Abstract

The Self-Prioritization effect denotes the apparent advantage in performance for self-related stimuli in a shape-label matching task. It has been argued that the effect reflects unique representations of self-related items that affect early perceptual processing. This study tested an alternative explanation according to which self-related items are not unique but rather the first in line for comparison in the memory matching task. Experiment 1 replicated the basic effect. Experiment 2 examined the necessity of self-related stimuli to the emergence of a prioritization effect and found a similar effect with another socially important concept – *father*. The father concept also yielded responses similar to the self when both of these labels appeared in the same setting (Experiment 3). Finally, the Self-Prioritization effect was eliminated when the associations used in Experiment 1 were learned in a structured order in which the self-label was the second association to be learned (Experiment 4). Together, these findings indicate that the effect is driven by the tendency to start the shape-label matching process with the self. This tendency is robust, but not unique to the self and can be easily modified with short practice. Hence, the Self-Prioritization effect can be explained without postulating unique representations of self-related items.

***Keywords**:* Self-prioritization, Shape-label matching task, Memory scanning

Significance Statement

- The Self-Prioritization effect (SPE) is a widely investigated effect, that denotes an extraordinary advantage in performance to objects related to the self-concept relative to other objects.
- The study tested a more parsimonious explanation for this effect, that builds on people’s tendency to scan objects in memory according to their hierarchy.

- To test this explanation, and more generally, the uniqueness of the self in producing such prioritization effects, we conducted several experiments.
- We found prioritization effects for concepts other than the self, even when the self was present in the same context. Moreover, a short training task that tampers with the hierarchy of the concepts eliminated the SPE.
- These findings suggest that the SPE can be explained without postulating unique representations of self-related items.

Are Self-Related Items Unique? The Self-Prioritization Effect Revisited

There is a long history to the claim that the self is an extraordinary and unique concept that modulates how people attend, perceive, and remember items that relate to it. Memory, for example, was found to improve when information is encoded with relevance to the self. In a seminal study (Rogers et al., 1977), participants recalled words better when those words were encoded with relevance to the self than when the words were encoded with a different, non-self relevance. This effect emerged even for words that were not self-describing, suggesting that any information relevant to the self is encoded more deeply and thoroughly (Klein & Loftus, 1988; Symons & Johnson, 1997, see also Leshikar et al., 2015; Markus, 1977).

The strong claim regarding the uniqueness of the self-concept was later undermined by evidence showing that other concepts are capable of inducing memory advantages similar to those found for the self-concept (e.g., the mother concept, Bower & Gilligan, 1979). That research concluded that the self-concept is “ordinary but powerful” (Greenwald & Banaji, 1989). That is, it has robust effects on information processing, but so do other concepts. Moreover, some research failed to find an advantage of the self-concept (e.g., Maki & McCaul, 1985; Velichkovsky, 1999, see review in Klein, 2012; McConnell et al., 2013), suggesting that the self-concept is “neither necessary nor sufficient for memory of input to be facilitated” (Higgins & Bargh, 1987, p. 392).

The claim that the self-concept has unique consequences in information processing has recently been revived with the introduction of a novel paradigm by Sui and colleagues that consistently demonstrated differential effects of items associated with the self-concept relative to other concepts (Sui et al., 2012). In this paradigm, geometric shapes (circle, square, triangle) are verbally associated with labels denoting the self (*you*), and familiar and unfamiliar others (e.g., *your friend*, *a stranger*). Then, participants undergo a shape-label matching task, in which they are required to indicate whether a presented shape-label pair matches or does not match the information learned earlier. The results consistently showed a self-prioritization effect: RTs were faster on match trials that contained the shape that was previously associated with the self-concept, compared to trials in which the shape was associated with a familiar or unfamiliar other. Furthermore, accuracy rates and perceptual sensitivity (as measured by d`) followed this pattern and indicated better overall accuracy and higher perceptual sensitivity to the shape associated with the self. Subsequent experiments showed that the effect was not due to the enhanced familiarity with the self-concept (a critical problem of other self-related paradigms) because the self-related items were prioritized even over items that were associated with the highly familiar *mother* concept (Sui et al., 2012).

The self-prioritization effect (SPE) is robust and has been successfully replicated multiple times in several labs since its original demonstration (e.g., Enock et al., 2018; Kim et al., 2019; Woźniak et al., 2018; Yin et al., 2019). To account for the effect it has been argued that items associated with the self are more strongly bound and can therefore act as perceptually salient items in that they automatically capture attention and their visual processing is prioritized (Humphreys & Sui, 2016; Sui et al., 2012; Sui & Humphreys, 2015; Sui & Rotshtein, 2019). Thus, the SPE reflects a perceptual advantage similar, yet distinct to the ones found for stimuli associated with monetary reward (Yankouskaya et al., 2018) and to emotional stimuli (Stolte et al., 2017).

Support for the unique representation of self-related items further comes from an imaging study that related the perceptual advantage of self-related stimuli over other-related stimuli to the activation of different brain regions (Sui et al., 2013). Self-related stimuli were also found to be unique in that they gain quicker access to visual awareness (Macrae et al., 2017; but see Stein et al., 2016) and that they can affect eye-movements behavior (Stolte et al., 2017; Yankouskaya et al., 2017). It was also found that self-related items serving as attentional cues can facilitate early perceptual processes (Macrae et al., 2018). Together, these findings suggest that items that are associated with the self-concept are uniquely represented from relatively early stages of processing.

Still, the results of several other studies were not in line with the dominant view that self-related items are unique. For instance, it was found that the SPE is task-specific and that the perceptual advantage of self-related items is not obligatory and does not readily transfer to another non-matching task (e.g., Caughey et al., 2020; Siebold et al., 2015). Moreover, the results of Janczyk et al. (2018) that used the psychological refractory period paradigm to pinpoint the locus of the effect indicated that self-related items affect central, capacity-limited processes rather than early perceptual processes. Together, these findings give rise to the notion that the SPE is task-specific that could be related to late decisional and memory processes, rather than to the unique representation of self-related items. Thus, the exact mechanism underlying the SPE still needs to be determined. Notably, given the conclusions of the previous round of the debate regarding the (lack of) unique processing of self-relevant items, it seems particularly important to examine whether the SPE can be explained without postulating unique representations of self-related items.

