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The "Plus Polar Self": A Reinterpretation of the Self-Prioritization Effect as a Polarity Correspondence Effect

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We suggest that the polarity correspondence principle (PCP; Proctor & Cho, 2006) can explain the self-prioritization effect (SPE), that is, that matching responses for self-labels and self-assigned shapes are faster than matching responses for other labels and other-assigned shapes. According to PCP, one can argue that self-label, self-shape, and the "yes, match" responses are all + polar (hence full correspondence is given), whereas other label and other shape are both – polar, which does not correspond to the + polarity of the "yes" response. Our argument is based on a structural analogy of the self-matching task with an experiment by Seymour (1969)—a pillar of the PCP—who conducted an experiment where participants determined if the location of a dot (above or below a rectangle) matched the word ("above" or "below") presented within the rectangle. Faster reactions occurred in above–above matching trials than in below–below or nonmatching trials. We replicated this finding (Experiment 1A) and showed the close analogy to the self-matching task by replicating the SPE with a single "other" category. In Experiment 2, we showed that the SPE disappears if participants are instructed to respond with "no" to matches. Experiment 3 replicated Experiment 2 with two instead of one "other" category (which is more common in SPE research). Again, the SPE in the "yes" condition significantly exceeded the one in the "no" condition. However, the latter SPE was still significant, suggesting that part of the SPE might be due to the PCP, but a small self-related effect remains.

Public Significance Statement

The processing advantages of stimuli related to the self are attributed to a more general principle, the polarity correspondence principle. This principle states that judgments are facilitated when responses and stimuli in judgmental tasks share a structural property called "polarity." Evidence supports this explanation, thereby strengthening the general principle and preventing the misattribution of some empirical results as being caused by self-related processes.

Keywords: self-prioritization effect, polarity correspondence principle, self-relevance, polarity

Sui et al. (2012) introduced the self-prioritization effect (SPE), another much-noticed effect in the "self-zoo" (Tesser et al., 1996) of self-serving biases. Self-biases typically show up as advantages in the cognitive processing of stimuli associated with oneself. Up to this point, research has demonstrated that familiar stimuli, such as one's own face (Keyes & Brady, 2010; Ma & Han, 2010) or name (Conway et al., 2001; Frings, 2006; Moray, 1959), enjoy processing advantages. However, in the experiment conducted by Sui et al. (2012), participants associated completely arbitrary stimuli (e.g., geometrical shapes) with themselves and, typically, two contrast categories, such as "a friend" and "a stranger." At the start of an experiment, participants are assigned shapes to represent them and two others. In a subsequent matching task, participants are shown a label such as "You," "Friend," or "Stranger," along with a shape such as a triangle, square, or circle. They must indicate whether the label–shape combination matches the previously learned associations or not. For instance, if participants are presented with the label "you" and the shape assigned to the self, they should press the "match" button as fast as possible. In trials where the label "you" and the shape associated with another person are presented, participants should press the "nonmatch" button. In matching trials, responses are faster and more accurate on self-relevant label–shape

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Raw data, analysis scripts, and experiment files for each experiment are publicly on the Open Science Framework at https://osf.io/2zr78/. All experiments were carried out according to the principles of the Declaration of Helsinki; all participants provided informed consent. Part of this study was presented at the Conference of Experimental Psychologists in March 2024, Regensburg, Germany.

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combinations compared with combinations that refer to other people. In nonmatching trials, there is no such difference. The SPE is typically measured as the discrepancy in reaction times (RTs) between self-matching and other-matching trials. The study has been replicated numerous times, and the results demonstrate that the SPE is a robust phenomenon that occurs even when stimuli other than geometric shapes are paired with their corresponding labels. For instance, auditory and tactile stimuli (Schäfer et al., 2016, 2019) or even certain movements (Frings & Wentura, 2014) can also elicit the effect.

The publication by Sui et al. (2012) has prompted many researchers to investigate the cognitive processes that underlie the SPE. For instance, Sui et al. (2012) themselves suggested that the effect is due to the higher salience of self-relevant stimuli (see also Liu & Sui 2016). Similar to perceptual salience, which refers to the ability of stimuli to be processed more quickly if they are relevant to the task at hand, "social salience" refers to the phenomenon where participants react more quickly to stimuli that are relevant to themselves. The concept of social salience can be linked to early cognitive processes. The findings of Macrae et al. (2017) support this idea. In a continuous flash suppression paradigm, the researchers found that stimuli related to the self have privileged access to visual consciousness at an early level of cognitive processing. However, a further study from Stein et al. (2016) did not find such advantages for self-related stimuli in a comparable experiment.

Sui and Rotshtein (2019) suggested that the salience of self-relevant stimuli directs individuals' attention, resulting in prioritized processing of these stimuli and faster responses to them (see also Dalmaso et al., 2019). Moreover, Golubickis and Macrae (2021) demonstrated that self-relevant targets can reduce the impact of distractors in a flanker task, supposedly by adjusting attentional breadth. Neuroimaging studies have shown that the ventromedial prefrontal cortex and the posterior superior temporal sulcus are the neural substrates of the SPE (Humphreys & Sui, 2016; Sui et al., 2013). The posterior superior temporal sulcus is associated with attention processes (Allison et al., 2000; DiQuattro & Geng, 2011; Saxe & Kanwisher, 2003).

Schäfer et al. (2020) suggested that self-relevance not only affects attention but also plays a role in binding processes (see also Humphreys & Sui, 2016). It is assumed that the self acts as an associative glue, leading to stimuli being better associated with oneself than with another person. This association advantage results in faster reactions to self-relevant label–shape combinations in the matching task. This finding is also supported by another study showing that shapes that have been associated with the participants themselves are subsequently more difficult to associate with another entity than shapes that were previously associated with another person (Wang et al., 2016).

Other researchers suggest that response selection may also be a causal factor. For instance, Wade and Vickery (2018) found that the self-relevance of targets in a visual search paradigm did not affect the search efficiency. Thus, self-relevant stimuli did not attract participants' attention more than non-self-relevant stimuli (at least in this paradigm; see also Siebold et al., 2015). Nevertheless, there was a main effect of relevance, indicating that participants were generally faster at detecting self-relevant stimuli than other-relevant stimuli. This suggests that self-relevant stimuli still have an influence on cognitive processes that are post-attentional, such as response selection. Moreover, studies using event-related potentials suggest that response selection may play a role. For instance, Sui et al. (2023) found that the P3 event-related potential is stronger in self-relevant matching trials than in other-relevant matching trials. The P3 is associated with rather late cognitive processes and, in this study, correlated with the boundary separation parameter α of drift-diffusion models (see also Haciahmet et al., 2023). In summary, several studies suggest that self-relevant stimuli affect various cognitive domains. However, it is unclear which processes specifically cause the SPE.

Polarity Correspondence

Here, we present a new approach that can be best introduced by recalling an old study by Seymour (1969). In this experiment, participants were presented in each trial either with the word "above" or "below" within a square at the center of the screen. Simultaneously, a dot appeared either above or below the square. The participants' task was to indicate whether the position of the dot and the word matched (e.g., the dot was above the square containing the word "above"). If they did, they were instructed to respond with "yes." If the position of the dot and the word did not match, the participants were instructed to respond with "no." Interestingly, in matching trials, participants responded clearly faster in above-matching trials compared with below-matching trials. In nonmatching trials, reaction times were comparable with those in below-matching trials and unmoderated by word type and dot location.

Seymour (1973) explained his results in terms of "polarity" attributions for the stimulus and response features. The basic idea was later expanded and elaborated by Proctor and Cho (2006) into the "polarity correspondence principle" (PCP). They assume that stimulus and response features are assigned plus (+) and minus (−) polarities during binary classification tasks. According to Seymour's (1969) experiment, a correspondence in polarity between stimulus and response features can aid in response selection and result in faster participant responses. In his experiment, three binary dimensions are involved: (a) the word dichotomy ("above" vs. "below"), (b) the dot location (above vs. below the square), and (c) the response dichotomy ("yes" vs. "no"). If we assume—just for the sake of argument—that the word "above," the dot location "above," and the "yes" response are the + polarities of their respective dichotomies, the polarities of all three dichotomies match in the above/above/yes constellation. This does not hold for the alternative match trials (i.e., below [−], below [−], yes [+]), and it does not hold for all nonmatching constellations. As a result, the polarity correspondence in the above-matching trials leads to faster reaction times than in all other trials. The response times in the other trial types are similar, as there is no full polarity correspondence in any of these trial types.

