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Relevant for Us? We-Prioritization in Cognitive Processing

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Humans are social by nature. We ask whether this social nature operates as a lens through which individuals process the world even in the absence of immediate interactions or explicit goals to collaborate. Is information that is potentially relevant to a group one belongs to ("We") processed with priority over information potentially relevant to a group one does not belong to ("They")? We conducted three experiments using a modified version of Sui, He, and Humphreys' (2012) shape–label matching task. Participants were assigned to groups either via a common preference between assigned team members (Experiment 1) or arbitrarily (Experiment 2). In a third experiment, only personal pronouns were used. Overall, a processing benefit for we-related information (we-prioritization) occurred regardless of the type of group induction. A final experiment demonstrated that we-prioritization did not extend to other individual members of a short-term transitory group. We suggest that the results reflect an intrinsic predisposition to process information "relevant for us" with priority, which might feed into optimizing collaborative processes.

Public Significance Statement

This study demonstrates that humans rapidly and preferentially process group-relevant information even in the absence of an immediate goal to collaborate with a group. The "we" effect obtained for the present ad hoc transitory groups is likely to be distinct from self-prioritization because familiar others who were integrated within the group did not similarly elicit prioritization effects as predicted by an "extended self" hypothesis. We-prioritization might stem from top-down prioritization of information that is beneficial to the group.

Keywords: self-prioritization, we-prioritization, group processing, we-mode, joint action

Humans live in a social world and have evolved to adapt and succeed within their environments through highly collaborative means (Tomasello, 2014). Indeed, the strength of human society seems to rest upon individuals working together. One intrinsic aspect of this collaborative tendency is that humans may process information and act upon the world not only from an individual point of view but as part of a group. Indeed, it may be that processing information as an individual and as a social entity is qualitatively different (Gilbert, 1989).

It is clear that the self holds considerable weight in the human cognitive system from the abundance of research demonstrating self-advantages on a range of stimuli (Own Face: Brédart, Delchambre, & Laureys, 2006; Sui, Zhu, & Han, 2006; Virtual and real self-owned objects: Constable, Welsh, Huffman, & Pratt, 2019; Truong, Roberts, & Todd, 2017; Arbitrary shapes: Constable, Rajsic, Welsh, & Pratt, 2019; Sui, He, & Humphreys, 2012). It often seems that, regardless of the social environment, humans must be permanently tuned to seek and respond to self-related information. Indeed, self-stimuli prompt increased information uptake that results in faster decision making (Golubickis et al., 2017), and recent theory has suggested a dedicated self-network that is primed to process incoming self-stimuli (Humphreys & Sui, 2016).

However, the cognitive system also clearly assigns considerable weight to processes that support human interaction. Here we ask whether the human collaborative predisposition acts as a lens through which we process the world. To be precise, even in absence of an explicit intention to collaborate, is information that is relevant for the collective opportunistically prioritized in cognition? Prioritization of information that is relevant for "us" may serve to benefit future joint actions (Sebanz, Bekkering, & Knoblich, 2006). In this way, the selection and prioritization of group relevant information might be an important component of the "we-mode" (Gallotti & Frith, 2013), enabling individuals to

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see what is relevant and what can be achieved from the perspective of the group rather than from the perspective of the individual. It has been proposed that the we-mode is supported by a set of cognitive functions that support successful interactions with others and the achievement of collaborative goals (Gallotti & Frith, 2013; Tuomela, 2006). It allows individuals to process incoming information within the context of an interaction and thus gain access to their interaction partner's cognitive experience while enhancing the potential for understanding (see Gallotti & Frith, 2013; Vesper & Sebanz, 2016 for reviews). Although the we-mode is often described in terms of explicit mentalizing (Tuomela, 2006), implicit processes such as preferential processing of information relevant to one's own group may also contribute.

Previous research has discussed implicit processes implicated in the we-mode extensively in relation to joint tasks and coordination. For example, it is thought that humans spontaneously represent other's tasks much as they would their own (Elekes, Bródy, Halász, & Király, 2016; Sebanz, Knoblich, & Prinz, 2003; Welsh & McDougall, 2012) and in certain situations may covertly simulate the perceptual (Constable, Pratt, Gozli, & Welsh, 2015) and/or bodily states of another person (Brass, Bekkering, Wohlschläger, & Prinz, 2000). Although initiation of such processes is dependent on specific task demands (Constable et al., 2017, 2015; Constable, Pratt, & Welsh, 2018; van der Wel & Fu, 2015), dyads might corepresent each other's tasks even to the detriment of individual performance (Sebanz et al., 2003; Welsh et al., 2005).

