure that the stimulus mappings were committed to memory. Participants were posed with the question "Who does this stimulus represent?" The text "Happy" or "Sad" appeared below the question and participants were required to indicate if that type of stimulus represented themselves or the stranger. On average, participants achieved 97.32% (SD = 7.80%) accuracy with 50 participants answering all trials correctly.

*Matching task*. Participants were required to indicate if a given facial expression and an identity label (Self/Stranger) matched by pressing the "L" or the "K" key (counterbalanced between participants). The visual angle (VA) was estimated on the basis of the average viewing distance of 57 cm. A trial began with a black fixation cross (1.4° X 1.4° VA) on a grey background presented for 500 ms. A facial expression (5° X 3.5° VA; Happy: Wide smile, Slight smile; Sad: Slight frown, Wide frown) appeared above or below the fixation cross-paired with a label (height: 1.4° VA) that was on the other side of the fixation cross (vertical dimension) for 233 ms after which the screen went blank. The centre of the fixation cross was 5.0° VA away from the centre of each stimulus (Shape and Label). Participants were required to respond within 1500 ms after the stimulus disappeared. Response feedback ("Correct", "Incorrect", "Too slow") was presented for 500 ms. There was a variable intertrial interval of 500–800 ms. See Figure 1, E1 for a visual depiction of a trial. After completing the above training trials, participants completed 4 blocks totalling 384 trials (96 in each block). Participants received feedback regarding the percentage of trials on which they answered correctly after each block. The factors of location, facial expression stimulus, and label were fully counterbalanced and randomised within a block.

*Questionnaire*. Upon completing the matching task, participants were asked to rate their personality along a given dimension where 0 = Sad and 100 = Happy.

## Design and data analysis

Self-prioritisation is a well-established phenomenon and the hypotheses speak to modulation of the self-prioritisation effect rather than its existence. For this reason, response time difference between stranger- and self-trials (the self-prioritisation effect itself) was used as the dependent variable as a direct test of the hypotheses.[4] A positive value represents a self-prioritisation effect, and a negative value represents a self-inhibition effect.

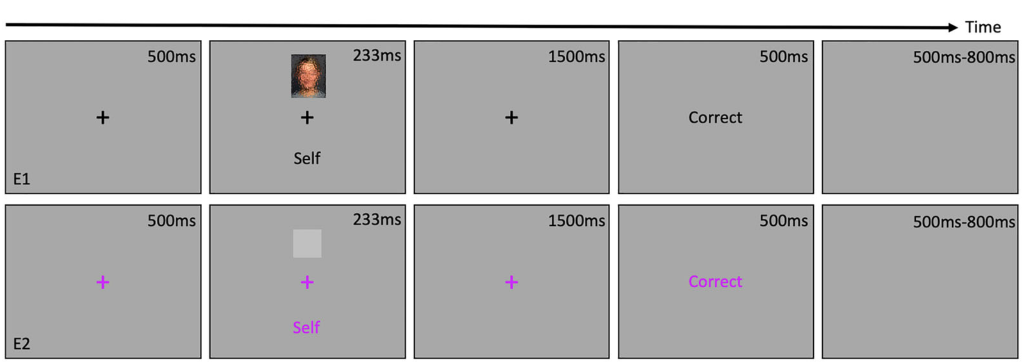


**Figure 1.** Time course of a trial for Experiments 1 and 2. The blur to the face depicted is only for the purpose of the figure. In the experiment, the real unblurred image was used. Text in Experiment 2 was purple to avoid possible priming effects.

In line with previous work within this laboratory (Constable, Elekes, et al., 2019), the study was designed to prioritise accuracy, thus, difference in response time is the primary measure of interest and the difference in accuracy is only provided for the sake of completeness. Comments in the manuscript are thus restricted to response time self-prioritisation effects.

An accuracy threshold of 60% was selected to increase the likelihood that we were analysing the processes of interest (e.g. this removed participants who guessed the majority of their answers). Participants who performed worse than this pre-defined criterion were not submitted to inferential statistics. Similarly, if participants could not accurately indicate what type of stimuli they and the stranger had been assigned to on more than 50% of the training trials then they were excluded.

Hypotheses focus on match trials because self-prioritisation reliably manifests in those trials only. This resulted in a primary analysis plan that consisted of a 2(Strength) × 2(Association) mixed ANOVA, with strength as the within-subjects factor and association as the between-subjects factor, and appropriate follow up tests. This same analysis was completed for mismatch data and accuracy data on an exploratory level.