Polarity Correspondence and Self-Prioritization

The structural similarity of Seymour's (1969) experiment and the matching task introduced by Sui et al. (2012) is striking: If we equate the word dichotomy "above" versus "below" with the self-relevant label "You" and an other-relevant label (e.g., "Friend") and replace the match of the dot position to the word with the match of the shape to the label shown, we have a structurally equivalent task. Even more, the reaction time pattern of Seymour's (1969) experiment corresponds exactly to the typical reaction time pattern observed in the matching task. In the matching trials, participants reacted faster to the self-matching label–shape combinations than to the other-matching combinations. Furthermore, the reaction times in the nonmatching trials were typically significantly slower than in the self-matching trials but comparable with the other-matching trials.

It is therefore reasonable to apply the polarity assumptions to the matching task as well. Because the PCP is typically applied to tasks in which dichotomous categories are related to each other (e.g., in Seymour's experiment the distinction between above and below) and there is a dichotomous response format (e.g., "yes" or "no" responses), we first transfer the assumptions to a matching task in which participants learn only two associations (instead of typically three) and thus only have to make a self versus other distinction. In this experiment, participants are taught to associate a geometric shape A with a self-label and a geometric shape B with an other label.

We assume that the self-relevant label is + coded and the other-relevant label is – coded. For the shapes, we assume that their a priori polarity is neutral and that the association of a shape with the self (or another person) is crucial for the coding as + or −. This means that the moment a geometric shape is associated with my self, it becomes +, and the shape associated with the other person becomes −. The response of "matching" was assigned a + polarity, and the response of "nonmatching" was assigned – polarity. In self-matching trials, there is full correspondence between the polarities of the stimulus and response features (i.e., self-label [+]/self-shape [+]/"yes, match" [+]). However, in other-matching and nonmatching trials, this correspondence no longer exists. Thus, the PCP could potentially explain the anticipated reaction time pattern in a matching task where two associations are learned.

However, how can these assumptions be tested? Seymour (1973) demonstrated that reversing the response assignments in the above–below experiment eliminated the reaction time advantage of above matching. In this experiment, participants were instructed to respond with "no" to matching trials and with "yes" to nonmatching trials. The reaction times in the matching and nonmatching trials were now comparable, and there was no longer an advantage in above-matching trials. According to the PCP, this can be explained by the absence of correspondence between stimulus and response polarities in the above-matching trials. Participants now responded to the word "above" and dot position "above," which are both + polar, with the "no" response, which is – polar.[1] This manipulation can also be applied to the matching task, where only two associations are learned. Assuming that the self-relevant label and shape A are coded + and the other-relevant label and shape B are coded –, and that participants now respond "no" to matching trials, we should find a comparable result (see Table 1 for the polarity codes in the match = "yes" vs. in the match = "no" condition). In the self-matching trials, correspondence between the stimulus and response features is no longer given because the self-label and self-shape are assigned a + polarity and the "no" response is assigned a – polarity. This suggests that the SPE should no longer be present. Therefore, if at least parts of the SPE can be explained by participants coding the stimulus and response categories with + and – polarities in the matching task, then we should be able to at least significantly reduce the SPE with this type of manipulation.

In summary, it is hypothesized that the SPE could be caused by the PCP and that manipulating response assignments could significantly reduce the SPE. Two experiments (Experiments 2 and 3) were conducted to test these hypotheses. The study on which our theory is based dates back to 1969 (i.e., Seymour, 1969) and does not measure reaction time with key presses but vocalization onset (of "yes" and "no"). Therefore, in Experiment 1A, we first replicated Seymour's results using a reaction time experiment with key-press responses. Similar to the typical results in the matching task, we found an interaction between the presented word (above or below) and the matching of the circle position to the word. A significant above-prioritization effect was found when the reaction times in above-matching trials were subtracted from the reaction times in below-matching trials. In Experiment 1B, participants performed the matching task, but only learned two associations to demonstrate that the SPE is present for this type of trial arrangement. We observed an interaction between the label and shape (matching vs. nonmatching) and the presumed SPE when we subtracted the reaction times in the self-matching trials from the other-matching trials.

Experiment 1

In Experiment 1A, we replicated Seymour's (1969) results using a reaction time experiment with key-press responses. In Experiment 1B, participants performed the matching task (Sui et al., 2012) but only learned two associations to demonstrate that the SPE is present for this type of trial arrangement.

Method

Transparency and Openness

We report how we determined our sample size, any data exclusions, all manipulations, and all measures in this study, and we follow journal article reporting standards (Kazak, 2018). Raw data, analysis scripts, and experiment files for each experiment can be found at https://osf.io/2zr78/. All experiments were preregistered before data were collected. Preregistration for Experiment 1 A is available at https://aspredicted.org/KHK_S99. Preregistration for Experiment 1B is available at https://aspredicted.org/4NH_Z8B. Data were analyzed using IBM SPSS Statistics (Version 29), developed by IBM Corp and R, Version 4.3.0 (R Core Team, 2022).

Participants

Experiment 1 A. Our final sample comprised $N = 30$ participants. Seymour (1969) did not report the interaction test (i.e., label [above vs. below] vs. dot relation [match vs. nonmatch]) that we plan to replicate. However, a conservative estimation based on means and the omnibus test for differences between the four means (i.e., label [above vs. below] × dot relation [match vs. nonmatch]) indicate $dz > 1$ for the interaction. Conservatively, we decided to collect enough participants to find an effect of $dz = .70$, given $\alpha = .05$ (two-tailed), with a power of $1 - \beta = .95$. For this effect, $N = 29$ participants are required (calculated with G*Power; Faul et al., 2009). We collected data from $N = 32$ participants on Prolific to account for possible dropouts. Only people living in the United States or United Kingdom were invited to participate and they had to be fluent in English (we applied this criterion in all

[1] The attentive reader will now wonder why the RTs in the below/below trials were not faster because these trials are now characterized by a complete negative polarity correspondence (i.e., below [−], below [−], no [−]). We will address this question in more detail in the General Discussion section.

Table 1
Polarity Assignments for Stimulus and Response Alternatives for Match = "Yes" and Match = "No" Trials

	Match = "yes"		Match = "no"	
Dimension	Self	Other	Self	Other
Label	+	−	+	−
Shape	+	−	+	−
Dimension	Match	Non-match	Match	Non-match
Response	+	−	−	+

further experiments). Two participants did not provide any study data, so they could not be included in the analysis. In the current and all further studies, we obtained the sociodemographic data from the information provided by the participants on Prolific. Median age was 34.5 years (range = 22–50); 19 participants identified as cisgender women and 11 as cisgender men.

Experiment 1B. The effect sizes for the SPE are usually quite high. Sui et al. (2012) reported large effect sizes ($dz \sim .80$) for the SPE. Conservatively, we decided to collect data from enough participants to find an effect of $dz = .70$, given $\alpha = .05$ (two-tailed), with a power of $1 - \beta = .95$ (calculated with G*Power; Faul et al., 2009). For this effect, $N = 29$ participants are required. We collected data from 32 participants on Prolific to account for possible dropouts. Median age was 32 years (range = 19–64); 13 participants identified as cisgender women and 19 as cisgender men.

Design

Experiment 1A comprised a 2 (label: above vs. below) × 2 (dot relation: match vs. nonmatch) within-participants design.

Experiment 1B comprised a 2 (label: self vs. other) × 2 (shape relation: match vs. nonmatch) within-participants design.

Materials

The study was conducted online. Participants could participate using a desktop or laptop computer. The experiment was built with PsychoPy3 and its built-in online translation PsychoJS (Peirce et al., 2019). We used the *ScreenScale* code to ensure a consistent stimulus size across participants (Morys-Carter, 2023). The data were collected via https://pavlovia.org.

Experiment 1A. The words were written in Arial font and were presented in white in the middle of the screen. The words were surrounded by a white square. The background was black. Letter size was set to a height of 1 cm. The square's width and height were both 4 cm. The dot's diameter was 1.75 cm.

Experiment 1B. Labels were written in Arial font and were presented in white. The labels used were the pronouns "You" as the self-relevant and "She" as the other-relevant pronoun. The size of the used shapes was set to 2.5 cm in height and width, and the size of the letters was set to 0.6 cm. A square and a circle were used as shapes. The shapes were blue (RGB_{255}: 68, 114, 196). The background was black.