There seems to be a dissociation in goal representations when the self is contextualized as an individual or as a social entity. That is, when two or more people try to achieve a joint goal they spontaneously represent the task as joint rather than simply representing the self and the other's tasks in tandem (e.g., Loehr, Sebanz, & Knoblich, 2013; Sacheli, Arcangeli, & Paulesu, 2018). Following on from the established literature concerning the prioritization of collective goals in joint action, we predict that individuals should display a general tendency to prioritize information associated with groups of which they are members relative to information associated with groups they do not belong to. "We-prioritization" should occur even when individuals are not directly engaged in an interaction and when there is no explicit group goal. We also predict that we-prioritization should manifest without the "glue" that holds real-world teams together. We predict this because prioritizing information that is "relevant for us" should reflect a general and established group orientation within the human cognitive system that helps humans act effectively in their social environments and discover collaborative opportunities.

We also note that such predictions concerning we-prioritization could be made on the basis of extant self-models (Humphreys & Sui, 2016; Symons & Johnson, 1997) if one views the group as a collective self that extends from the individual self. Indeed, the theory of the *extended self* (Belk, 1988) has previously been applied to account for the prioritization effects that are sometimes observed for participants' mothers and best friends because these individuals are supposedly close to the self (Schäfer, Wentura, & Frings, 2017). Concerning real world teams, football fans show prioritization for the badge of their favorite football team as compared to badges from a rival or neutral team (Moradi, Sui, Hewstone, & Humphreys, 2015) and rowers show prioritization for their own rowing team (Enock, Sui, Hewstone, & Humphreys, 2018). Interpreted within the context of the Self-Attention Network (Humphreys & Sui, 2016), one's own team would be prioritized within perceptual and attentional networks because the team can be characterized as an extension of the self to the collective (Schäfer et al., 2017).

An alternative self-framework based on memory (Symons & Johnson, 1997) also predicts a self-based effect for one's own team, but for different reasons. In this framework, the team would be integrated within a rich self-semantic network (Bower & Gilligan, 1979; Symons & Johnson, 1997) by virtue of its connection to the self. This embeddedness within the self-semantic network allows for more efficient access to and retrieval of information related to the self because the "self" acts as an entry point to memory structures that connect to a vast array of information that might be activated and used for verification purposes (Constable, Rajsic, et al., 2019; Klein & Kihlstrom, 1986; Klein & Loftus, 1988). We-prioritization under this framework would be a byproduct of the group connection to the self.

The Present Study

To investigate if we-prioritization is evident in cognitive processing we adapted a shape–label matching task (Sui et al., 2012) that has been shown to be sensitive to self-prioritization. This task demonstrates that information arbitrarily associated with self (e.g., a particular shape) enjoys immediate processing benefits relative to other-associated stimuli (for an overview see Humphreys & Sui, 2016). We used the Sui et al. (2012) procedure to establish whether information arbitrarily associated to one's own group enjoys similar immediate processing benefits. In a short induction, participants associated arbitrary shapes with (a) a collective including self (we), (b) a collective not including self (they), (c) self (me), and (d) a stranger (he or she). The individual conditions were included to check whether the usual effects of self-prioritization were present for our materials. Our primary prediction was that participants should respond faster for we-matches than for they-matches. We tested this hypothesis across different kinds of group induction. We started with groups that were formed on the basis of shared preferences (Experiment 1). We then tested whether these shared preferences were important by evaluating whether we-prioritization could also be elicited through arbitrarily defined groups (Experiment 2). Experiment 3 did not employ a group induction and tested whether the mere use of the pronoun *we* would be sufficient for we-prioritization. If we-prioritization reflects a general processing benefit for information that is relevant for us it should occur across all three experiments, independently of whether group membership is established through shared preferences, knowledge of individual group members, or use of pronouns.