## Results and discussion

Raw data and the data submitted to inferential statistics has been uploaded to the OSF.

Outliers (3 SD above or below the mean) and trials on which participants did not respond were removed prior to analysis (2.70%). Three sets of participant data were removed prior to the analysis because participants did not achieve above the required performance threshold (>60%, Participants 14, 34, and 53 in raw data). Henceforth, n = 53. All data was analysed using JASP (JASP Team, 2020).

*Personality check.* Participants rated themselves as more happy than sad as indicated by a one sample t-test with a test value of 50, $M = 68.89$, $t(52) = 5.47$, $p < .001$, $d = .75$. No difference was observed for ratings as a function of association, $M_{diff} = 7.79$, $t(51) = 1.13$, $p = .26$, $d = .31$.

*Match trials.* The match trials were submitted to a 2(Strength) × 2(Association) mixed ANOVA with Strength as the within-subjects factor and Association as the between-subjects factor for both response time and accuracy difference scores.

*Response time difference.* A main effect of Strength emerged, $F(1,51) = 5.62$, $p = .02$, $\eta_p^2 = .10$, such that the self-prioritisation effect was larger when participants were responding to the strongly representative stimuli (108 ms) than when they were responding to the weakly representative stimuli (86 ms). There was also an effect of Association, $F(1,51) = 14.51$, $p < .001$, $\eta_p^2 = .22$. A larger self-prioritisation effect was observed when participants made the association with "Happy" (146 ms) than when they made the association with "Sad" (56 ms). These effects were qualified by an interaction, $F(1,51) = 24.67$, $p < .001$, $\eta_p^2 = .33$, such that the magnitude of the self-prioritisation effect was larger for participants who made the "Happy" association only when the stimuli strongly represented the concept, $M_{diff} = 137$ ms, $t(51) = 5.34$, $p < .001$, $d = 1.47$. On trials where stimuli only weakly represented the concept, no difference was observed in the magnitude of the self-prioritisation effect on the basis of the association made, $M_{diff} = 36$ ms, $t(51) = 1.49$, $p = .14$, $d = .41$ (See Figure 2).

*Accuracy difference.* No main effects or interactions were obtained in terms of accuracy rates, $Fs < 1.08$ (See Table 1).

*Mismatch trials.* As with match trials, the mismatch trials were submitted to a 2(Strength) × 2(Association) mixed ANOVA with Strength as the within-subjects factor and Association as the between-subjects factor.

*Response time difference.* A main effect of Strength emerged, $F(1,51) = 5.93$, $p = .02$, $\eta_p^2 = .10$, such that a larger self-inhibition effect was observed on trials where the stimulus weakly represented the concept (43 ms) as compared to trials where the stimulus strongly represented the concept (19 ms). There was no effect of Association, $F(1,51) < 1$. There was, however, an interaction between Strength and Association, $F(1,51) = 30.58$, $p < .001$, $\eta_p^2 = .38$. The source of this interaction was a larger self-inhibition effect for stimuli that strongly represented the concept relative to stimuli that weakly represented the concept for the participants who made the "Sad" association, $M_{diff} = -35$ ms, $t(27) = -2.45$, $p = .02$, $d_{av} = -.64$. The opposite was the case for participants who made the "Happy" association: stimuli that weakly represented the concept resulted in a larger self-inhibition effect as compared to stimuli that strongly represented the concept, $M_{diff} = 91$ ms, $t(24) = -5.06$, $p < .001$, $d_{av} = 1.46$ (see Figure 2). In fact, testing against zero, stimuli that were strongly happy did not generate any observable self-prioritisation/inhibition effects, $t(24) = 1.60$, $p = .13$, $d = .32$.