Procedure

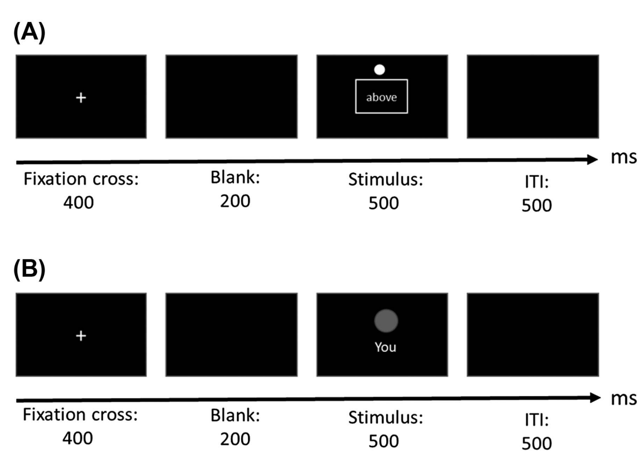
Experiment 1A. Task instructions were presented on the screen in white against a black background. Participants were told that in each trial, the word "above" or "below" and a dot will be presented on the screen and that the dot can be presented above or below the word. We showed all possible word–dot combinations on the screen. The first two examples showed combinations where the word matched the location of the dot. The other two examples introduced nonmatching combinations, where the word and dot location did not match each other. Participants were instructed to respond with the "yes" key in case of a match combination and with the "no" key in case of a nonmatch. We used the D and K keys as response keys and varied the keys assigned "yes" and "no" between participants.

Each trial began with the presentation of a fixation cross in the middle of the screen for 400 ms (see Figure 1A for the trial sequence). After a blank screen for 200 ms, the word and dot appeared for 150 ms, and the participants had 2,000 ms to respond. At the end of each trial, a blank screen appeared again for 500 ms.

In total, there were four different trial types depending on the presented word (above vs. below) and the dot location (above vs. below). The experimental phase consisted of 120 trials, separated into three blocks of 40 trials. Each trial type was presented 30 times, and participants could take a short break after each block if they wanted to. A practice phase of 12 trials preceded the actual experimental phase. Throughout the experiment, participants received feedback when they gave an incorrect response.

Experiment 1B. The experiment closely followed the procedure of Experiment 1A. One deviation results from the fact that this time participants had to learn label–shape associations at the beginning of the experiment (e.g., "You are a square. Another person (she) is a circle." Label–shape assignments were counterbalanced between participants). Participants were told that they had to remember these assignments well because they would need them throughout the experiment. Once they felt like they had learned the assignments, they should press the space bar to continue. They now

Figure 1
Trial Procedures for Experiment 1A (A) and Experiments 1B, 2, and 3 (B)



Note. Proportions of the stimuli are not true to scale. ITI = intertrial interval.

were instructed that they had to react to whether a label–shape combination shown on the screen matches with the previously learned assignments of a label to a shape. We used the same response keys as in Experiment 1A and counterbalanced the assignment of matching and nonmatching keys between participants. The trial sequence was the same as in Experiment 1A, with the only difference being that now label–shape pairings were presented and the shape was always presented above the label. Again, we had four different trial types by orthogonally varying the factors label and shape relation. The experimental phase consisted of 120 trials separated into three blocks of 40 trials. Each trial type was presented 30 times.

Results

Response Times

The analysis focused on RTs from trials with correct answers. Only RTs greater than 150 ms and less than 1.5 interquartile ranges above the third quartile of the overall RT distribution (Tukey, 1977) were used for the analysis. Averaged across participants, in Experiment 1A, 88% of all trials were selected for RT analysis; 9% of trials were excluded due to incorrect responses and 3% due to the RT outlier criterion. In Experiment 1B, 86% of all trials were selected for RT analysis; 12% of trials were excluded due to incorrect responses and 2% due to the RT outlier criterion. Mean RTs and error rates are shown in Table 2.

Experiment 1A. We conducted a repeated-measures analysis of variance (ANOVA) with the factors word (above vs. below) and dot relation (match vs. nonmatch). This analysis revealed significant main effects of dot relation, $F(1, 29) = 33.70$, $p < .001$, $\eta_p^2 = .54$, indicating faster responses in matching trials, and label, $F(1, 29) = 47.32$, $p < .001$, $\eta_p^2 = .62$, indicating faster responses for "above" trials. The two-way interaction between dot relation and label was significant as well, $F(1, 29) = 40.31$, $p < .001$, $\eta_p^2 = .58$.

To investigate this interaction in more detail, we computed a prioritization effect by subtracting RTs for above-matching trials from RTs for below-matching trials (see Figure 2). We found a significant above-prioritization effect, $M = 132$ ms ($SE = 14$ ms), $t(29) = 9.24$, $p < .001$, $d_z = 1.69$, 95% CI [1.12, 2.24]. The corresponding difference for nonmatching trials was not significant, $M = -7$ ms ($SE = 14$ ms), $t(29) = -.48$, $p = .638$, $d_z = .09$, 95% CI [−0.44, 0.27].

Experiment 1B. We conducted a repeated-measures ANOVA with the factors label (self vs. other) and shape relation (match vs. nonmatch). This analysis revealed significant main effects of shape relation, $F(1, 31) = 67.93$, $p < .001$, $\eta_p^2 = .69$, indicating faster responses in matching trials, and label, $F(1, 31) = 20.79$, $p < .001$, $\eta_p^2 = .40$, indicating faster responses for self-label trials. The two-way interaction between shape relation and label was significant, $F(1, 31) = 33.07$, $p < .001$, $\eta_p^2 = .52$.

We computed a prioritization effect for matching trials by subtracting RTs for self-matching trials from RTs for other-matching trials (see Figure 2). We found a significant SPE, $M = 126$ ms ($SE = 22$ ms), $t(31) = 5.69$, $p < .001$, $d_z = 1.00$, 95% CI [0.57, 1.43]. We did the same in nonmatching trials (RTs for self-nonmatching trials were subtracted from RTs for other-nonmatching trials). This effect was not significant, $M = -2$ ms ($SE = 11$ ms), $t(31) = -.22$, $p = .824$, $d_z = -.04$, 95% CI [−0.39, 0.31].

Table 2
Mean Probe Reaction Times (in ms; Error Rates in % in Parentheses) Across Conditions for Experiments 1A and 1B

Word/label	Relation: Match	Relation: Nonmatch
Experiment 1A		
Above	653 (0.92)	798 (2.00)
Below	786 (4.23)	791 (2.08)
Experiment 1B		
Self	705 (1.30)	841 (2.78)
Other	832 (5.10)	839 (2.73)

Note. In Experiment 1A, the factor relation refers to whether the dot position matched or did not match the word; in Experiment 1B, the factor relation refers to whether the shape matched or did not match the label.

Sensitivity Measures

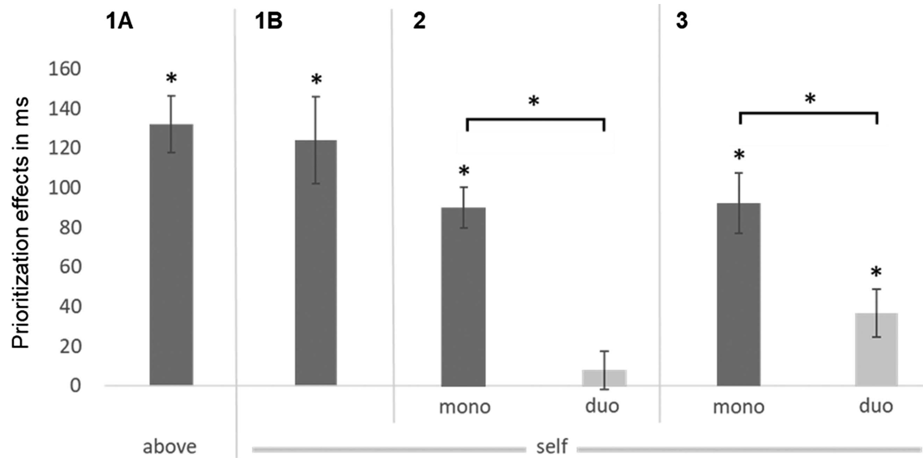
Because Sui et al. (2012) reported *d′* instead of error rates, we will follow this approach and report *d′* as sensitivity measures in all of our experiments as well (for an analysis of error rates of all experiments see Appendix). We used signal detection sensitivity indices for each stimulus condition. We defined correct responses in matching trials as hits and erroneous responses in matching trials as misses. Correct responses in nonmatching trials were defined as correct rejections, and erroneous responses were treated as false alarms. To deal with participants with 100% or 0% false alarms, we applied the log-linear approach (see Hautus, 1995; Stanislaw & Todorov, 1999) and added 0.5 to the number of hits and the number of false alarms before calculating the hit and false alarm rates.