The goal of the present study was to test the possibility that the source of the SPE lies in the specific characteristics of the shape-label matching task, and not in the self. In this matching task, participants need to scan their memory and make self-terminating serial comparisons between the probe display and the learned associations (Ratcliff, 1978; Sternberg, 1966). Critically, we speculated that a highly salient concept is likely to be prioritized in the comparison process and participants are therefore prone to initiate their scan with the information that is ranked highest in the memory hierarchy, typically the self-concept (e.g., *was this shape associated with the 'you'* *label?*). Only if the outcome of this comparison is negative then they move on to scan and match the other types of information (*was this shape associated with 'friend', or with 'stranger'?*). Thus, according to this alternative explanation, the main reason that the SPE is repeatedly observed is not that self-related items are uniquely represented but rather because the self-concept is typically ranked the highest in the hierarchy. To test this explanation, the current study examined whether manipulating the hierarchy of the memory items, either by using another highly important concept or by manipulating the order the items are learned, would considerably affect the SPE.

Initial support for the notion that the prioritization in the shape-label matching task depends on a serial matching based on the hierarchy of the items in memory (hereafter 'scanning-and-matching' account), comes from a study by Wade and Vickery (2017) that has recently manipulated the concreteness of non-self objects and found SPE-like effects. That is, it could be argued that this manipulation directly affected the hierarchy of items in memory. A similar claim could also be made about rewarding and emotional items that also produced SPE-like effects (Stolte et al., 2017; Yankouskaya et al., 2018, see also, Kim et al., 2019). These findings support the idea that the experimental setting can determine the highest-ranking concept in the experiment, and this, in turn, leads to a prioritized matching of the item associated with that concept.

The present study aimed, therefore, to directly test the scanning-and-matching account and the possibility that in the SPE participants are typically relying on a default hierarchy in memory, in which the self is prioritized over familiar and unfamiliar concepts, without postulating unique processing of items related to the self.

Experiment 1: Self, Friend, and Stranger

The goal of the first experiment was to replicate the findings of prioritization in responses to the self-concept, compared with other familiar and unfamiliar concepts. For this purpose, we conducted a nearly direct replication of the first experiment in Sui et al.'s (2012) study. In that experiment, geometric shapes were associated with either the self, a best friend (familiar), or a stranger (unfamiliar). A subsequent task required participants to indicate whether a shape-label pair presented on the screen matched or did not match the information learned earlier. The authors found a prioritization effect: responses were faster and more accurate on trials containing the self-shape, compared with trials containing other shapes.

Method

Participants

Participants in all experiments were undergraduate students aged 18 to 40, with Hebrew as their mother tongue. All were with normal or corrected-to-normal vision, and without learning disabilities or attention disorders. The study was approved by the Ethics committee of the Psychology and Education department at the Open University of Israel. Thirteen participants (3 males, M_{age} = 27.23, SD_{age} = 4.87) completed Experiment 1. This sample size was matched to Sui et al.'s (2012), experiment 1. In all subsequent experiments, the sample size was doubled to obtain higher statistical power. This sample-size of 27 subjects provides a power of more than 99% to find a within-subject effect with a size of η^2 = .64 (the effect size found in the central comparison of RT in match trials, see below. Calculated with G-Power; Faul et al., 2007).

Stimuli and Procedure

The experiment was run using E-prime software (version 2.0, Psychology Software Tools, 2002), and a 23.5" monitor (1920 × 1080, 60 Hz). Participants were seated approximately 60 cm from the screen. For the Friend label, they were asked to name their best, gender-matched friend before the beginning of the experiment. For the Stranger label, they were given a list of 69 common Israeli, gender-matched names, and were asked to pick a name that was not associated with a person familiar to them. Table S1 in the Supplementary Materials describes the properties of the Hebrew labels across all experiments

Acquisition. Three category and geometric shape pairs appeared on the screen: a pairing between the participant (*you*) and a geometric shape (e.g., *circle*), a pairing between the participant's friend's name and another shape (e.g., *square*), and a pairing between the stranger's name and a shape (e.g., *triangle*). The assignment of the shapes to the categories was counterbalanced across participants and so was the order of the presentation of the pairings. The three pairings were presented textually (e.g., *You* = *Circle*) in 18-point font-size with bolded text. Each pairing appeared in a separate row at the center of the screen. Participants were asked to learn these three pairings and to move on only when they were certain that they remember all the presented pairings.

Matching-task. Following the acquisition phase, participants continued to the matching task that was introduced by the experimenter. On each trial, the participants saw a shape and a label on the screen and were asked to indicate as fast and as accurate as possible whether or not it matched one of the pairings they previously learned. A trial started with a white fixation cross presented against a gray background for 500 ms. Then, a shape and a label appeared until the participant made a response[1]. Each pair consisted of a white-colored image of a geometric shape (about $3.0^{o} \times 3.0^{o}$), presented 2.51^{o} above a white fixation cross ($0.8^{o} \times 0.8^{o}$), and a target label (1.5^{o}-$2.0^{o} \times 1.0^{o}$) presented 2.51^{o} below the fixation cross. The labels were the Hebrew words for *you*, *friend*, or *stranger*, with female or male indication (see Table S1 in the Supplementary Materials). A green tick (✓) was shown for 400 ms following a correct response and a red cross

[1] Unlike Sui et al., (2012) we chose not to limit the presentation time and the deadline for responding, because for the present purposes, we wanted to focus our analyses on RTs in the match trials (see below), while d' takes into account both match and non-match trials.