Experiment 4 contrasted predictions based on we-mode literature (where "we" is distinct) and the "extension of self" literature where "we" includes the self). Pairs of participants were recruited to perform a task together as a "team", which existed solely for the purpose of the experiment and disbanded upon completion of the experiment. A short induction required participants to make associations between arbitrary shapes and themselves (self and assigned team member/coactor), a stranger, their team, and another team. The pairs were then asked to perform the shape/label matching task adapted to a joint task: one participant responded on match trials and the other responded on mismatch trials. If we-prioritization is a mere extension of self-prioritization then participants should also prioritize their coactor's stimulus because their coactor's stimulus should also be integrated into the self-network more than a stranger's stimulus (similarly to a mother's or a best friend's stimulus, see Schäfer et al., 2017). Alternatively, if we-prioritization stems from a general collaborative orientation (Gallotti & Frith, 2013; Tomasello, 2014), then only information that is relevant to the self and the group should be prioritized. This go–no go task was also chosen to demonstrate how we-prioritization might generalize to a situation more akin to real-world transitory group formation whereby members of a group come together to perform a task using complimentary actions.

Experiment 1

To induce a feeling of group membership, a preference-based group induction (Tajfel, 1970) was used whereby participants indicated a painting they preferred and were then matched with another individual who allegedly preferred the same painting. The induction procedure also presented the participants with other individuals who allegedly preferred different paintings. This well-established manipulation generates a social identity in a deductive manner on the basis of commonality between group members (Postmes, Spears, Lee, & Novak, 2005) and produces robust in-group versus out-group effects (Pinter & Greenwald, 2011). Thus, we used this induction as a means to signal who the group members were. Nevertheless, we note that it was not our intention to evaluate group identity in the traditional sense in relation to prioritization effects (see Enock et al., 2018), but rather to evaluate the potential for we-prioritization in minimally indicated transitory groups that have been established for the sole purpose of a given task.

After the group induction participants were asked to associate four labels with arbitrary shapes: one shape representing their group "We," one shape representing another group "They," one shape representing the participant "Me/I," and one shape representing another participant "He/She."[1] Participants then completed the shape–label matching task. We predicted faster Response Times (RTs) for we-matches than for they-matches, and faster RTs for me-matches than for he- or she-matches.

Method

Participants. The participants were 28 native Hungarian speakers aged 19 to 37 ($M = 24.82$, $SD = 4.75$, 12 male). They participated in the experiment in exchange for 1,500 Hungarian Forints (HUF) worth of supermarket vouchers. All participants had normal or corrected-to-normal vision. Based upon the critical comparison of interest (RTs toward self vs. stranger stimuli), 28 participants will provide an implied power of 96% for the large effect sizes ($d_z = .8$) reported in previous studies.

Stimuli and apparatus. Eight photographs (4 male, 4 female) of young adults were taken from the FEI Face Database (Thomaz & Giraldi, 2010) to serve as potential group members. Each person within the picture was centered and had a neutral expression. Eight four-letter common Hungarian names (4 male: Máté, Imre, Márk, Ákos, 4 female: Anna, Sára, Réka, Dóra) were selected to match the photographs. Three artworks by similar artists (Klee, Kandinsky, and Marc) were used for the group induction. Stimuli were presented through a computer running Windows 10 on a computer screen with a spatial resolution of 1920×1080 and refresh rate of 60 Hz. All text was presented in Hungarian.

Procedure. Prior to testing, the experimenter took a picture of the participant and cropped the picture in the same manner as the pictures of the photographs of people that would serve as potential group members. This picture was then inserted into the experimental program. The whole experiment was presented in Hungarian and any English instructions below have been translated from the original experiment.

Group induction. To start, participants were given the following instructions on screen: "Past studies have shown that people have distinct preferences when it comes to artistic works. It has been shown that preferences reveal something fundamental about the psychological characteristics and personality of the person. In this experiment, you will first indicate your preferences between three paintings by different artists." Participants were then asked to indicate which of the three paintings they liked best from an array by pressing the *A*, *B*, or *C* key. The location of the paintings was randomized for each participant. A screen then appeared with the participant's photo and the painting they chose: "You indicated that you prefer painting X." A picture of another "participant" (randomized) who supposedly chose the same painting then appeared alongside the chosen painting and the participant's picture: "X indicated that they preferred X painting as well. Because you and X picked the same painting and X is similar to you, you will be in a group together." A second group without the participant was then presented: "X and X indicated that they preferred painting X. Because they picked the same painting and they are similar they will be in a group together." Last, a single individual was presented: "X preferred painting X. Because they were the only one to pick painting X they will be in a group by themselves." Participants always viewed pictures of the same gender. Group assignment and the names of "other participants" were all randomized.