For Experiment 1A, we conducted a dependent *t* test to compare sensitivity for the "above" word with sensitivity for the "below" word. This test indicated a higher sensitivity for above than for below, $t(29) = 2.44$, $p = .021$, $d_z = .45$, 95% CI [0.07, 0.82]. For Experiment 1B, we conducted a dependent *t* test to compare sensitivity for the self-shape with sensitivity for the other shape. This test indicated a higher sensitivity for the self-shape, $t(31) = 3.84$, $p < .001$, $d_z = .68$, 95% CI [0.29, 1.06].

Discussion

In Experiment 1A, we replicated the findings of Seymour (1969). Participants reacted faster in above-matching trials than in below-matching trials. In nonmatching trials, there was no difference between the two word-conditions, and both are at the level of below-matching trials. Moreover, in Experiment 1B, we found an SPE for a task where participants only learned two label–shape combinations, instead of the often-used three combinations (however, there are already studies in which only two labels are used to investigate the SPE; see Desebrock & Spence, 2021; Keil et al., 2023; Hu et al., 2020; Orellana-Corrales et al., 2020; Svensson et al. 2022). The SPE is reflected in participants responding faster in self-matching trials than in other-matching trials. In the nonmatching trials, there was no difference between the two label conditions (with both at the level of other-matching trials). Both experiments showed a highly comparable pattern: One matching condition differed significantly from the other (indicating prioritization effects for above matching in Experiment 1A and self-matching in Experiment 1B), whereas the same difference was not found in nonmatching trials.

Figure 2
Mean Prioritization Effects for the Above Label in Experiment 1A and for the Self-Label in Experiments 1B, 2, and 3 in Matching Trials



Note. Error bars depict standard errors of the mean.
* $p < .05$.

Based on these results, in the following experiments, we wanted to see if we could significantly reduce the SPE by manipulating the response assignments. Similar to Seymour (1973), we implemented a between-participants condition and manipulated whether participants had to respond with a "yes" answer to matching trials or with a "no" answer to matching trials. We expected that in the first case, polarity correspondence between stimulus and response features is given and we therefore will replicate the SPE found in Experiment 1B. In the other condition, the SPE should at least be significantly reduced because polarity correspondence between the self-relevant stimuli and the matching response is no longer given (we will refer to the condition where the self-features and the response share polarity as the match = "yes" condition, whereas the condition where the self-features and response do not share polarity is termed the match = "no" condition; both conditions are levels of the factor "task" in the following experiments).

Experiment 2

Method

Transparency and Openness

The general statement about transparency and openness made for Experiment 1 also applies to Experiment 2. The preregistration for Experiment 2 is available at https://aspredicted.org/BQG_TPM.

Participants

Our final sample size comprised $N = 109$ participants. Because we expected that our manipulation sharply reduces the SPE in the match = "no" condition, we collected sufficient participants to find at least an effect of $d = .5$ for the crucial difference. For this effect, $N = 102$ participants (51 per task condition) are required, given $\alpha = .05$ (one-tailed), with a power of $1 - \beta = .80$ (calculated with G*Power; Faul et al., 2009). We collected data from $N = 112$ participants on Prolific. We excluded the data of three participants because they responded at chance level (overall error rates were >50%). Median age was 32 years (range = 18–50); 48 participants identified as cisgender women and 61 as cisgender men.

Design

Our design comprised a 2 (label: self vs. other) × 2 (shape relation: match vs. nonmatch) × 2 (task: match = "yes" vs. match = "no") design. The first two factors were varied within, and the last factor was varied between participants.[2]

Material

Programming of the experiment, data collection, and stimulus presentation (background, arrows, size, and color of shape and label) were the same as in Experiment 1B.

Procedure

Task instructions were presented on the screen in white against a black background. The instructions and the experimental procedure differed depending on the task condition. In the match = "yes" condition, participants were told that they have to react to label–shape combinations presented on the screen. We asked half of the participants to watch for trials in which the label and shape referred to the same person (matching trials), which we termed "mono-combinations." The participants' task was to respond to whether they saw a mono-combination or not. If they saw one, they were asked to respond by pressing the "yes" key. If they did not see one, they were asked to respond by pressing the "no" key. The other half of the participants were asked to watch for trials in which the label referred to one person but the shape referred to another person

[2] Note that in our preregistration for Experiment 2, our factors are labeled slightly differently. However, the descriptions of the three factors in the preregistration are equivalent in meaning to the description of the factors in this article.

(nonmatching trials), which we termed "duo combinations." We asked this half of the participants to respond "yes" if they saw a duo combination and "no" if they did not see such a combination. With these instructions, we manipulated whether participants responded "yes" to matching trials (which was the case for participants in the match = "yes" condition) or "no" to matching trials (which was the case for participants in the match = "no" condition). There were two response keys (D, K). We counterbalanced the assignment of the yes and no keys between participants as well as the assignments of shapes to self and other. For half of the participants, D was the yes key and K the no key. For the other half, K was the yes key and D the no key. Trial sequence was identical to Experiment 1B (see Figure 1B).

We had the same four trial types as in Experiment 1B. The experimental phase consisted of 200 trials, randomly presented and separated into four blocks of 50 trials. Each trial type was presented 50 times, and participants could take a short break after each block if they wanted to. A practice phase of 12 trials preceded the actual experimental phase. Throughout the experiment, participants received feedback when they gave an incorrect response.

Results

Response Times

The analysis focused on RTs from trials with correct answers. Error and outlier treatment was as in Experiment 1A. Averaged across participants, 85% of all trials were selected for RT analysis; 13% of trials were excluded because of erroneous prime responses and 2% due to the RT outlier criterion. Mean RTs and error rates are shown in Table 3.

We conducted a mixed ANOVA with the factors label (self vs. other) and shape relation (match vs. nonmatch) as within-participants factors and task (match = "yes" vs. match = "no") as between-participants factor. All main effects were significant, with $F(1, 107) = 34.81$, $p < .001$, $\eta_p^2 = .25$; $F(1, 107) = 27.28$, $p < .001$, $\eta_p^2 = .20$; and $F(1, 107) = 7.16$, $p = .009$, $\eta_p^2 = .06$, for shape relation, label, and task, respectively, as well as all two-way interactions: $F(1, 107) = 17.43$, $p < .001$, $\eta_p^2 = .14$, for shape relation and task; $F(1, 107) = 11.62$, $p < .001$, $\eta_p^2 = .10$, for label and task; and $F(1, 107) = 27.26$, $p < .001$, $\eta_p^2 = .20$, for label and shape relation. Most importantly, all effects were qualified by the expected three-way interaction, $F(1, 107) = 26.04$, $p < .001$, $\eta_p^2 = .20$ ($d_z = 1.11$, 95% CI [0.71, 1.52]).

To analyze this three-way interaction in more detail, we computed prioritization effects by subtracting RTs for self-matching trials from RTs for other-matching trials for both polarity conditions (see Figure 2). We found a significant SPE, $M = 93$ ms ($SE = 11$ ms), $t(53) = 8.72$, $p < .001$, $d_z = 1.12$, 95% CI [0.83, 1.53], in the match = "yes" condition. However, in the match = "no" condition, the SPE disappeared, $M = 9$ ms ($SE = 10$ ms), $t(54) = .88$, $p = .384$, $d_z = .12$, 95% CI [−0.15, 0.38]. In nonmatching trials, as expected, we did not find any prioritization effects ($M = 2$ ms ($SE = 6$ ms), $t(53) = .32$, $p = .751$, $d_z = .04$, 95% CI [−0.22, 0.31], for match = "yes" and $M = 8$ ms ($SE = 9$ ms), $t(54) = .84$, $p = .407$, $d_z = .11$, 95% CI [−0.15, 0.38], for match = "no").