(╳) was shown for 1000 ms following an error. There was no additional inter-trial interval following the presentation of the response feedback. The task consisted of one practice block (12 trials: 4 × 3 shape categories, half match, half non-match, randomly divided), and three 120-trial blocks. The trials within each block were equally and randomly divided into the three shape categories and half of the trials in each category (20) were match trials, and half were non-match trials. The overall performance information (i.e., averaged accuracy and speed) was presented at the end of each block.

Data Analysis

As in Sui et al. (2012), RT and accuracy data were analyzed by comparing the participants' responses to each of the three *shape* categories that were presented in the matching task. We additionally examined the data as a function of the *label* categories that were presented in the same trials. We reasoned that this type of analysis might yield a different pattern of results because there are several possible strategies for completing the matching task. Indeed, it is possible, as was implicitly assumed, that participants based their judgment on the familiarity of the stimulus pair presented on the screen. If this is the case, then there should not be an inherent difference between sorting the data according to labels rather than shapes. However, if, as implied in the memory scanning-and-matching account, participants do not base their judgments on the familiarity of the pair, but rather serially compare one of the categories (the shape or the label) with their memory – then differently sorting the data might lead to different results. For example, some participants might start the comparison process from the label (e.g., which shape was associated with this particular label?) while others start the comparison process from the shape (e.g., which label was associated with this particular shape?). As it turned out, and in support of the scanning-and-matching account, this different way of sorting the data produced a different pattern of results. In

Experiment 1 we report both types of analyses. However, to remain consistent with Sui et al.'s analysis, Experiments 2-4 report the analysis based on the shapes whereas the label-based analysis is summarized in the Supplementary Materials (Table S2). Also note that for Experiments 2-4, we centered our investigation on the differences between the categories (e.g., Self, Friend, Stranger) in the match condition, because only this condition yielded significant results in Sui et al. (2012). Analyses of the non-match condition are reported in the Supplementary Materials.

The analysis of RT was conducted on correct responses and trials that deviated in ±2.5 standard deviations from each participant's mean in each condition, were omitted. Accuracy performance was analyzed using signal detection theory and thus perceptual sensitivity (d') and criterion (c) were computed. Correct responses on match trials were classified as 'hits', whereas incorrect responses on non-match trials were classified as 'false alarms'.

All post-hoc tests were corrected using Bonferroni corrections. To conclude about the existence or absence of an effect, we used planned Bayesian *t*-tests and we report BF_{10} as evidence for the support for the alternative hypothesis: category 1 (e.g., self) > category 2 (friend), category 3 (stranger); category 2 ≠ category 3. All data, materials, and analyses can be found in the OSF project of this manuscript (masked link for review: https://osf.io/4srhn/?view_only=70ea4888bf524b598b0d61d04a54d9d9).

Results

RT

Applying the exclusion criteria described above resulted in the exclusion of 8.26% of the trials for the shape category analysis, and 8.24% of the trials for the label category analysis.

Sorting by shape. Mean RTs were submitted to a 3 (shape category: self, friend, stranger) × 2 (match, non-match) repeated-measures analysis of variance (ANOVA). Replicating the results of Sui et al. (2012), we found a main effect of shape category, $F(2,24) = 5.41$, $p = .01$, $\eta^2_p = .31$, as well as a main effect of matching, $F(1,12) = 40.73$, $p<.001$, $\eta^2_p = .77$, in that, as can be seen in Figure 1(A), responses were faster for match than non-match trials. In addition, there was a significant interaction between the two factors, $F(2,24) = 26.60$, $p < .001$, $\eta^2_p = .69$. To uncover the source of this interaction we conducted separate ANOVAs for match and non-match trials. As for the match trials, there was a main effect of shape category, $F(2,24) = 19.74$, $p < .001$, $\eta^2 = .62$, that reflected faster responses for Self, versus Friend trials ($p = .001$, $d = -1.14$, $BF_{10} = 57.25$), and Stranger trials ($p < .001$, $d = -1.71$, $BF_{10} = 280.18$). There was no significant difference between the responses to Friend and Stranger trials, ($p = .15$, $d = -0.56$, $BF_{10} = 1.35$). In sharp contrast, there was no effect of shape category in the non-match trials, $F(2,24) = 2.46$, $p = .10$, $\eta^2 = .17$.

Sorting by label. Once again, mean RTs were submitted to a 3 (label category: Self, Friend, Stranger) × 2 (match, non-match) repeated-measures ANOVA. Similar to the shape category analysis, there was a main effect of label category, $F(2,24) = 30.80$, $p < .001$, $\eta^2_p = .72$, that reflected faster responses for Self, versus Friend trials ($p < .001$, $d = -1.43$, $BF_{10} > 1000$), and Stranger trials ($p < .001$, $d = -2.13$, $BF_{10} > 1000$). There was also and a marginal effect in responses to Friend versus Stranger trials ($p = .056$, $d = -0.70$, $BF_{10} = 4.77$). As before, there was a main effect of matching, $F(1,12) = 43.99$, $p < .001$, $\eta^2_p = .78$, in that responses were faster for the match than for the non-match trials. However, unlike the shape category analysis, there was no interaction between these two factors. $F(2,24) = 0.24$, $p = .78$, $\eta^2_p = .02$ (Figure 1, B).