Shape assignment and training. For each participant, the pronouns were each randomly assigned a shape. Onscreen, the shape and group pairing was presented for 30 s. For example, "YOU are represented by the CIRCLE, YOUR GROUP is represented by the DIAMOND, THE OTHER GROUP is represented by the TRIANGLE, THE PERSON NOT IN A GROUP is represented by the STAR." Each shape and label pairing were then presented alone for 10 s. For example: Me = Diamond, We = Star, They = Circle, He or She = Triangle. Participants then completed 60 (15 for each shape) training trials indicating who a shape represented, by pressing the *q*, *w*, *o*, or *p* keys (response mappings randomized). The shape in the training trials was presented as a word rather than the actual shape to ensure participants made an association with the concept but had no prior training with the images of the shapes prior to the experimental phase.

Matching task. In the matching task participants indicated whether the label did or did not match the shape by pressing the *n* or *m* key (counterbalanced). We estimated visual angle (VA) on

[1] Note that our participants were Hungarian. In Hungarian the same gender-neutral pronoun *ő* is used for *she* as well as *he*, similar to singular *they*.

the basis of the average viewing distance of 57 cm. A trial began with a white fixation cross (1.4° × 1.4° VA) on a black background presented for 500 ms. A white shape (3.5° × 3.5° VA) and a white label (height: 1.4° VA) then appeared above and below the fixation cross for 233 ms after which the screen went blank. The center of the fixation cross was 5.0° VA away from the center of each stimulus (Shape and Label). Participants were required to respond within 1,500 ms after the stimulus disappeared. Participants were provided with a longer time window to make a response than in the original task because pilot testing revealed that too many of our participants were unable to do the task with the original timings (Sui et al., 2012). Response feedback was given for 500 ms in the form of Correct (*Helyes* presented in white text), Incorrect (*Téves* presented in red text), or Too slow (*Túl lassú* presented in yellow text). There was a variable intertrial interval of 500–800 ms. Participants completed 20 practice trials followed by three blocks of 96 trials. Location, shape, and label were fully counterbalanced and randomized within a block. See Figure 1 for the time course of a trial.

Design. A 2 × 2 within-subjects design with Reference and Entity as factors (see Table 1) was used. The pronouns used in Hungarian are in brackets.

Results

Participants were generally accurate, $M = 91.37\%$, $SD = 4.91\%$, with participants performing more accurately on self-trials (Me and We) than other-trials (He/She and They). Because participants performed at ceiling in many cells, measures such as accuracy and d' are not likely to represent self-prioritization appropriately in the present experiment. For this reason, our primary dependent measure is RT. Matching trials and Mismatching trials were analyzed separately because they are thought to involve different processes (Humphreys & Sui, 2016) and because Mismatch trials contain the important additional factor of Label Type. Trials 3 *SD* above or below the participant's mean and trials on which no response was made (1.12%) were removed prior to analysis. Effect sizes for the planned comparisons were calculated using the average standard deviation of both repeated measures in question as the standardizer (d_{av}; Lakens, 2013). Following our primary analysis of RT we provide exploratory analyses concerning sensitivity (d') and decision criteria (c). We computed d' and c using the "psycho" package in R (Makowski, 2018). As mentioned, many participants performed at ceiling levels. Because participants displayed very high hit rates and low false alarm rates we corrected for extreme values using a log-linear approach (Hautus, 1995). Nevertheless, we would like readers to keep in mind these estimates are still likely to be biased. All data for all experiments and the data submitted to inferential statistics in JASP (JASP Team, 2018) can be found on the OSF: https://osf.io/sejw7/.

Match trials. A 2 × 2 repeated measures ANOVA with the factors Reference (self-referential vs. other-referential) and Entity (individual vs. group) was conducted on matching trials. A main effect of Reference was observed, $F(1, 27) = 43.18$, $p < .001$, $\eta^2 = .62$: Participants responded faster on self-referential (750 ms) than on other-referential trials (849 ms). A main effect of Entity also emerged, $F(1, 27) = 8.47$, $p = .007$, $\eta^2 = .24$, with faster performance on individual trials (774 ms) compared to group trials (822 ms). These effects were qualified by an interaction, $F(1, 27) = 9.50$, $p = .005$, $\eta_p^2 = .26$ that reflected a larger self-advantage in the individual trials (138 ms) compared to the group trials (61 ms), $t(27) = 3.08$, $p = .005$, $d_{av} = .74$, 95% CI [0.03, 0.13]. Because our research question centers on whether We may be prioritized over They, we performed a *t* test comparing We and They trials only to confirm the presence of we-prioritization, $t(27) = 3.25$, $p = .003$, $d_{av} = .48$, 95% CI [0.02, 0.10]. Together the results of Experiment 1 show that we-prioritization was present but did not manifest to the same extent as self-prioritization (see Figure 2).