Sensitivity Measures

We conducted a mixed ANOVA using d' as the dependent variable, with relevance (self vs. other) as a within factor and task (match = "yes" vs. match = "no") as a between factor. This ANOVA showed a significant main effect of task, $F(1, 107) = 12.67$, $p < .001$, $\eta_p^2 = .11$, and a significant two-way interaction between label and polarity assignment, $F(1, 107) = 7.83$, $p = .006$, $\eta_p^2 = .07$ ($d_z = .54$, 95% CI [0.15, 0.92]). The main effect of label, $F(1, 107) = 11.93$, $p < .001$, $\eta_p^2 = .10$, was not significant. We also calculated a self-prioritization index for errors by subtracting d' for the self-relevant shape from d' from the other-relevant shape in each condition. This effect was significant in the match = "yes" condition, $t(53) = 4.03$, $p < .001$, $d_z = .55$, 95% CI [0.26, 0.83], but not significant in the match = "no" condition, $t(54) = .52$, $p = .606$, $d_z = .07$, 95% CI [−0.20, 0.33].

Discussion

The results are clear-cut. In the match = "yes" condition, participants responded with "yes" to matching trials, and we were able to replicate the typical matching task pattern: We found a significant interaction between label and shape relation. This interaction was based on the significant SPE of participants responding faster in self-matching than in other-matching trials. By contrast, in the match = "no" condition, where participants responded with "no" to the matching trial, the SPE disappeared. This result replicates Seymour's (1973) findings for the "above versus below" paradigm and strongly suggests that the SPE can be explained by polarity correspondence. In the task where participants learn to associate one label with themselves and another label with another person, they code the two stimulus categories with different polarities, just as they do with the response alternatives. The relationship between the polarity of the stimulus and the response can explain the presence or absence of a pattern similar to the SPE.

Table 3
Mean Probe Reaction Times (in ms; Error Rates in % in Parentheses) Across Conditions for Experiments 2 and 3

		Experiment 2		Experiment 3	
Task	Label	Match	Nonmatch	Match	Nonmatch
Match = yes	Self	671 (1.90)	765 (2.23)	715 (1.50)	832 (2.29)
	Other (she)	764 (3.61)	767 (2.70)	800 (3.15)	832 (2.33)
	Other (he)			822 (2.67)	863 (2.70)
Match = no	Self	796 (3.68)	807 (3.62)	804 (2.45)	878 (2.83)
	Other (she)	805 (3.98)	814 (3.81)	827 (2.56)	881 (3.18)
	Other (he)			857 (3.16)	909 (3.31)

However, as stated in the introduction, the PCP is typically applied to contexts with binary categories (e.g., above vs. below). To emphasize the transferability of the PCP to the matching paradigm, we had participants learn only two associations in Experiments 1B and 2 instead of the usual three in the matching task. Nonetheless, the principles of polarity correspondence can tentatively be applied in contexts with more than two categories. When participants learn to associate three shapes with three labels, such as in the standard matching task, we can still assume that the self-relevant shape and label are coded with a + polarity. We can further assume that the other-relevant labels and shapes are coded as not self-relevant and are thus summarized on a common pole. Non-self-relevant stimuli are therefore coded as – polar. In other words, in a matching task with more than two stimulus categories, we assume that participants do not code whether a stimulus is referring to Category 1 (the self-referential category), 2 (the first "other" category), or 3 (the second "other" category). Rather we assume—as a working hypothesis—that participants code the categories whether they are self-referential or not. We therefore assume that the original three categories are actually coded into two categories: a self-category and a not-self-category. When examining the initial example, where the participant learned to associate shape A with themselves, shape B with a friend, and shape C with a stranger, it can be assumed that the self-label and self-shape have a + polarity. Conversely, the friend label and friend shape have a – polarity, and the stranger label and shape have a – polarity, too. Note that, even in a three-category context, the response options remain binary. Participants respond with either a matching or a nonmatching response. If we further assume that the matching response is + and the nonmatching response is −, we ultimately have a similar task in this context as in Experiment 2. On the stimulus side, participants code stimuli as to whether they are self-relevant [+] or not [–]; on the response side, they code responses as to whether they make a matching [+] or nonmatching [−] response.

Of course, this example immediately raises the question of the functionality of "polar coding" because within the items poled –, the match task responses cannot be longer based on polar correspondence because the combination of, for example, "friend" label and friend shape calls for a match response, whereas the combination of "friend" label and stranger shape calls for a nonmatch response. However, it is an empirical question whether polar correspondence plays a role even in the three-condition setting, despite the fact that −/− correspondences have to enter a second-stage check. Of course, these considerations underscore the importance of replicating Experiment 2 with three conditions.

Interestingly, an earlier study by Schäfer et al. (2017) already corroborates the working hypothesis that even in a matching task with three label–shape combinations polarity correspondences play a role. The authors argued that part of the SPE elicited by label sets such as "you," "friend," and "stranger" (or you, mother, and other) might be due to confounding, that is, the fact that a self-relevant pronoun (e.g., you) is tested against two other-relevant nouns (e.g., friend, stranger). It was argued that the pronoun constitutes a distinctive category in itself. In other words, the pronoun can be considered the "figure," while the two other-relevant nouns can be viewed as the "ground" (see also Rothermund & Wentura, 2004). The notion that a category (the figure) is set in opposition to another category (representing the ground) and therefore stands out is related to PCP (see Proctor & Cho, 2006). In the PCP, stimuli are also ultimately coded to contrast categories, with one category being + polar and the other being – polar. However, Schäfer et al. (2017) argued that if there is anything to the "pronoun versus noun" argument, it is no longer the contrast between self and other that triggers the prioritization effect. Indeed, Schäfer et al. observed a prioritization effect for a pronoun when it was tested against two nouns, despite the pronoun (i.e., he) lacking self-relevance.

Two points follow from this study. First, this study gives a hint that even in the matching task with three label–shape pairs polarity principles play a role in the sense that one category (i.e., the pronoun) is set in opposition to the remaining ones (i.e., the nouns). Second, because we want to test whether an SPE (and not a *pronoun*-prioritization effect) can be explained by PCP, we should avoid the confound that is typically given by labels like "you," "friend," and "stranger." Accordingly, in Experiment 3, the self-relevant pronoun was tested against two non-self-relevant pronouns (i.e., she and he) to eliminate the possibility that the word category was influencing the observed effects.

It is expected that the SPE will be replicated in the match = "yes" condition. In self-matching trials, participants will respond fastest compared with other-matching trials. However, in the match = "no" condition, the SPE should be significantly reduced. In our next experiment, we tested this hypothesis.

Experiment 3

Method

Transparency and Openness

The general statement about transparency and openness made for Experiment 1 also applies to Experiment 3. The preregistration for Experiment 3 is available at https://aspredicted.org/TQ4_3MZ.

Participants

Our final sample size comprised $N = 69$ participants. In Experiment 2, we found a large effect of $d = 1.1$ for the difference between the SPE in the match = "yes" condition and the SPE in the match = "no" condition. Conservatively, we proceed from $d = .8$ for Experiment 3. For $d = .8$, $N = 70$ participants (35 per task condition) are required, given $\alpha = .05$ (one-tailed), to achieve a power of $1 - \beta = .95$ (calculated with G*Power; Faul et al., 2009). To account for possible dropouts, we collected data from $N = 72$ participants on Prolific. We excluded the data of three participants because they responded at chance level (overall error rates were >50%). Median age was 35 years (range = 22–49; a total of 27 participants identified as cisgender women and 41 as cisgender men, and one individual did not disclose their gender).

Design, Materials, and Procedure

Everything was the same as in Experiment 2 except that three instead of two labels (and shapes) were used. That is, our design now comprised a 3 (label: self vs. other female vs. other male) × 2 (shape relation: match vs. nonmatch) × 2 (task: match = "yes" vs. match = "no") design. The first two factors were varied within, and the last factor was varied between participants.[3] We used the labels "you,"

[3] Note: In our preregistration for Experiment 3, our design is labeled differently. However, the descriptions of our design in the preregistration and in this article are equivalent.

"she," and "he" and the shapes square, circle, and triangle. The experimental phase consisted of 240 trials separated into four blocks of 60 trials each. In detail, each label was presented 80 times, half with matching pairings, half with nonmatching pairings. Half of the trials were matching trials and the other half nonmatching trials.

Results

Response Times

The analysis focused on RTs from trials with correct answers. Error and outlier treatment were as before. Averaged across participants, 81% of all trials were selected for RT analysis; 13% of trials were excluded because of erroneous prime responses and 6% due to the RT outlier criterion. Mean RTs and error rates are shown in Table 3.