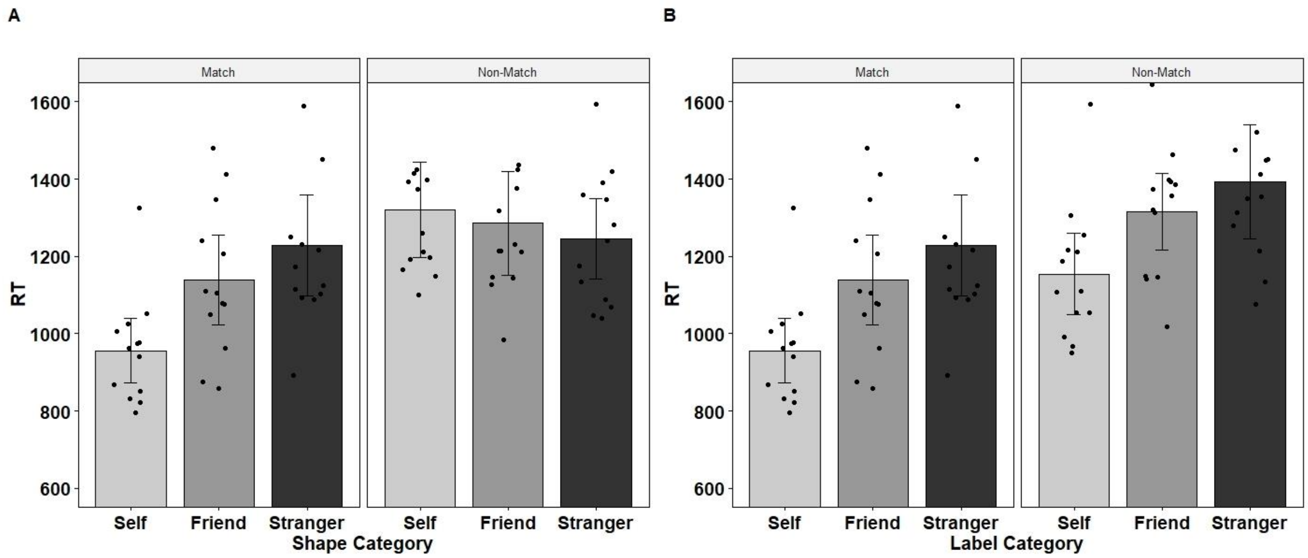

Figure 1. Experiment 1's mean RTs data as a function of sorting by the shape category (A) or by the label category (B) and the matching condition. Error-bars represent a 95% confidence interval and each data point stands for a single subject.

Accuracy

Sorting by shape. The averaged d' and response criterion (c) for each shape condition are reported in Table 1 (note that these measures are calculated across match and non-match trials). A repeated-measures ANOVA found no effect of shape condition on d', $F(2,24) = 2.123$, $p = .142$, $\eta^2 = .15$. In contrast, there was a main effect of shape category on the response criterion, $F(2,24) = 3.44$, $p = .048$, $\eta^2 = .22$. This difference was driven by a larger response bias in the Self trials compared to the Stranger trials ($p = .06$, $d = 0.68$, $BF_{10} = 3.17$), as no other comparison approached significance (Self versus Friend: $p = .17$, $d = 0.54$, $BF_{10} = 1.24$, Friend versus Stranger: $p = 1.0$, $d = 0.14$, $BF_{10} = 0.30$). Finally, it is noteworthy that the response criterion was significantly different from zero only in the Self trials ($t(12) = 3.60$, $p = .002$, $d = 0.99$, $BF_{10} = 26.40$), suggesting that participants were biased to respond match on these trials, whereas no such bias was found on other trials (*p*s = .46, .72).

Sorting by label. The averaged d' and response criterion (c) for each label condition are reported in Table 1. A repeated-measures ANOVA found a marginally significant effect of label category on d', $F(2,24) = 3.03$, $p = .067$, $\eta^2 = .20$. This effect was primarily due to higher sensitivity in the Self trials than in the Friend trials ($p = .071$, $d = 0.67$, $BF_{10} = 4.49$) whereas no other difference approached significance (*p*s = .36-1.0, *d*s = -0.22-0.44, BF_{10} = 0.33-1.03). A similar analysis of the criterion yielded a marginal effect of label, $F(2,24) = 2.90$, $p = .07$, $\eta^2 = .19$. This was in line with the shape category analysis as, once again, significant response bias was found only in the Self trials ($t(12) = 3.17$, $p = .004$, $d = 0.88$, $BF_{10} = 13.80$, *p*s for other categories = .38, .81). Yet, the response bias for the Self was only marginally larger than in the Stranger trials ($p = .07$, $d = 0.65$, $BF_{10} = 3.02$). No other difference between the categories was observed (Self versus Friend: $p = .39$, $d = 0.43$, $BF_{10} = 0.64$, Friend versus Stranger: $p = 1.0$, $d = 0.22$, $BF_{10} = 0.36$).

Table 1

Signal detection indices (d′ sensitivity index and c criterion) as a function of shape category and label category in all experiments.

Experiment	Category	d′ by shape	c by shape	d′ by label	c by label
Experiment 1	Self	3.62 (0.78)	0.17 (0.17)**	3.64 (0.64)	0.16 (0.19)**
	Friend	3.26 (0.73)	0.00 (0.22)	3.20 (0.83)	0.02 (0.25)
	Stranger	3.30 (0.63)	-0.03 (0.22)	3.35 (0.52)	-0.05 (0.21)
Experiment 2	Father	3.45 (0.92)	0.19 (0.23)***	3.57 (0.81)	0.15 (0.22)**
	Close-Relative	3.11 (1.04)	0.07 (0.18)*	2.98 (1.02)	0.12 (0.22)**

	Stranger	2.91 (0.81)	-0.06 (0.15)*	2.95 (0.89)	-0.08 (0.18)*
Experiment 3	Self	3.17 (0.68)	0.12 (0.20)**	3.57 (0.81)	0.08 (0.21)*
	Father	3.19 (0.75)	0.09 (0.16)**	2.98 (1.02)	0.10 (0.15)**
	Stranger	3.00 (0.83)	-0.02 (0.15)	2.95 (0.89)	-0.00 (0.16)
Experiment 4	Self	3.40 (0.69)	0.11 (0.21)*	3.29 (0.72)	0.15 (0.19)***
	Friend	3.26 (0.83)	0.13 (0.22)**	3.35 (0.87)	0.08 (0.18)*
	Stranger	3.16 (0.69)	-0.08 (0.12)**	0.96 (0.03)	-0.09 (0.14)**

Note. Standard deviation in brackets. Asterisks refer to the statistical significance of a comparison of the mean to zero (which indicates no bias): * $p < .05$, ** $p < .01$, *** $p < .001$.