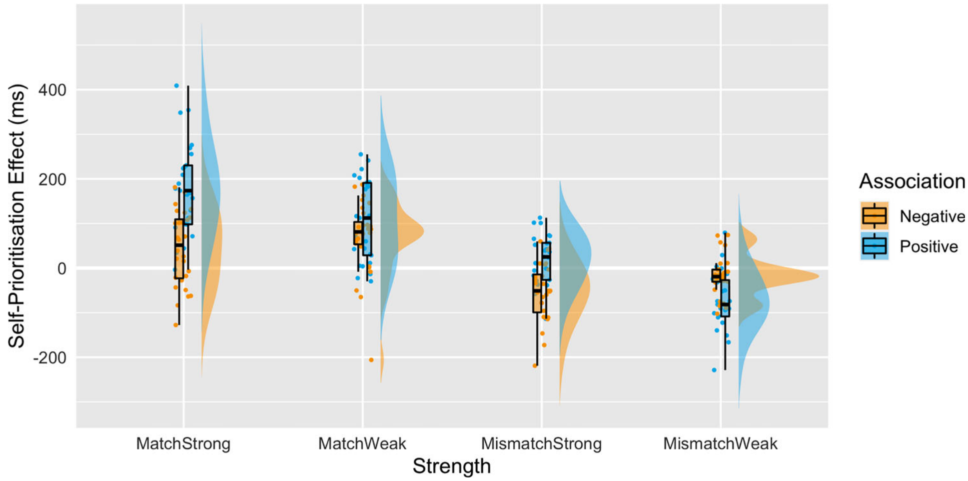


**Figure 2.** Raincloud plots (Allen et al., 2019) of the Self-Prioritisation Effect (Stranger RT – Self RT) as a function of Trial Type (Match/Mismatch), Strength (Strong/Weak) and Association (Negative/Positive). Participants who associated themselves with the negative concept are shown in orange and participants who associated themselves with the positive concept are shown in blue. Scatter points (randomly jittered) show individual average self-prioritisation effects, and boxplots and vertical density plots show the distribution of these individual averages.

*Accuracy Difference*. No main effect of Strength was obtained, $F(1,51) = 1.40$, $p = .24$, $\eta_p^2 = .03$, but an effect of Association did emerge, $F(1,51) = 7.1$, $p = .01$, $\eta_p^2 = .12$. Participants who had made the positive association demonstrated a larger self-inhibition effect (4.29%) as compared to those who made the negative association [0.77% was not significantly different from 0, $t(27) = 0.58$, $p = .57$, $d = .11$]. The interaction term was not significant, $F(1,51) = 3.28$, $p = .08$, $\eta_p^2 = .06$ (see Table 1).

Overall, the data indicate that positively valenced stimuli result in a larger self-prioritisation effect in match trials. The results are consistent with the original theoretical rationale that positively valenced self-associations are more readily embedded and/or accessed within memory structures. For the weakly representative trials (and thus less affectively valenced trials), the self-prioritisation effect is of similar magnitude regardless of association. It is possible that weakly representative stimuli may be affectively (and conceptually) more neutral and thus result in less of a boost to self-stimuli in the case of consistent (happy) stimuli or less conflict during retrieval in the case of inconsistent (sad) stimuli.

**Table 1.** Self-prioritisation accuracy effect (Self – Stranger) for Happy and Sad Associations by Strength and Trial Type. SD in brackets.

| | Happy | Sad |
|---|---|---|
| Match | | |
| Strong | 10.74%(9.25%) | 9.69%(9.95%) |
| Weak | 8.63%(14.51%) | 10.91%(12.51%) |
| Mismatch | | |
| Strong | −3.76%(9.66%) | −1.92%(9.43%) |
| Weak | −4.90%(9.28%) | 3.53%(10.15%) |

## Experiment 2

Experiment 1 supplied preliminary evidence suggesting that strongly negatively and positively valenced concepts respectively dampen and amplify the self-prioritisation effect. Perhaps the self-compatibility of a stimulus can impact the extent to which a self-judgment benefits from processes that lead to the phenomenon of self-prioritisation? Experiment 2 was designed to determine if the valence effect obtained above would extend to a metaphorical level. Although a stimulus might be conceptually abstract in terms of possible links to the self and affect, emotional experiences are nonetheless often embodied within stimuli (Crawford, 2009). This can be seen and experienced through day to day use of metaphoric language: "The sunny side up", "The bright side of life", "In a dark place". The dark/light to negative/positive association has been well researched and is pervasive (Meier et al., 2007). Thus, participants were asked to associate themselves with dark or light stimuli and strangers with the opposing stimulus category. Participants then performed the matching task with stimuli that differed in luminance.

## Methods

*Participants*. Using the observed match trial data from Experiment 1, a power simulation (Lakens & Caldwell,

2019) revealed sufficient power to detect the interaction of interest with 28 observations per cell (98%).[5] Thus, the same target for recruitment as Experiment 1 was set. Fifty-six adults ($M = 24.34$, $SD = 4.37$) volunteered to participate in the study in exchange for supermarket vouchers (1500 HUF). Twenty-five were male and thirty-one were female. All had normal or corrected to normal vision and could speak English.