We conducted a repeated-measures multivariate analysis of variance (MANOVA; O'Brien & Kaiser, 1985) with the factors label (self vs. other female vs. other male) and shape relation (match vs. nonmatch) as within-participants factors and task (match = "yes" vs. match = "no") as a between-participants factor. For all analyses involving the *label* factor, we report the two Helmert contrasts: self versus other (i.e., female and male collapsed; Hypothesis 1) and female versus male (Hypothesis 2). Our hypotheses always focus on Hypothesis 1; there are no hypotheses concerning Hypothesis 2.[4] This analysis revealed significant main effects of shape relation, $F(1, 67) = 35.53$, $p < .001$, $\eta_p^2 = .35$, and label, $F(2, 66) = 59.46$, $p < .001$, $\eta_p^2 = .64$; $F(1, 67) = 68.68$, $p < .001$, $\eta_p^2 = .51$; and $F(1, 67) = 39.61$, $p < .001$, $\eta_p^2 = .37$, for Hypotheses 1 and 2, respectively, but not task, $F(1, 67) = 1.82$, $p = .182$, $\eta_p^2 = .03$. The two-way interaction between label and shape relation was significant, $F(2, 66) = 24.97$, $p < .001$, $\eta_p^2 = .43$. The Hypothesis 1 contrast, corresponding to an overall SPE, was significant, $F(1, 67) = 29.92$, $p < .001$, $\eta_p^2 = .31$; Hypothesis 2 was significant as well, $F(1, 67) = 21.24$, $p < .001$, $\eta_p^2 = .24$, indicating differences between the two other conditions.[5] The other two-way interactions did not reach significance, $F(2, 66) = 1.53$, $p = .224$, $\eta_p^2 = .04$; $F(1, 67) = 2.41$, $p = .125$, $\eta_p^2 = .03$; and $F < 1$ for Hypotheses 1 and 2, respectively, for label and task, and $F(1, 67) = 1.97$, $p = .304$, $\eta_p^2 = .02$, for shape relation and task.

In the overall (i.e., 2 *df*) test, the three-way interaction just missed the significance criterion, $F(2, 66) = 2.93$, $p = .060$, $\eta_p^2 = .08$. However, Hypothesis 1 reached significance decisively, $F(1, 67) = 5.67$, $p = .020$, $\eta_p^2 = .08$, whereas there was a complete lack of evidence for Hypothesis 2, $F < 1$ (a fact—though perfectly in line with our considerations—that weighed on the overall test).

To further analyze the three-way interaction, we calculated prioritization effects by subtracting RTs for self-matching trials from RTs for other-matching trials (i.e., the mean of reaction times for "he" and "she" matching trials) for both task conditions (see Figure 2). We found a significant and large SPE in the match = "yes" condition, $M = 97$ ms ($SE = 16$ ms), $t(34) = 6.00$, $p < .001$, $d_z = 1.01$, 95% CI [0.60, 1.42]. In the match = "no" condition, the SPE was significant as well but halved in size, $M = 39$ ms ($SE = 13$ ms), $t(33) = 3.02$, $p = .005$, $d_z = .52$, 95% CI [0.16, 0.87]. Most importantly, the two effects differed significantly from each other, $t(67) = 2.82$, $p = .006$, $d_z = .68$, 95% CI [0.19, 1.16]. In the nonmatching trials, both prioritization effects did not reach significance: $M = 15$ ms ($SE = 9$ ms), $t(34) = 1.63$, $p = .112$, $d_z = .28$, 95% CI [−0.06, 0.61] in the match = "yes" condition and $M = 17$ ms ($SE = 10$ ms), $t(33) = 3.02$, $p = .097$, $d_z = .29$, 95% CI [−0.05, 0.63] in the match = "no" condition.

Sensitivity Measures

We conducted a repeated-measures MANOVA using d' as a dependent variable, with relevance (self vs. other female vs. other male) as a within-factor and task (match = "yes" vs. match = "no") as a between factor. This analysis revealed a significant main effect of label, $F(2, 66) = 59.46$, $p < .001$, $\eta_p^2 = .64$; $F(1, 67) = 10.33$, $p = .002$, $\eta_p^2 = .13$; and $F < 1$, for Hypotheses 1 and 2, respectively. The two-way interaction between label and task was significant, $F(2, 66) = 8.09$, $p < .001$, $\eta_p^2 = .20$ ($d_z = .90$). The Hypothesis 1 contrast was significant, $F(1, 67) = 13.82$, $p < .001$, $\eta_p^2 = .17$; Hypothesis 2 was significant as well, $F(1, 67) = 4.72$, $p = .033$, $\eta_p^2 = .07$. We also calculated a self-prioritization index for sensitivity in both conditions. This effect was significant in the match = "yes" condition, $t(34) = 4.45$, $p < .001$, $d_z = .75$, 95% CI [0.37, 1.12], but not significant in the match = "no" condition, $t(33) = -.41$, $p = .687$, $d_z = -.07$, 95% CI [−0.41, 0.27].

Discussion

In this experiment, we were able to significantly reduce the SPE in the match = "no" condition and therefore found a similar pattern to Experiment 2. However, in contrast to the second experiment, the SPE did not completely disappear in this condition. The implications are discussed in the General Discussion section.

General Discussion

In the present study, we investigated whether polarity correspondence can explain the SPE. Based on the experiment by Seymour (1969) and the explanations of the results by Seymour (1973) and Proctor and Cho (2006), we assumed that participants in the matching task assign + and – polarities to the different stimulus and response features and that polarity correspondence between the features can account for the SPE. Because Seymour's (1969) experimental data are quite old and have—to our knowledge—not been replicated, we first aimed to replicate his results, which provide the basis for our assumptions. In addition to successfully replicating these results in Experiment 1A, we were able to demonstrate in Experiment 1B that the typical SPE pattern is present even when participants learn only two associations at the start of the experiment and can therefore categorize the stimuli into a self versus other category. We presented this evidence because the principles of polarity correspondence are typically only applied to dichotomous categories. In Experiment 2, participants again learned two associations, and we manipulated the assignment of "yes" and "no" responses to match and nonmatch trials (Seymour, 1973). In this experiment, one group of participants was instructed to respond "yes" to matching trials, while the other group was instructed to respond "no" to these trials. The results from the correspondence group were consistent with those from Experiment 1B, demonstrating the

[4] Note that because we used the multivariate approach in the repeated measures analysis, part of the procedure is to a priori transform the tripartite factor for the label condition into a vector of two orthogonal contrast variables (see, e.g., Dien & Santuzzi, 2005).

[5] Significant differences between non-self-relevant conditions are not uncommon, as demonstrated in Experiments 2A and 2B in Sui et al. (2012). However, as these differences are not relevant to the hypothesis, we will not discuss them further.

typically observed SPE, whereas the other group did not show the SPE. These findings suggest that polarity correspondence can account for the SPE in experiments in which participants learn only two associations. In Experiment 3, we tested whether a comparable result could be found when participants learned three associations, as three associations are used in the standard paradigm. The SPE was replicated in the match = "yes" condition; again, in the match = "no" condition, the SPE was significantly smaller than in the match = "yes" condition. However, in contrast to Experiment 2, there was still a significant SPE in the match = "no" condition.

Implications for the SPE

The findings indicate that polarity correspondence can account for a significant proportion of the SPE. However, it cannot fully explain the SPE, as evidenced by the fact that it is still present in Experiment 3 despite being significantly reduced. If the SPE could be fully explained by PCP, we would have expected it to be absent in the match = "no" condition, as was the case in Experiment 2. Thus, the results of Experiment 3 suggest that part of the SPE may be due to processes that are genuinely self-related. Nonetheless, the fact that the SPE disappears in Experiment 2 indicates that polarity correspondence plays a significant role in the SPE. This implies that participants in the experiments differentiate stimuli based on their relevance to the self. The stimuli with self-relevance are coded on a + pole, and the stimuli without self-relevance are coded on a – pole. This suggests that the influence of self-relevance may be mediated differently than previously assumed. In addition to the possibility that attentional or binding processes are influenced by self-relevance, the encoding of self-relevant stimuli on a + pole and non-self-relevant stimuli on a – pole plays a crucial role.