Mismatch trials. For mismatch trials, the factor of Label (Self/Other) was added to the analysis. Labels were coded in terms of identity relation (Self: Me and We, Other: He/She, They). Thus, a 2 (Reference: Self-Referential/Other-Referential) × 2 (Entity: Individual/Group) × 2 (Label: Self/Other) repeated measures ANOVA was performed on the data for Mismatch Trials. The only significant main effect observed was that of Label, $F(1, 27) = 23.29$, $p < .001$, $\eta^2 = .46$, with participants responding faster on trials with a self-label (Me or We) than trials with an other-label (He/She, or They), 850 ms and 884 ms respectively. Main effects associated with Reference and Entity did not reach significance, $ps > .3$. Because the three-way interaction was significant, $F(1, 27) = 10.96$, $p = .003$, $\eta^2 = .29$, we follow up the interaction by focusing on Individual trials and Group trials separately.

Individual trials. A 2 (Reference) × 2 (Label) repeated measures ANOVA was conducted on the mismatch trials where the shapes represented only one person. Consistent with the three-way Omnibus ANOVA, a main effect of Label was observed, $F(1, 27) = 7.98$, $p = .009$, $\eta^2 = .23$. No effect of Reference was observed, $F(1, 27) < 1$; however, an interaction between Label and Reference was observed, $F(1, 27) = 17.45$, $p < .001$, $\eta^2 = .39$. Follow-up *t* tests revealed that the self-advantage (50 ms) was only present when the label was other-related, $t(27) = 2.28$, $p = .03$, $d_{av} = .20$, 95% CI [0.005, 0.095]. When the label was self-related no difference was observed between shapes representing self and shapes representing other, $t(27) = -1.64$, $p = .11$, $d_{av} = -.08$,

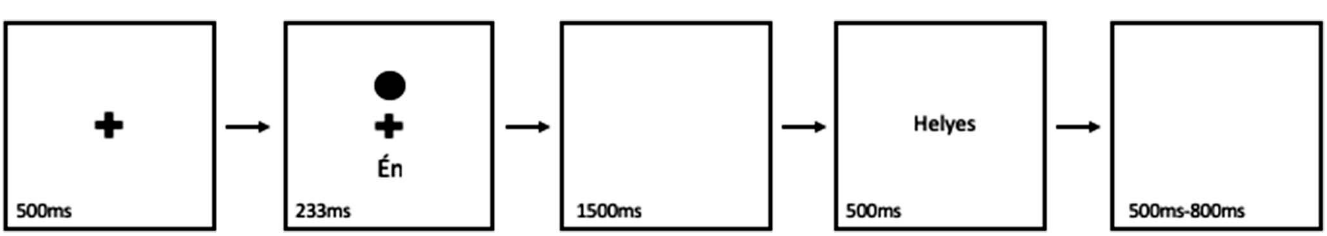

Figure 1. Time course of a trial (not to scale).

Table 1
Experimental Design

	Entity	
	Individual	Group
Reference		
Self	Me (Én)	We (Mi)
Other	He/She (Ő)	They (Ők)

95% CI [−0.044, 0.005]; in fact, numerically the effect was a disadvantage (−19 ms). This pattern of results suggests that any presence of a self-relevant stimulus (whether label or shape) results in a self-advantage because for self-labeled trials even when the shape was other-related a self-advantage emerged. Further, regarding the presence of two self-related stimuli (e.g., Shape = Me, Label = We), no support for an additive effect was obtained from a *t* test comparing self and other labeled trials in the self-reference condition, $t(27) = .86$, $p = .40$, $d_{av} = .04$, 95% CI [−0.012, 0.029]. In fact, a Bayesian analysis performed to compare the paired means revealed that the data were 3.55 times more likely under the null hypothesis that there was no difference between these two conditions ($BF_{10} = 0.28$).