*Stimuli and apparatus.* Four grey scale squares that varied in luminance were used as stimuli. All stimuli were presented on a grey background that was set such that the luminance difference between the light and dark stimuli was approximately equal. The weakly representative stimuli were set to the midpoint between the background and the "strong" stimuli. Luminance: Strong Dark = 2 cd/m$^2$, Weak Dark = 86 cd/m$^2$, Grey (Background) = 169 cd/m$^2$, Weak Light = 255 cd/m$^2$, Strong Light = 340 cd/m$^2$. These stimuli were measured with a ColorCAL MKII Colorimeter (Cambridge Research Systems). All text was presented in purple to avoid possible correspondence with the squares. Stimuli were presented on a computer running Windows 10 and a screen at maximum brightness with a spatial resolution of 1920X1080 and a refresh rate of 60 Hz. All text was presented in English and the experiment was completed in darkness because luminance was the relevant feature of the stimuli.

### Procedure

*Stimulus assignment and training.* Participants were instructed that they would be represented by either the "Dark" or the "Light" stimuli and a stranger would be represented by the other type of stimuli (between-subjects manipulation). Participants then performed a brief training session (8 trials) to ensure that the stimulus mappings were committed to memory. Participants were posed with the question "Who does this stimulus represent?" The text "Dark" or "Light" appeared below the question and participants were required to indicate if that type of stimulus represented themselves or the stranger. On average, participants achieved 95% accuracy with 44 participants answering correctly on all trials. One participant achieved 37.5% accuracy (Participant 25 in raw data). Their data was not included in the inferential statistics according to the same criterion used in Experiment 1.

*Matching task.* Participants were required to indicate if a given gray-scale patch and a label matched by pressing the "L" or "K" key (counterbalanced between participants). The time course of the trial remained the same as in Experiment 1. Participants completed 8 practice trials, followed by 4 blocks totalling 192 trials. Participants were given feedback regarding the percentage of trials on which they answered correctly after each block. The factors of location, text colour, grey-scale stimulus and label were fully counterbalanced and randomised within a block. See Figure 1, E2 for the time-course of a trial.

### Design and data analysis

The design and data analysis remained the same as in Experiment 1.

## Results and discussion

Raw data and the data submitted to inferential statistics has been uploaded to the OSF.

Trials three standard deviations above or below the participant's mean and trials where no response was made (3.5%) were removed prior to analysis. One participant was removed because they failed to make a response on 38.8% of all trials (participant 14 in the raw data). This issue was not foreseen, and the removal of this participant was therefore a post hoc decision. According to the original data treatment plan, a further four participants were removed because they achieved less than 60% accuracy (participants 2, 27, 30 and 53 in the raw data). Henceforth, $n = 50$. All data was analysed using JASP (JASP Team, 2020).

*Match trials.* The match trials were submitted to a 2 (Strength) × 2(Association) mixed ANOVA with Strength as the within-subjects factor and Association as the between-subjects factor.

*Response time difference*. There was a main effect of Association, $F(1,48) = 8.87$, $p = .005$, $\eta_p^2 = .16$. The magnitude of self-prioritisation was larger when participants made a "Light" association (90 ms) than when they made a "Dark" association (41 ms). The main effect of Strength did not reach significance, $F(1,48) = 2.87$, $p = .10$, $\eta_p^2 = .056$. An interaction also emerged, $F(1,48) = 16.78$, $p < .001$, $\eta_p^2 = .26$. The source of this interaction was due to a significant effect of Association for the weakly representative trials, $M_{diff} = 78$ ms, $t(48) = 4.39$, $p < .001$, $d = 1.24$: the self-prioritisation effect was larger for participants who made the "Light" Association (99 ms), those who made the "Dark" association did not exhibit a self-prioritisation effect [21 ms was not significantly different from 0, $t(24) = 1.53$, $p = .14$, $d = .31$]. No difference on the basis of Association was observed for the strongly representative trials, $M_{diff} = 22$ ms, $t(48) = 1.21$, $p = .23$, $d = .34$ (Light = 83 ms, Dark = 60 ms, see Figure 3).

*Accuracy difference*. No main effects were obtained: Strength, $F(1,48) = 0.57$, $p = .46$, $\eta_p^2 = .01$; Association, $F(1,48) = 3.33$, $p = .07$, $\eta_p^2 = .07$. An interaction did, however, emerge: $F(1,48) = 10.93$, $p = .002$, $\eta_p^2 = .19$. The source of this interaction was due to a significant effect of Association for the weakly representative trials, $M_{diff} = 8.50\%$, $t(48) = 2.99$, $p = .004$, $d = .85$: the self-prioritisation effect was larger for participants who made the "Light" association (11.50%). Those who made the "Dark" association did not exhibit a self-prioritisation effect [3% was not significantly different from 0: $t(24) = 1.59$, $p = .13$, $d = .32$]. No difference on the basis of Association was observed for the strongly representative trials, $M_{diff} = 1.6\%$, $t(48) = .53$, $p = .60$, $d = .15$ (Light = 8.9%, Dark = 7.2%, see Table 2).