Discussion

Replicating previous findings, Experiment 1 found that RT was faster in Self trials than in Friend or Stranger trials. This effect was found regardless of whether the data was sorted by the shape category or by the label category. However, our findings diverged from those of Sui et al. (2012) in a couple of ways. First, while there was a significant interaction between shape category and matching, as was reported in Sui et al., no such effect was found when the data were sorted by label rather than shape. That is, there were main effects of label category and matching, but the two did not interact. The different patterns of results observed in the shape and label conditions seem to support the idea that participants might differ in the strategy they use to complete the task. Consequently, one must take into consideration that the self-label category and the shape category associated with the self yield different patterns of results. Furthermore, the fact that the SPE is restricted to the match trials in the by-shape sorting, but not in the by-label sorting, suggests that the label was the driving factor in this effect. It is currently not clear which sorting strategy is preferable. One might argue that the label strategy is better because it showed a self-advantage effect both in the match and in the non-match conditions. However, for the current purposes, we focused on the shape sorting as this was typically done in previous research. We return to this issue in the General Discussion.

Second, accuracy performance in our experiment did not follow the pattern found in Sui et al. (2012), as there was no perceptual sensitivity benefit for the self-category. Instead, our results indicate that any accuracy difference between the self and other concepts were driven by a response bias found in Self trials and not in Friend or Stranger trials. However, the discrepancy between the present results and those of Sui et al. should be taken with caution because it might be due to the unlimited presentation of the test in the present experiment that aimed to emphasize RT over accuracy.

Experiment 2: Other Memory Hierarchy

The goal of Experiment 2 was to test the prioritization effect with another memory hierarchy that does not include the self-concept. If the self is unique in its ability to elicit heightened performance, then other socially relevant concepts should not lead to similar effects. If, however, SPE-like effects would be found with other concepts it would entail that the self-concept is not unique and that the effects witnessed previously could be better explained by the alternative scanning-and-matching account. To form a new hierarchy ordered by social closeness we used the concepts *father*, *close-relative*, and *stranger* in the same paradigm of Experiment 1. Unlike previous experiments that used *mother* (Sui et al., 2012), the concept *father* was preferred because it better matched the gender of the terms close-relative and stranger in Hebrew. We further sought to compare it to a close-relative rather than to a friend as we reasoned this would form a clearer social-hierarchy among the concepts (father>close-relative>stranger). We hypothesized that if the self is not unique, but rather merely the highest in its hierarchy, then we should now find similar results with the father concept. Namely, shapes associated with the father concept would be responded to faster compared to shapes associated with the close-relative and stranger, due to the high rank of the father concept in this context.

Method

27 students aged 18 to 40 (9 males, M_{age} = 25.48, SD_{age} = 3.45) took part in the experiment. Before the experiment started, participants were asked to recall the name of a family relative (male) who does not belong to their nuclear family. They were also asked to pick a stranger's name from a list of common Israeli male names. In the acquisition stage, geometric shapes were paired with the word *father* (in Hebrew), with the close relative's name, and with the stranger's name. In the matching task, the pairings showed the following labels (in Hebrew): *father* ($1.5^{o} \times 1.0^{o}$), *close-relative* ($2.0^{o} \times 1.0^{o}$), *stranger* ($1.5^{o} \times 1.0^{o}$). All other aspects of the experiment were the same as Experiment 1.

Results

RT

10.44% of the trials were excluded after applying the exclusion criteria. A repeated-measures ANOVA of the shape category in the 'match' condition was conducted. The analysis yielded a significant effect, $F(2,52) = 47.66$, $p < .001$, $\eta^2 = .64$, that was due to faster responses to father trials compared with close relative trials ($p < .001$, $d = -1.67$, $BF_{10} > 1000$) and with stranger trials ($p < .001$, $d = -1.58$, $BF_{10} > 1000$). There was no difference between close relative and stranger trials ($p = .99$, $d = 0.09$, $BF_{10} = 0.22$, Figure 2).

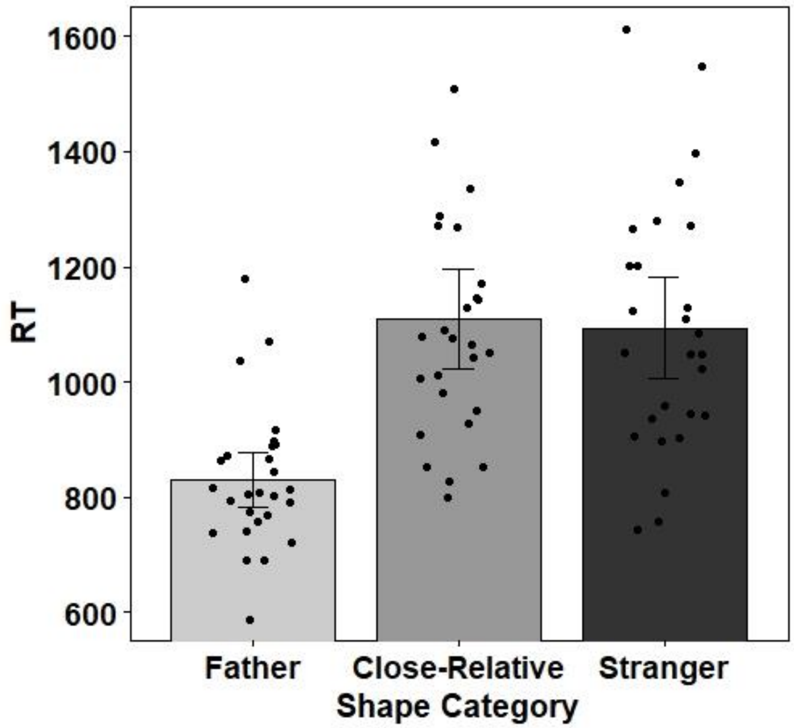

Figure 2. Mean RTs as a function of shape category in the 'match' condition of Experiment 2. Error-bars represent a 95% confidence-interval and each data point stands for a single subject.