Proctor and Cho (2006) stated that PCP is primarily a principle of response selection. In our context, this means that response selection in self-matching trials is faster than in self-non-matching or other-matching trials because the polarities correspond. Following Proctor and Cho (2006), a significant amount of the SPE is based on faster response selection in self-matching trials. This is also suggested by other studies (e.g., Wade & Vickery, 2018). Sui et al. (2023) discovered that self-relevance was linked to the boundary condition α in drift-diffusion models. The α component is typically defined as the decision threshold at which sufficient evidence has been accumulated to initiate a response. A lower threshold is linked to earlier selection and initiation of responses (Ratcliff et al., 2016).

Polarity Correspondence in Other SPE Studies

Additionally, polarity correspondence theory can account for findings in other studies on the SPE. Recently, Vicovaro et al. (2022) conducted a matching task where participants were required to associate symmetrical and asymmetrical shapes with self and other. In one condition, participants associated themselves with a symmetrical shape and the other person with an asymmetrical shape. In the second condition, this association was reversed. Interestingly, the SPE was found only in the condition in which participants associated themselves with the symmetrical shape. This pattern of results can be easily explained by the PCP.

For this explanation, recall first our interpretation of the standard SPE effect in terms of polarities. We consider both the self-label and the self-shape as + polar. Of course, it is implied that the shapes are equivalent a priori (i.e., have no polarity) but acquire polarity by virtue of the assignment (i.e., the self-assigned shape is coded as + polar; the other assigned shape is coded as – polar). In the experiment by Vicovaro et al. (2022), however, it can be argued that the geometric shapes already have an a priori polarity (symmetrical patterns [+] and asymmetrical patterns [−]), which might not be fully changeable by virtue of assignment. In the condition where participants associate the self-label with a symmetrical shape, both the self-label and self-shape are + polar, the latter one now by virtue of symmetry. The other label is coded as – polar, as is the assigned asymmetric shape. Thus, the polarity pattern is exactly the same as in the standard condition, although the polarity of the shapes is given a priori and not by virtue of assignment; hence, an SPE is expected. However, if participants learn to associate the self-label with an asymmetric pattern, polarity correspondence is no longer present in self-matching trials. They react with the matching response to the + coded self-label and the – coded asymmetric shape. Therefore, the SPE breaks down in this condition.

We should hasten to add that Vicovaro et al. (2022) explicitly argued that the PCP cannot explain their results. Although they acknowledged that the symmetry of stimuli can be coded on different poles (symmetric stimuli as + and asymmetric stimuli as − polar; see Bertamini et al., 2013; Makin et al., 2012), they argued that ultimately the congruence (vs. incongruence) of the label-pattern *combination* is coded as a polarity contrast and not the label and shape dichotomies themselves. Thus, according to the authors, polarity enters at two different levels. First, congruence is given when participants associate the self-relevant label with a symmetrical shape (because both stimuli are + polar) or when participants associate an other-relevant label with an asymmetrical shape (because both stimuli are – polar). Second, stimulus arrangements that are congruent are coded on a + pole, while incongruent ones are coded on a – pole. Participants are expected to respond faster to congruent trials when they respond with the "matching" response (which is also + polar) than when they respond with a "nonmatching" response (which is – polar, and there is no longer any polarity correspondence). Thus, according to the authors, faster responses to congruent trials should be found for self-relevant and other-relevant congruent trials. Of course, this prediction is at odds with finding an SPE. Because the authors found an SPE with congruent pairings, they concluded that PCP cannot be decisive for their results.

Note, however, that applying their interpretation of the PCP by analogy to Seymour's (1969) design and to our Experiment 1B is inconsistent with finding an above/above effect. In their view, the above/above and below/below combinations are both congruent. However, in contrast to their SPE results, there is no obvious alternative explanation for the above/above effect. Vicovaro et al. (2022) explained their results in terms of the valence of the patterns. They argued that symmetrical shapes, which have positive connotations, are more strongly associated with the self than asymmetrical shapes, which have negative connotations (Makin et al., 2012). This strong association of positive stimuli with the self results in an SPE (see also Schäfer et al., 2023). By contrast, the weak association of negative stimuli with the self leads to the absence of an SPE in this condition. Thus, the authors explain the SPE in terms of binding processes (see the introduction). This explanation is not plausible for the above/above effect because Seymour's experiment has no binding phase.

However, some studies suggest that self-relevance has an influence beyond polarity correspondence. For instance, Caughey et al. (2021) found that participants learned to associate shapes with themselves and others and had to evaluate whether shapes represented themselves or another person (without a label). Assuming that the self-relevant shapes are coded with a + polarity, participants will respond with a + polarity response to the self-relevant + polarity stimulus and with a – polarity response to the other-related shape. According to the PCP, both types of trials would show polarity correspondence, and no difference in reaction times would be expected. However, this experiment found that participants reacted more quickly to self-relevant stimuli than to other-relevant stimuli. This finding is consistent with Falbén's et al. (2019), who used ownership instead of shape association. In this study, participants were told that they owned objects from Category A (e.g., pens) and that other people owned objects from Category B (e.g., pencils). Then participants were shown objects from a specific category and asked to indicate whether the object belonged to them or to someone else. Participants categorized objects that belonged to them more quickly than objects that belonged to another person.

In summary, polarity correspondence has the potential to explain important aspects of the SPE, and this principle can also be applied to modulations of the SPE investigated in other studies (such as Vicovaro et al., 2022). However, self-relevance has other influences that are not compatible with this principle, as demonstrated by Caughey et al. (2021) and Falbén et al. (2019).

Future Research

Furthermore, interpreting some data from our experiments remains challenging. For instance, in Experiment 2, the absence of polarity correspondence between self-relevant stimulus features and the matching response leads to the disappearance of the SPE. However, our previous interpretation of the data assumed that in the match = "no" condition, there is now a correspondence between the other-relevant stimuli (other-label and other-shape, both – polar) and the matching response (also – polar). So, why did we not find an other-prioritization effect in the match = "no" condition? There are several possible explanations. It is possible that the effect is not completely reversed because the SPE cannot be entirely accounted for by the PCP. Therefore, there may still be an impact on self-matching trials that accelerates participants' responses to these trials. In this case, the possible difference between self- and other-matching trials could be diminished. Experiment 3 supports the existence of a genuine influence of self-relevance, as discussed above, because the SPE was still present in the match = "no" condition.

However, it is worth having a further look at a study by Seymour (1973), who found no reversal of the pattern either, that is, he found no faster responses in the below (−)/below (−)/no (−) condition. Obviously, in Seymour's experiment, factors other than self-relevance must explain this result. Seymour suspects that not only the polarities of the word (above vs. below) and the dot position (above vs. below) are coded but additionally the polarity of a "sameness" dimension. In the match = "yes" condition, we are still faced with complete congruence: above (+)/dot-above (+)/word-dot "sameness" (+)/yes (+). In the mirror-image condition (i.e., below/below/no), there is no complete congruence: below (−)/dot-below (−)/word-dot "sameness" (+)/no (−) because the "sameness" polarity is still +. (Note that this "sameness" dimension by Seymour, 1973, is equivalent to the congruence dimension in the argumentation by Vicovaro et al., 2022; see above.)

The role of sameness could also be considered in Experiments 2 and 3. Participants could have judged whether the label and shape refer to the same category on a sameness dimension. This would prevent a complete reversal of the reaction time pattern and eliminate the other-prioritization effect, resulting in only a breakdown of the SPE. Further research is necessary to determine the dimensions on which participants encode stimuli in matching experiments. These studies are crucial for explaining why the effect does not reverse when response assignments are changed and for better understanding the role of the self-relevance of stimuli in the lack of inversion.

Constraints on Generality

The participants in our study were drawn from either the United States or the United Kingdom, that is, English-speaking, Westernized countries. Nevertheless, we posit that our study results reflect a fundamental principle of human information processing. In particular, the coding of stimuli on + and – poles according to the PCP can be regarded as a general cognitive process. A potential limitation is the selection of stimulus categories to be coded on + and – poles. It is assumed that there are differences between individualistic and collectivistic cultures, particularly with regard to the processing of self-relevant information (e.g., Liu et al., 2015). Thus, in nonindividualistic cultures, it is possible that the coding of self-referential stimuli as + polar may be less robust than in individualistic countries. In these cultures, self-referential information may not be perceived as a more salient category than non-self-referential stimuli (but see Golubickis et al., 2019). Thus, for the time being, we have no reason to doubt the generalizability of the findings.