*Mismatch trials*. As with match trials, the mismatch trials were submitted to a 2(Strength) × 2(Association) mixed ANOVA with Association as the between-subjects factor.

*Response time difference*. There was a main effect of Association, $F(1,48) = 48.59$, $p < .001$, $\eta_p^2 = .50$. Participants who made the "Light" association did not exhibit a self-prioritisation effect [7 ms was not significantly different from 0: $t(24) = .12$, $p = .91$, $d = .02$] whereas participants who made the "Dark" association exhibited a 50 ms self-inhibition effect. The effect of Strength was not significant, $F<1$, but the interaction was significant, $F(1,48) = 6.08$, $p = .02$, $\eta_p^2 = .11$. The source of this interaction was a significant difference in the self-prioritisation (inhibition) effect between the strongly representative trials and the weakly representative trials in the "Dark" association group only, $M_{diff} = 16$ ms, $t(24) = 2.10$, $p = .046$, $d_{av} = .40$. Weakly representative trials displayed greater inhibition (58 ms) than strongly representative trials (42 ms). No difference between strongly and weakly representative trials was observed for participants who made the "Light" association, $M_{diff} = -13$ ms, $t(24) = -1.47$, $p = .16$, $d_{av} = -.41$ (see Figure 3).

*Accuracy difference*. A main effect of Strength was observed, $F(1,48) = 4.88$, $p = .03$, $\eta_p^2 = .09$, such that participants' self-inhibition effects in accuracy were greater for the strongly representative stimuli (−3.11%). No effects were observed for weakly

**Table 2.** Self-prioritisation accuracy effect (Self − Stranger) for Light and Dark Associations by Strength and Trial Type. SD in brackets.

| | Light | Dark |
|---|---|---|
| Match | | |
| Strong | 8.89%(11.41%) | 7.24%(10.45%) |
| Weak | 11.55%(10.66%) | 3.02%(9.48%) |
| Mismatch | | |
| Strong | −2.11%(5.24%) | −4.10%(8.65%) |
| Weak | −0.74%(4.81%) | −1.66%(7.72%) |

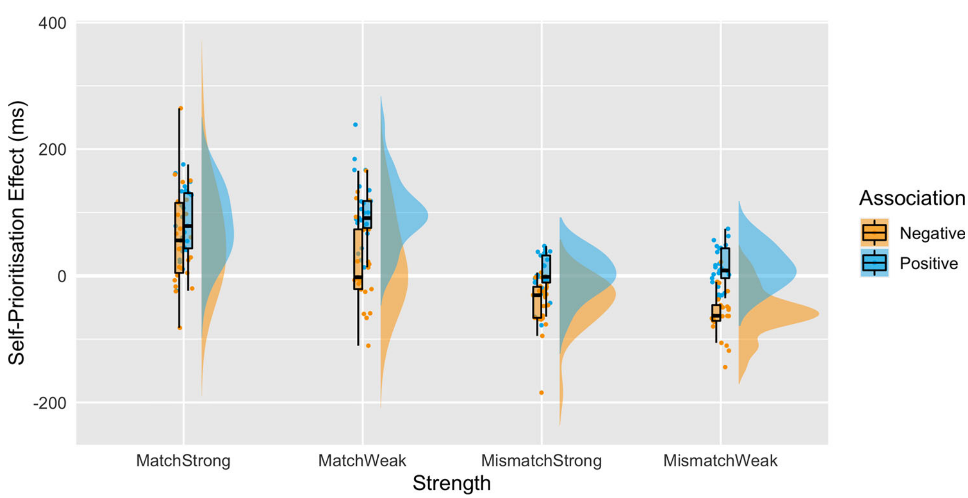


**Figure 3.** Raincloud plots (Allen et al., 2019) of the Self-Prioritisation Effect (Stranger RT − Self RT) as a function of Trial Type (Match/Mismatch), Strength (Strong/Weak) and Association (Negative/Positive). Participants who associated themselves with the negative concept are shown in orange and participants who associated themselves with the positive concept are shown in blue. Scatter points (randomly jittered) show individual average self-prioritisation effects, and boxplots and vertical density plots show the distribution of these individual averages.

representative stimuli [−1.20% was not significantly different from 0: $t(49) = -1.33$, $p = .19$, $d = -0.19$]. Neither the main effect of Association nor the interaction were significant, $Fs < 1$ (see Table 2).