Accuracy

Unlike Experiment 1, ANOVA of d′s as a function of shape category yielded a significant effect, $F(2,52) = 10.97$, $p < .001$, $\eta^2 = .29$, that was due to higher sensitivity for father, compared with close-relative ($p = .01$, $d = 0.56$, $BF_{10} = 14.14$), and with stranger trials ($p < .001$, $d = 0.89$, $BF_{10} = 196.00$). The comparison between close-relative and stranger was not significant ($p = .30$, $d = 0.32$, $BF_{10} = 0.94$). A repeated-measures ANOVA of c as a function of shape category also yielded a significant effect, $F(1.57, 40.94)$[2] = 12.01, $p < .001$, $\eta^2 = .31$. This points to a greater response bias in the father trials compared with close-relative ($p = .08$, $d = 0.43$, $BF_{10} = 1.71$), and with stranger trials ($p < .001$, $d = 0.74$, $BF_{10} > 1000$), and in the close-relative compared with the stranger trials ($p = .03$, $d = 0.51$, $BF_{10} = 0.89$, Table 1).

Discussion

The results of Experiment 2 clearly mimicked the ones of the self-concept obtained in Experiment 1. The father concept, which was presumably ranked highest in the current context, generated faster responses and higher accuracy relative to other familiar (close-relative) and unfamiliar (stranger) concepts. In other words, an available hierarchy in memory – in the absence of the self-concept – was sufficient to produce a large prioritization effect in the matching task, supporting the scanning-and-matching account (Kim et al., 2019; Sui et al., 2012; Wade & Vickery, 2017; Yankouskaya et al., 2018).

Experiment 3: Comparing Competing High-ranked Concepts

Experiment 2 demonstrated a prioritization effect with the father concept in the absence of the self in that context. This finding supports the notion that SPE reflects a prioritization of the concept ranked highest in the memory hierarchy in that context. It further suggests that the father concept is also high in the social hierarchy and could, therefore, yield greater competition for the self-concept than the previously used concepts. Hence, the goal of Experiment 3 was to test self and father concepts in the same setting. If self-related items are uniquely represented then SPE should be readily found whenever the self-concept is present, as was demonstrated, for example, by the advantage in items related to the self over mother (Sui et al., 2012, Experiment 2B). In contrast, the scanning-and-matching account predicts that the SPE should be diminished when two highly ranked concepts are competing within the same context.

Method

The method was identical to Experiment 1's, except that geometric shapes were paired with the Hebrew words for *you*, *father*, and with the stranger's name. Participants were 27 students aged 18 to 40 (12 males, M_{age} = 25.29, SD_{age} = 3.48).

Results

RT

9.65% of the trials were excluded after applying the exclusion criteria. A repeated-measures ANOVA on the shape category yielded a significant effect, $F(2,52) = 6.59$, $p = .003$, $\eta^2 = .20$ that was driven by the slow responses to stranger compared with both self (p=.003, d = -0.67, BF_{10} = 56.37), and father (p = .03, d = -0.49, BF_{10} = 3.28). Most importantly, there was no difference between the self and father trials (p = 1.0, d = -0.17, BF_{10} = 0.46).

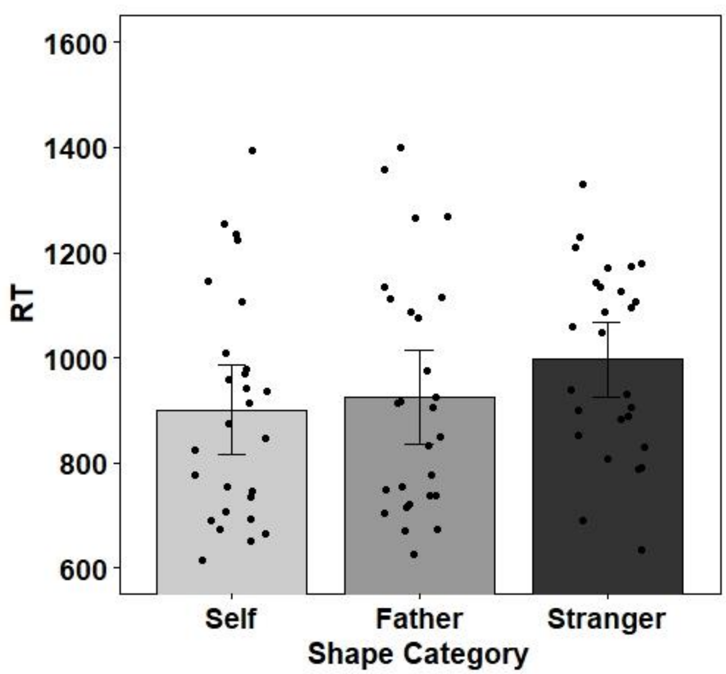

Figure 3. Mean RTs as a function of shape category in the 'match' condition of Experiment 3. Error-bars represent a 95% confidence interval and each data point stands for a single subject.

Accuracy

A repeated-measures ANOVA on d′ as a function of shape category did not yield a significant effect $F(2,52) = 1.57$, $p = .21$, $\eta^2 = .057$. In contrast, a similar analysis on c yielded a significant effect $F(2,52) = 5.15$, $p = .009$, $\eta^2 = .15$ that was driven by a stronger bias in the self trials compared with stranger trials ($p = .01$, $d = 0.58$, $BF_{10} = 10.44$) and father trials compared with stranger trials ($p = .052$, $d = 0.47$, $BF_{10} = 2.63$). As with the RT analysis, there was no difference between self and father ($p = .99$, $d = 0.10$, $BF_{10} = 0.34$, Table 1).