Group trials. A 2 (Reference) × 2 (Label) repeated measures ANOVA was conducted on the mismatch trials where the shapes represented a group. In this case only a main effect of Label emerged, $F(1, 27) = 20.34$, $p < .001$, $\eta^2 = .43$, with RTs to self-labeled (We) trials (849 ms) being faster than other-labeled (They) trials (900 ms). Neither the effect of Reference nor the interaction reached significance, *F*s < 1. For group trials, it seems that the label type is the primary driver of any self-benefit (see Figure 3).

Sensitivity. We conducted a 2 (Reference) × 2 (Entity) repeated measures ANOVA. A main effect of Reference was observed, $F(1, 27) = 24.86$, $p < .001$, $\eta^2 = .48$, such that participants exhibited greater sensitivity to self-stimuli than other-stimuli. Neither the main effect of Entity, $F(1, 27) = 1.37$, $p = .25$, $\eta^2 = .04$, or the interaction, $F(1, 27) = 3.89$, $p = .06$, $\eta^2 = .13$, reached significance. This effect is in contrast to the interaction with Entity in the RT measures. We suspect that the reason for this might be that many participants performed at ceiling in the task and thus we were unable to accurately estimate efficiency at the population level. Nevertheless, overall a similar pattern of results was obtained and it is clear that both self-prioritization and we-prioritization manifests in d'.

Decision criterion. We systematically tested each condition for response bias against the test value of 0. No bias was observed for self-stimuli (Individual: $t(27) = -.27$, $p = .79$, $d = -.05$, 95% CI [−0.12, 0.09], Group: $t(27) = 1.25$, $p = .22$, $d = .24$, 95% CI [−0.04, 0.17]). However, on trials with “other” stimuli participants had a significant bias to respond “Match” (Individual: $t(27) = 3.41$, $p = .002$, $d = .64$, 95% CI [.05, .22], Group: $t(27) = 3.47$, $p = .002$, $d = .66$, 95% CI [.06, .24]).

Experiment 2

Experiment 1 established a robust we-prioritization effect. Experiment 2 was conducted to determine whether the we-prioritization observed in Experiment 1 hinged on sharing preferences with other group members. Therefore, we used an arbitrary group induction that did not involve shared preferences. If we-prioritization reflects a general tendency to preferentially process information relevant for groups one belongs to, then we-matches should still be processed faster than they-matches under the arbitrary group induction.

Method

Participants. The participants were 28 native Hungarian-speaking participants aged 18 to 31 ($M = 22.50$, $SD = 2.67$, 6 male). They participated in the experiment in exchange for 1,500 HUF worth of supermarket vouchers. All participants had normal or corrected-to-normal vision.

Stimuli, apparatus, procedure, and design. All aspects of the experiment were the same as in Experiment 1, except that the painting induction was removed. Participants were assigned to groups and introduced to the group members with portrait photographs and names. No other information was given about the group

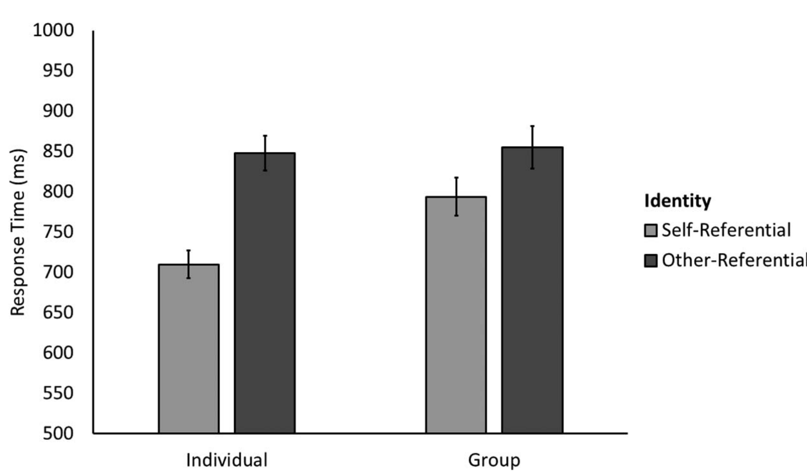

Figure 2. Reaction times for match trials by reference (Self/Other) and entity (Individual/Group). Error bars represent standard error.