Overall, the pattern of data still shows a reduced self-prioritisation effect for participants who made a negative association. In fact, the self-prioritisation effect was abolished for the weakly representative dark stimuli. This suggests that valence modulations can still be generated through more abstract and indirect routes. The pattern for the interaction, however, was not the same as in Experiment 1 and this issue will be explored further in the General Discussion.

## General discussion

The aim of the present work was to evaluate if and how stimulus-to-self consistency would modulate self-prioritisation. Greater self-prioritisation was expected when categorical associations were consistent with the universal link between positive affect and self, because an association that is compatible with the self could be more readily embedded within and retrieved from self-memory structures. The results broadly indicated that the magnitude of self-prioritisation was influenced by associations with emotional faces (Experiment 1) and luminance (Experiment 2) such that larger effects were observed for participants who made positive associations compared to participants who made negative associations.

Experiment 1 exhibited what could be characterised as a graded effect: a large self-prioritisation effect was observed for very happy stimuli, a smaller effect for the weakly happy and sad stimuli, and the smallest effect for the very sad stimuli. This graded effect could be explained by the extent to which the cue (face) is compatible with the self. That is, the cue that was most compatible with the universal self (very happy) acted as the best retrieval cue, followed by weak stimuli (effectively emotionally neutral), and finally the least compatible cue (very sad) acted as the poorest retrieval cue.

Such an effect could also be interpreted as an interaction between the strength of representativeness of the cue to its category (Happy/Sad) and the compatibility the cue had to the self. The weakly representative stimuli here are relatively neutral in terms of both valence and self-links and, indeed, both weakly happy and weakly sad stimuli exhibited self-prioritisation effects. In terms of the strongly representative cues, however, starkly different patterns of results were observed for each group of participants. Those who were assigned to the happy condition received an additional boost to self-prioritisation when they observed a smiling stimulus and those who were assigned to the sad condition lost the self-benefit. The compatible stimulus (smile) might have provided an additional benefit to self-prioritisation whereas the incompatible stimulus (frown) produced conflict or cognitive uncertainty between the self and the specific experimental self-mapping that was being retrieved resulting in a reduced self-prioritisation effect.

Experiment 2, however, indicates that a slightly more nuanced explanation might be needed. Although Experiment 2 replicated the main effect of Association (self-prioritisation was greater for participants who associated themselves with light stimuli), the interaction between strength and association manifested differently. Specifically, the disparity between the magnitude of self-prioritisation shifted to the weakly representative stimuli. There are several key differences between the experiments that may provide clues to why this was the case. First, the representation of valence was more metaphorical. That is, the experience of valence in relation to emotional faces was intended to be more direct than the experience of valence in relation to luminance. If there is a more direct pathway to valence for emotional faces, the strongly representative emotional stimuli might have also been more readily interpreted with reference to compatibility with the self than the more indirect route from luminance-based cues. Second, distinguishing the emotional faces was slower (897 ms) than the luminance-based stimuli (692 ms). This ~200 ms overall difference is likely due to the background representing an in-built direct comparison that assisted in identification of the stimulus in Experiment 2. Thus, it could be speculated that the self-prioritisation effect is modulated by stimulus-to-self compatibility only when there is sufficient time for connected nodes to be activated or through a very direct stimulus-to-concept (valence) connection. In the case of strongly representative luminance-based cues, there is sufficient access to the chronically activated self to generate a standard self-prioritisation effect. The weakly representative stimuli, however, created more perceptual uncertainty which resulted in longer reaction times and thus provided more opportunity for conceptual compatibility to exert an influence on the self-prioritisation effect. In the case of the more direct links from emotional stimuli in Experiment 1, the boosting and dampening effects may be observed more readily and the weak stimuli may simply represent more affectively neutral cues.

Another implication of this data pattern worth highlighting concerns the stimulus as a retrieval cue. Contrary to hypotheses, valence-based modulations were not uniformly present suggesting that retrieval plays a key role in the effect. This might also suggest that the retrieval cue provides greater weight in possible modulations than the initial association. Indeed, the results demonstrate that the self is not just a means to a positivity bias but that the assignment of even abstract valenced stimuli to the self-impacts the ability to process and respond to that stimuli.