Discussion

The results of Experiment 3 failed to find SPE when the father concept was included in the experiment together with the self-concept. Responses were not faster, nor more accurate to shapes associated with the self than with the father. Moreover, participants were similarly biased in their responses to self and father. These results indicate that when another high-in-order concept competes with the self-concept, the prioritization effect is attenuated dramatically. These findings diverge from those of Sui et al. (2012)'s Experiment 2B, which showed a unique prioritization effect only to the self, and not the mother-concept. The inconsistency between our findings and those of Sui et al. mirrors the inconsistency found in memory research, concerning the advantage of self compared with mother (Bower & Gilligan, 1979; Lord, 1980). It could also be the case that the father concept is different than the mother concept and poses a greater challenge to the self. Importantly, the fact that we did not find an advantage to the self-concept when another highly valued concept was present undermines the notion that self-related items are unique and aligns with the prediction of the scanning-and-matching account.

Experiment 4: Re-Ordering the Hierarchy

Experiment 4 directly tested the scanning-and-matching account by investigating whether a change in the "default" hierarchy would modulate the SPE. That is, if the effect is driven by the uniqueness of the self-concept then it should not be affected by the order the associations are learned. If, on the other hand, the effect is driven by the order of the items in the memory hierarchy then we might be able to de-prioritize the self-concept by instructing the participants to learn the associations in a different hierarchical order, one in which the self is not the first concept to be learned. Specifically, unlike the previous experiments, we compelled the subjects to learn the shape label associations in a fixed serial order. Participants first learned about the friend-shape pairing, then they learned the self-shape pairing, and finally, they learned the stranger-shape pairing. We reasoned that this manipulation of sequential encoding would reduce the tendency of participants to use a strategy in which the self-shape associations are prioritized during the test and therefore the SPE should be diminished.

Method

The experiment was identical to Experiment 1, except for the acquisition phase. As before, participants were asked to recall the name of their best, gendered matched, friend, and to choose a name of a stranger from a list of common Israeli, gendered-matched, names. Then, they learned the pairing between a geometric shape and the *friend* label. They were told to read the pairing aloud and advance to the next screen only when they were certain that they remember this pairing. On the next screen, the first pairing was shown again together with the pairing between a geometric shape and the *you* label. Participants were asked to read aloud the first pairing and then read the second pairing. Again, they were asked to continue only when they were certain in their memory of the pairings. Finally, on the third screen, the two previous pairings appeared, in the same order, together with a novel pairing, between a geometric shape and the *stranger* label. Participants read the three pairings aloud in the order of their appearance before moving on to the matching task. In all other respects, the experiment was identical to Experiment 1.

27 students aged 18 to 40 (9 males, M_{age} = 26.53, SD_{age} = 4.22) completed the experiment. The data of one participant were excluded from the analysis due to low overall accuracy (<80%).

Results

RT

3.34% of the trials were excluded after applying the exclusion criteria. A repeated-measures ANOVA on the shape category yielded a significant effect, $F(2,50) = 5.36$, $p = .008$, $\eta^2 = .17$, that was driven by faster responses to self compared to stranger ($p = .006$, $d = -0.63$, $BF_{10} = 16.52$). Most importantly, there was no difference between self and friend ($p = .58$, $d = -0.25$, $BF_{10} = 0.98$). There was also no difference between friend and stranger ($p = .17$, $d = -0.38$, $BF_{10} = 0.94$, Figure 4).

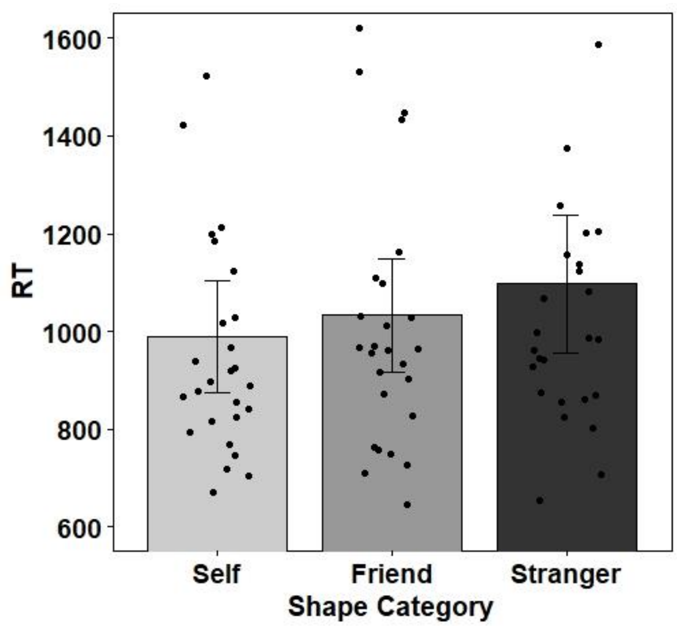

Figure 4. Mean RTs as a function of shape category in the 'match' condition of Experiment 4. Error-bars represent a 95% confidence interval and each data point stands for a single subject.

Accuracy

A repeated-measures ANOVA on d′s as a function of shape yielded a marginally significant effect $F(2,50) = 2.74$, $p = .07$, $\eta^2 = .09$, that was due to better sensitivity for self than stranger ($p = .07$, $d = 0.45$, $BF_{10} = 4.50$). There was no other significant difference (*p*s = .53-1.0, *d*s = 0.19-0.26, BF_{10} = 0.31-0.82). Analysis of c yielded a similar pattern: an effect of shape category, $F(2,50) = 8.18$, $p < .001$, $\eta^2 = .24$, that resulted from a stronger bias for the self, compared with stranger ($p = .005$, $d = 0.65$, $BF_{10} = 90.11$) and for friend compared with stranger ($t = 3.66$, $p = .002$, $d = 0.71$, $BF_{10} = 40.42$). Importantly, there was no difference between self and friend ($p = 1.0$, $d = 0.06$, $BF_{10} = 0.16$, Table 1).