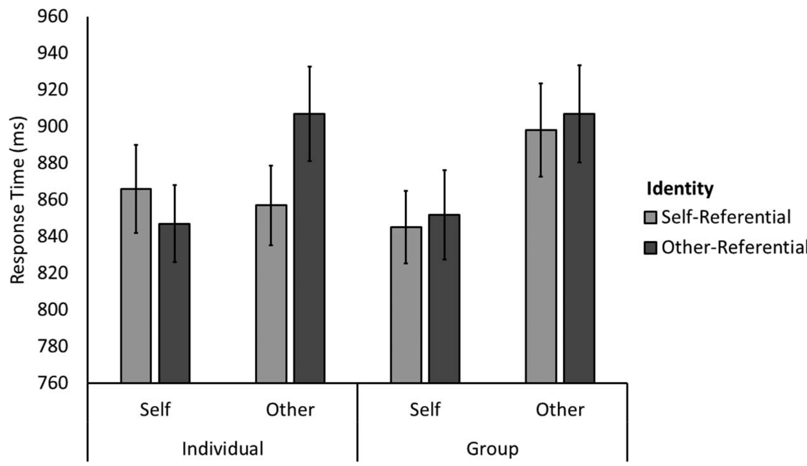

Figure 3. Reaction times for mismatch trials by reference (Self-referential/Other-referential), entity (Individual/Group), and label (Self/Other). Error bars represent standard error.

members. As such, participants were put into arbitrary groups with no basis for commonality between group members. After the group induction, participants experienced the same experimental task as those in Experiment 1.

Results

Data were analyzed in the same way as in Experiment 1. Accuracy was generally high ($M = 90.87\%$, $SD = 6.01\%$) with participants responding faster on self-referential trials than other-referential trials. Trials 3 *SD* above or below the participants mean and trials on which no response was made (1.50%) were removed prior to analysis. As with Experiment 1, d' was calculated with corrections to extreme values (Hautus, 1995; Makowski, 2018).

Match trials. A 2 (Reference) × 2 (Entity) repeated measures ANOVA was conducted on matching trials. A main effect of Reference emerged, $F(1, 27) = 51.66$, $p < .001$, $\eta^2 = .66$ such that participants responded faster on Self trials (765 ms) than on Other trials (849 ms). A main effect of Entity was also evident, $F(1, 27) = 20.04$, $p < .001$, $\eta^2 = .43$, with participants responding faster on Individual trials (765 ms) compared to Group trials (823 ms). The absence of an interaction in this data set, $F(1, 27) = 0.98$, $p = .33$, $\eta^2 = .04$, is contrary to Experiment 1 where the magnitude of we-prioritization was smaller than the magnitude of self-prioritization. To follow this up, the magnitude of we-prioritization (71 ms) was contrasted with self-prioritization (99 ms) in a Bayesian analysis. The results of the analysis provided moderate evidence for similarity of magnitude between we-prioritization and self-prioritization in this experiment, $BF_{10} = 0.31$ (see Figure 4).

Mismatch trials. A 2 (Reference: Self/Other) × 2 (Entity: Individual/Group) × 2 (Label: Self/Other) repeated measures ANOVA was performed on the data for Mismatch Trials. The only significant main effect observed was that of Label, $F(1, 27) = 26.00$, $p < .001$, $\eta^2 = .49$, with participants responding faster on trials with a self-label (Me or We) than trials with an other-label (He/She, or They), 864 ms and 905 ms, respectively. Main effects associated with Reference and Entity did not reach significance,

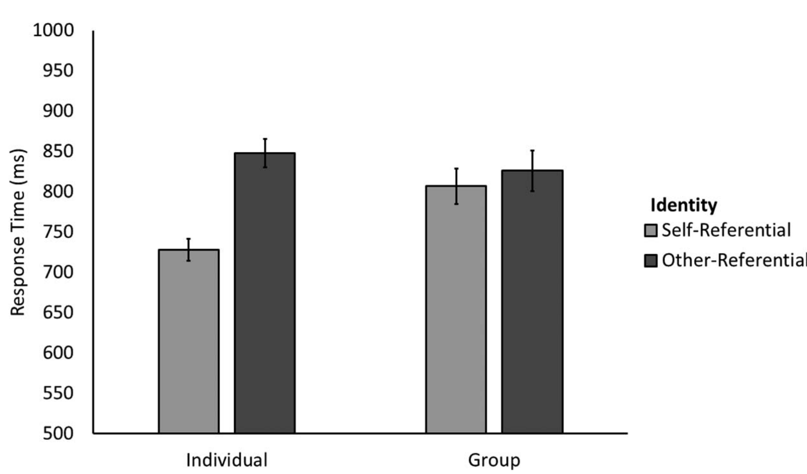

Figure 4. Reaction times for match trials by reference (Self/Other) and entity (Individual/Group). Error bars represent standard error.