The hypotheses in the present work were generated from memory-based theories. Perceptual/Attentional theories of the self-prioritisation effect have also been popular (SAN: Humphreys & Sui, 2016; SOAP: Truong & Todd, 2017). The theory of the Self-Attention Network (SAN) has been particularly influential and proposes that self-representations are rapidly activated by the presence of a self-stimulus and this rapid self-activation triggers bottom-up orienting processes. Top-down attentional control may also operate to inhibit these processes when required and enhance self-biases further by tapping into prior expectancies for the presence of self-related stimuli. Can the present data also be explained using perceptual and attentional processes? From an attentional perspective such as the SAN, there are no clearly laid out predictions concerning valence. However, the results of Experiment 1 may be consistent with an attentional account when integrating findings concerning the Happy Face Superiority Effect.

Happy faces (and Angry faces) often receive elevated attention (Craig et al., 2014; Savage et al., 2013). Here, weakly representative stimuli could initially be processed as relatively (emotionally) neutral, therefore, a standard self-prioritisation effect would occur on these trials. In the case of the strong condition, one would expect the happy faces to receive a boost to processing. Combining this boost with the happy association condition, a larger self-prioritisation effect could be observed because of a boost from happy and a boost from self. In the sad association condition, however, a boost from self and a boost from happy (which is associated with stranger) would combine and look like a reduced self-prioritisation effect. Further post hoc analysis of the data looking at mean response times before calculation of the self-prioritisation effect does support this prediction with participants who made the sad association responding slower to self and faster to stranger on strongly representative trials (see supplementary analyses on the OSF). Nevertheless, it is unclear how these predications would map theoretically to the abstract valence mappings used in Experiment 2. Further, and regardless of theory, the pattern of results for Dark/Light associations does not follow the pattern of a uniform boost to light even when associated with stranger.

Where an attentional explanation of the present data does not seem to be the most parsimonious, the self-prioritisation effect is thought to index multiple (and possibly interactive) processes in the cognitive timeline. Beyond memory, the research on the self-prioritisation effect has generated studies that have been either designed or analysed in a way that illustrates the effects of the self on perception (Macrae et al., 2018; c.f. Stein et al., 2016), attention (Truong et al., 2017), and response biases (Constable, Welsh, et al., 2019; Golubickis et al., 2018), as well as the influence of selection history on cognitive processing (Woźniak & Hohwy, 2020). As such, valenced manipulations using such stimulus assignment tasks may provide a means of tapping into the self-positivity bias at multiple stages of the cognitive processing timeline and allow researchers to isolate how and when valence has an impact on the ability to respond to a self-relevant stimulus.

One curious by-product of a cognitive system that amplifies a positive link or dampens a negative link to the self may be that the positive-self might be regularly reinforced. For example, easily retrieving a happy association reinforces the belief “I am happy”. Conversely, difficulty retrieving a negative association reinforces the belief “I am not sad”. And, these effects might extend outwards to a generalised positivity bias. Such effects could contribute to the maintenance of a positive self-esteem. Nevertheless, these effects might not necessarily be characterised within the context of a positivity bias; a consistency bias might be more accurate (Kuiper & Derry, 1982; Lloyd & Lishman, 1975). In this case, if self-prioritisation is looked at on the individual level, it would be expected that modulations would occur in relation to the individual’s own self-representation. Although it is true that on a population level the self is viewed as positive, there is considerable variation on the individual level with how much positive and negative representations are integrated with the self.

Where typical investigations of the self-prioritisation effect have focused on how the cognitive system rapidly processes self-tagged stimuli, the present work asks how the valence of the self-tagged stimulus might modulate this rapid processing. The addition of valence as a factor in the present studies is reminiscent of the Self Implicit Association Test (sIAT), which measures the automatic association between a relative dichotomous concept and the self-other dimension (Greenwald & Farnham, 2000; Karpinski, 2004; Pinter & Greenwald, 2005). In the sIAT participants responses are measured when the self-shares the same response key with the measured dimension (e.g. pleasant and unpleasant stimuli). The stronger the association between the concepts bound to the same key, the easier the response execution. An aggregate score that consists of responses when the self is bound to the same key as pleasant and unpleasant stimuli is computed (along with a score for other). This is thought to measure the relative strength of pleasantness/unpleasantness in relation to the self. Although similar in nature, the present approach considers how well a positive concept is integrated with the self and separately considers the level of resistance that the cognitive system has against incorporating (or retrieving) a negative association.