Comparison with Experiment 1

In order to conclude whether the responses to the shape categories were significantly different between the current experiment and Experiment 1, we ran another ANOVAs, with experiment as a between-subjects factor. For the RT data, there was a significant interaction between the shape category and experiment $F(2,74) = 4.48$, $p = .01$, $\eta^2_p = .10$, indicating that these results were indeed moderated by the experiment. The analyses of d′ and c did not reveal an interaction effect, d′: $F(2,74) = 0.57$, $p = .56$, $\eta^2_p = .01$, c: $F(2,74) = 2.06$, $p = .13$, $\eta^2_p = .05$.

Discussion

In contrast to Experiment 1, the results of Experiment 4 showed no facilitation in responses to self versus friend trials. Thus, the robust SPE found in Experiment 1 was completely eliminated by a simple, short training that introduced a new hierarchy in the acquisition stage. This finding provides strong and direct support for the scanning-and-matching account that emphasizes the matching order of the stimuli as the source of the SPE.

General Discussion

Recent research has demonstrated that stimuli that were associated with the self-concept were responded to faster and more accurately than stimuli that were associated with other concepts. It has been suggested that this SPE is driven by the uniqueness of the self-concept (Humphreys & Sui, 2016; Sui & Humphreys, 2015; Sui et al., 2012; Sui & Rotshtein, 2019), an interpretation that is consistent with past claims that the self-concept is unique in its ability to affect the way people attend, perceive, and remember items that relate to it (e.g., Leshikar et al., 2015; Markus, 1977; Rogers et al., 1977; Symons & Johnson, 1997). In the present study, we challenged this interpretation of the SPE and examined the possibility that the effect is mainly the result of the serial nature of the shape-label matching task and not the unique nature of the items related to the self. In line with this possibility, Experiment 2 that used a *father* concept embedded in the context of father-close-relative-stranger found a prioritization effect similar to the one found with the self-concept (Experiment 1).

We further speculated that a shape associated with the self-label is prioritized because the matching process tends to start with the self, and therefore manipulating the rank of the self in the memory hierarchy should modulate the effect. Accordingly, Experiment 3 revealed that when two highly-ranked concepts in the hierarchy (father, self) were competing within the same context – the SPE was largely diminished and shapes associated with both concepts were prioritized only relative to the less relevant concept (stranger). Experiment 4 further demonstrated that a brief training session that introduced the learned associations in a structured serial order was sufficient to eliminate the SPE. These findings provide direct support for the scanning-and-matching account, which postulates that the SPE can be explained merely by the properties of the matching task and the hierarchy of items held in memory.

The conclusions of this study do not fit with the current explanations of the SPE. Sui and colleagues (e.g., Sui & Humphreys, 2015) suggested that the prioritization found in the matching task reflects a benefit for self-related stimuli from early on in the information processing stages. This advantage in processing is similar to this of a perceptually salient stimulus and leads to faster responses and higher perceptual sensitivity to the shape associated with the self (Sui et al., 2012). The notion that associating items to the self affects perceptual processing has been recently challenged by the results of several studies (Janczyk et al., 2018; Schäfer et al., 2016). Consistent with these findings we also found inconsistent effects of self-related items on perceptual sensitivity and strong evidence that the effect is largely related to response bias (increased tendency to respond match, for self-related items). Furthermore, the premise that the self is unique in producing prioritization effects was also not supported. Indeed, in line with other studies that reported SPE-like effects (Kim et al., 2019; Stolte et al., 2017; Wade & Vickery, 2017; Yankouskaya et al., 2018) we showed that the father-concept can produce an effect similar to the self-concept.

Most importantly, the alternative explanation suggested to account for the SPE, the scanning-and-matching account, was tested and confirmed. That is, we argue that participants match the presented items with the associations held in memory serially and while this matching typically starts with the highly ranked self-concept, this is not mandatory, and the order of this matching process depends on the context of the task. Subsequently, manipulating the order in which the items were ranked in memory, either by the inclusion of another salient concept or merely by instructions, had dramatic effects on the SPE. Furthermore, the scanning-and-matching explanation of the SPE, which focuses on the properties of the matching task readily account for recent findings that showed the SPE is task-specific and not obligatory (e.g., Caughey et al., 2020; Siebold et al., 2015).

Finally, it is important to note the finding that the analysis strategy – by shape or by label – yielded different patterns of results, in support of the underlying assumption that participants perform the matching task serially. In Sui et al. (2012), and most of the following studies, prioritization effects were analyzed with respect to the shape that appeared in the trial. This was likely done because the newly learned shapes were of most interest. However, if the matching task takes place in a serial fashion, then sorting the responses based on shape or label should yield a different pattern of results, as observed here. Interestingly, we found that the shape was not necessary to produce the effect, as we observed self-prioritization effects even when only the self-label, but not the shape, was present (i.e., under non-match trials sorted by label), and larger effects were often found when the data were sorted by the label than by the shape (see Table S2 in the Supplementary Materials). This is indeed reasonable when assuming a serial matching process, because the label is more related to the concept than the newly acquired shape association, and because word reading (i.e., the labels) is often considered to be automatic (Stroop, 1935). This factor could also potentially explain the absence of a self-priority effect when the label was not presented (e.g., Siebold et al., 2015; Stein et al., 2016). Yet, additional research is still needed to examine the differential contribution of the shape and label to the SPE.

To summarize, our results suggest that the prioritization effect documented previously for the self-concept reflects a specific benefit stemming from the serial properties of the matching task, without assuming unique representations of items associated with the self. Consistent with this view, we found an SPE-like effect with another socially salient concept and that the SPE was eliminated when two salient items were used. The effect was also eliminated when participants were instructed to learn the associations in a structured order, supporting the idea that the order that the concepts are held in memory plays a critical role in the effect. Future studies should test the generality of this conclusion using other social and non-social concepts. More research is also needed to elucidate the way participants perform the matching task as well as the role of the label and shape in this task. Yet, similar to past debates on the matter we conclude that the unique status of self-related items is not sufficiently supported.

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