Conclusion

In summary, our experiments have revealed an approach to explaining significant parts of the SPE. This approach is based on the principles of polarity correspondence and assumes that in the matching task, the relevant stimuli are coded to + and – polarities, depending on whether they are associated with the participant or with another person. The speed of participants' reactions to label–shape combinations and the presence or absence of the SPE are determined by the correspondence between stimulus polarities and response polarities. The PCP attributes the SPE not to the prioritized processing of self-relevant stimuli but to the encoding of stimulus and response alternatives in general, regardless of (possible) prioritized processing of self-relevant stimuli. It is a broad theoretical construct under which the SPE can be subsumed. The PCP was originally used to explain a number of effects in binary classification tasks, such as the Simon effect (Simon & Rudell, 1967; see Proctor & Xiong, 2015, for the PCP explanation) or effects in the implicit association test (Greenwald et al., 1998; see Proctor & Cho, 2006; Rothermund & Wentura, 2004, for PCP explanations). This means that the SPE can be described with the same explanans as the Simon effect or implicit association test effects. While the PCP is not yet fully understood, it has shown applicability to a range of cognitive phenomena (Proctor & Xiong, 2015). These findings have interesting implications for research on the cognitive processing of self-relevant stimuli. Future research should consider the possibility that PCP may explain the (apparent) prioritization of self-relevant stimuli to differentiate between genuinely self-relevant influences and those that can be attributed to other cognitive processes. Additionally, further experiments should be conducted to investigate how polarity differences between self-relevant and other-relevant stimuli affect our behavior.

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(*Appendix follows*)

Appendix

Analysis of Error Rates

Error Rates: Experiment 1A

We conducted a repeated-measures ANOVA with the factors word (above vs. below) and dot relation (match vs. nonmatch) and arcsine transformed error rates as dependent variables. This analysis revealed a significant main effect of word, $F(1, 29) = 28.07$, $p < .001$, $\eta_p^2 = .49$, indicating less errors for "above" words. The main effect of dot relation did not reach significance, $F < 1$. The two-way interaction between dot relation and label was significant as well, $F(1, 29) = 15.84$, $p < .001$, $\eta_p^2 = .35$.

To investigate this interaction in more detail, we computed a prioritization effect by subtracting RTs for above-matching trials from RTs for below-matching trials (see Figure 2). We found a significant above-prioritization effect, $t(29) = 5.76$, $p < .001$, $d_z = 1.05$, 95% CI [.60, 1.49]. The corresponding difference for nonmatching trials was not significant, $t(29) = .14$, $p = .887$, $d_z = .03$, 95% CI [−0.32, 0.37].

Error Rates: Experiment 1B

We conducted a repeated-measures ANOVA with the factors label (self vs. other) and shape relation (match vs. nonmatch) and arcsine transformed error rates as dependent variables. This analysis revealed a significant main effect of label, $F(1, 31) = 29.20$, $p < .001$, $\eta_p^2 = .49$, indicating less errors for self-label trials. The main effect of shape relation was not significant, $F < 1$. The two-way interaction between shape relation and label was significant, $F(1, 31) = 12.75$, $p = .001$, $\eta_p^2 = .29$.

We computed a prioritization effect for matching trials by subtracting error rates for self-matching trials from error rates for other-matching trials. We found a significant self-prioritization effect, $t(31) = 5.72$, $p < .001$, $d_z = 1.01$, 95% CI [0.58, 1.43]. We did the same in nonmatching trials (RTs for self-non-matching trials were subtracted from RTs for other-nonmatching trials). This effect was not significant, $t(31) = .50$, $p = .620$, $d_z = -.09$, 95% CI [−0.26, 0.42].

Error Rates: Experiment 2

We conducted a mixed ANOVA with the factors label (self vs. other) and shape relation (match vs. nonmatch) as within-participants factors and task (match = "yes" vs. match = "no") as between-participants factor and arcsine error rates as dependent variables. The main effect of matching was significant, $F(1, 107) = 18.22$, $p < .001$, $\eta_p^2 = .15$, indicating less errors in matching trials. The main effect of task, $F(1, 107) = 11.31$, $p < .001$, $\eta_p^2 = .10$, indicating less errors in the mono-condition, was significant, too. The two-way interaction of shape relation and task, $F(1, 107) = 6.84$, $p = .010$, $\eta_p^2 = .06$, and the two-way interaction of label and shape relation, $F(1, 107) = 9.57$, $p = .003$, $\eta_p^2 = .08$, were significant, as was the three-way interaction, $F(1, 107) = 6.89$, $p = .010$, $\eta_p^2 = .06$. All other effects did not reach significance, Fs < 1.

We computed prioritization effects for both polarity conditions. We found a significant self-prioritization effect, $t(53) = 5.91$, $p < .001$, $d_z = .81$, 95% CI [0.49, 1.11], in the match = "yes" condition. However, in the match = "no" condition, the self-prioritization effect disappeared, $t(54) = 1.15$, $p = .257$, $d_z = .16$, 95% CI [−0.11, 0.42]. In nonmatching trials, as expected, we did not find any prioritization effects: $t(53) = .82$, $p = .416$, $d_z = .11$, 95% CI [−0.16, 0.38] for match = "yes" and $t(54) = .70$, $p = .487$, $d_z = .09$, 95% CI [−0.17, 0.35] for match = "no."

Error Rates: Experiment 3

We conducted a repeated-measures MANOVA (O'Brien & Kaiser, 1985) with the factors label (self vs. other female vs. other male) and shape relation (match vs. nonmatch) as within-participants factors and task (match = "yes" vs. match = "no") as a between-participants factor. For all analyses involving the *label* factor, we report the two Helmert contrasts: self versus other (i.e., female and male collapsed; Hypothesis 1) and female versus male (Hypothesis 2). This analysis revealed a significant main effect of label, $F(2, 66) = 3.65$, $p = .031$, $\eta_p^2 = .10$, $F(1, 67) = 7.28$, $p = .009$, $\eta_p^2 = .10$ and $F < 1$ for Hypotheses 1 and 2, respectively, but not shape relation, $F(1, 67) = 2.29$, $p = .135$, $\eta_p^2 = .03$. The two-way interaction between label and shape relation was significant, $F(2, 66) = 9.26$, $p < .001$, $\eta_p^2 = .22$. The Hypothesis 1 contrast, corresponding to an overall SPE, was significant, $F(1, 67) = 18.78$, $p < .001$, $\eta_p^2 = .22$; Hypothesis 2 did not reach significance, $F < 1$. The two-way interaction between label and task was also significant, $F(2, 66) = 4.71$, $p = .012$, $\eta_p^2 = .13$, $F < 1$ and $F(1, 67) = 8.50$, $p = .005$, $\eta_p^2 = .11$, for Hypotheses 1 and 2, respectively. Again, the three-way interaction was significant, $F(2, 66) = 5.86$, $p = .005$, $\eta_p^2 = .15$. The Hypothesis 1 contrast reached significance, $F(1, 67) = 7.37$, $p = .008$, $\eta_p^2 = .10$, whereas Hypothesis 2 was not significant, $F(1, 67) = 3.17$, $p = .080$, $\eta_p^2 = .05$. All other effects did not reach significance, Fs < 1.

To further analyze the three-way interaction, we calculated prioritization effects by subtracting error rates for self-matching trials from error rates for other-matching trials (i.e., the mean of reaction times for "he" and "she" matching trials) for both task conditions. We found a significant self-prioritization effect in the match = "yes" condition, $t(34) = 5.89$, $p < .001$, $d_z = 1.00$, 95% CI [0.58, 1.40]. In the match = "no" condition, the self-prioritization effect was not significant, $t(33) = 1.26$, $p = .215$, $d_z = .22$, 95% CI [0.13, 0.56]. The two effects differed significantly from each other, $t(67) = 3.30$, $p = .002$, $d_z = .80$, 95% CI [0.30, 1.28]. In the nonmatching trials, both prioritization effects did not reach significance: $t(34) = .17$, $p = .866$, $d_z = .03$, 95% CI [−0.30, 0.36] in the match = "yes" condition and $t(33) = 1.43$, $p = .162$, $d_z = .25$, 95% CI [−0.10, 0.59] in the match = "no" condition. The two effects did not differ significantly from each other, $t(67) = .93$, $p = .533$, $d_z = .15$, 95% CI [−0.62, .32].

Discussion

The results of the error analysis either corroborate the findings of the response time data or do not negate them. This indicates that a potential speed–accuracy trade-off can be excluded.

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