Given that those with low self-esteem or depressive symptoms incorporate both positive and negative concepts into the self-schema whereas controls tend not to incorporate negative concepts (Dozois & Dobson, 2001; Kuiper & Derry, 1982), an easy to employ tool such as a shape/label matching task that can index the strength of positive and negative associations separately could be useful. A resistance to incorporating overly negative concepts into the self could have protective capabilities (Taylor & Brown, 1988); therefore, it could be interesting to use this task to explore the link between resilience and the strength of negative associations in cognition, as measured by verification times towards the self and the negative concept. Although it is possible to extract similar measures from sIAT data, the presently discussed method is complementary because computational investigations of this task have shown that a range of processes within the cognitive processing timeline can be isolated (Constable, Rajsic, et al., 2019; Constable & Knoblich, 2020; Falbén et al., 2020; Golubickis et al., 2018). It is quite possible that assigning valenced stimuli to the self-influences perception, attention, memory and response biases differently and this may have further consequences for the way in which an individual responds and interacts to the world around them. Nevertheless, the present work targeted self-prioritisation (Sui et al., 2012) and the universal positive self (Schmitt & Allik, 2005; Yamaguchi et al., 2007) on the population level; informative work on individual differences would require that the psychometric properties of the present task had been properly assessed (Parsons et al., 2019).

The focus of the present work was to evaluate how compatibility of self-associated information shapes information processing. The self-prioritisation effect was found to be consistent with the general prediction that conceptual consistency with the self would modulate the self-prioritisation effect. The work also provides a new take on the link between positive valence and the self by showing that even abstract embodied connections between a stimulus and the self can spark modulations in the self-prioritisation effect. In sum, the pattern of results are consistent with the idea that self-semantic networks are organised in such a way that facilitates the encoding and/or retrieval of positive and neutral information but dampens the influence of negative information. By design, this is suggestive of a human cognitive system that is oriented to shape a positive and consistent reality.

## Ethical declaration

Prior to the experiment participants gave written informed consent to the procedures. All procedures were in adherence with the ethical standards of the 1964 Declaration of Helsinki regarding the treatment of human participants in research and were approved by the local ethics committee (United Ethical Review Committee for Research in Psychology [EPKEB]).

## Notes

1. Perceptual matching tasks typically show that confirmatory responses are responded to more efficiently than disconfirmatory responses (Krueger, 1978; Proctor, 1981; Ratcliff, 1985). In terms of a self-categorization task, it is possible that a “self” response could be cognitively represented as a confirmatory response (e.g. mine vs. not mine).
2. Female Files: 115_y_f_n_h & 152_y_f_n_h. Male Files: 062_y_m_n_h & 099_y_m_n_h from the FACES database

3. Female Files: 115_y_f_n_s & 152_y_f_n_s. Male Files: 062_y_m_n_s & 099_y_m_n_s from the FACES database
4. An analysis of the averages of each condition is provided on the OSF, see discussion for more details.
5. We took a conservative estimate of the population standard deviation (0.11 s). All other values were the observed values in Experiment 1. Given that Experiment 2 was not a direct replication, the RTs were less variable and the correlation between variables was higher than Experiment 1, a second power simulation was conducted on the results of Experiment 2. This power simulation indicated 98.3% power to detect the interaction of interest with a population standard deviation of 0.063 which was more reflective of the results.

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MDC & GK conceived of the studies. MDC, MB & GK designed the experiments, Y-IO collected E1 data, MB collected E2 data. MDC, MB, & Y-IO wrote the results. MDC wrote the manuscript. All authors contributed to editing the manuscript.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

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## Appendix

**Table 3.** Response Time means (ms, SD in brackets) for Experiment 1 as a function of Association, Identity, Trial Type and Strength.

| | Happy | | Sad | |
|---|---|---|---|---|
| | Self | Stranger | Self | Stranger |
| Match | | | | |
| Strong | 761(101) | 941(127) | 841(139) | 884(132) |
| Weak | 875(111) | 980(123) | 862(151) | 932(148) |
| Mismatch | | | | |
| Strong | 917(101) | 936(116) | 939(133) | 886(116) |
| Weak | 1013(120) | 941(128) | 945(135) | 927(120) |

**Table 4.** Response Time means (ms, SD in brackets) for Experiment 2 as a function of Association, Identity, Trial Type and Strength.

| | Light | | Dark | |
|---|---|---|---|---|
| | Self | Stranger | Self | Stranger |
| Match | | | | |
| Strong | 618(99) | 700(100) | 667(103) | 727(131) |
| Weak | 612(89) | 719(111) | 714(118) | 735(119) |
| Mismatch | | | | |
| Strong | 699(91) | 700(99) | 763(114) | 721(118) |
| Weak | 697(89) | 711(96) | 784(127) | 726(111) |