$F(1, 27) = 2.76$, $p = .11$, $\eta_p^2 = .09$ and $F(1, 27) = 0.03$, $p = .87$, $\eta^2 = .001$, respectively. Because the three-way interaction was significant, $F(1, 27) = 23.06$, $p < .001$, $\eta^2 = .46$, we followed up the interaction by focusing on Individual trials and Group trials separately.

Individual trials. A 2 (Reference) × 2 (Label) repeated measures ANOVA was conducted on the mismatch trials where the shapes represented only one person. Consistent with the three-way Omnibus ANOVA, a main effect of Label was observed, $F(1, 27) = 17.50$, $p < .001$, $\eta_p^2 = .39$. No effect of Reference was observed, $F < 1$. However, the main effect of Label was qualified by an interaction between Reference and Label, $F(1, 27) = 22.20$, $p < .001$, $\eta^2 = .45$. Follow-up t tests revealed that the self-advantage (55 ms) was only present when the label was other-related, $t(27) = 2.45$, $p = .02$, $d_{av} = .41$, 95% CI [0.009, 0.101]. When the label was self-related, a significant self-disadvantage (−46) was observed, $t(27) = -4.03$, $p < .001$, $d_{av} = -.45$, 95% CI [−0.069, −0.023]. This pattern of results is consistent with the above conclusions that the label is of critical importance when exploring any effects that bear out of mismatch trials.

Group trials. A 2 (Reference) × 2 (Label) repeated measures ANOVA conducted on the mismatch trials where the shapes represented groups. Consistent with the three-way Omnibus ANOVA, a main effect of Label was observed, $F(1, 27) = 15.02$, $p < .001$, $\eta^2 = .36$, with participants responding faster on self-labeled trials (868 ms) than on other-labeled trials (914 ms). A main effect of Reference was also observed, $F(1, 27) = 7.32$, $p = .01$, $\eta^2 = .21$, with participants responding faster on self-shape trials (886 ms) than on other-shape trials (894 ms). No interaction was observed, $F < 1$. This pattern of results suggests that at the group level there is a self-advantage associated with both the label and the shape (see Figure 5).

Sensitivity. We conducted a 2 (Reference) × 2 (Entity) repeated measures ANOVA. A main effect of Reference was observed, $F(1, 27) = 25.12$, $p < .001$, $\eta^2 = .48$, such that participants exhibited greater sensitivity to self-stimuli than other-stimuli. A main effect of Entity was also observed, $F(1, 27) = 10.47$, $p = .003$, $\eta^2 = .28$, such that participants exhibited greater sensitivity on Individual trials than on Group trials. The interaction did not reach significance, $F < 1$. The pattern of results mirrors the results obtained in the RT measure and provides evidence that self- and we-prioritization can be observed in measures of sensitivity.

Decision criterion. We systematically tested each condition for response bias against the test value of 0. No bias was observed for self-stimuli (Individual: $t(27) = -.56$, $p = .58$, $d = -.11$, 95% CI [−0.12, 0.06], Group: $t(27) = -0.69$, $p = .50$, $d = -.13$, 95% CI [−0.15, 0.07]). However, on trials with "other" stimuli participants had a significant bias to respond "Match" (Individual: $t(27) = 3.17$, $p = .004$, $d = .60$, 95% CI [0.04, 0.17], Group: $t(27) = 2.66$, $p = .01$, $d = .50$, 95% CI [0.03, 0.20]).

Experiment 3

Experiment 2 demonstrated that we-prioritization occurs independently of shared preferences. However, in both experiments, participants had knowledge of who the other individual group members were. Does we-prioritization also occur for generic groups where individual group members are not known? To address this question, we tested whether we-prioritization can manifest in the case of disembodied pronouns. When reading the pronoun *we*, an exemplar concept of the self and group should be activated even though the individual group members are unknown (Tulving, Schacter, & Stark, 1982). If we-prioritization reflects a general tendency in cognition, then we-matches should still be processed faster than they-matches under these conditions.

Method

Participants. The participants were 28 native Hungarian speakers aged 18 to 31 ($M = 22.68$, $SD = 2.82$, 8 male). They participated in the experiment in exchange for 1,500 HUF worth of supermarket vouchers. All participants had normal or corrected-to-normal vision.

Stimuli, apparatus, procedure, and design. The experiment was identical to previous experiments, except that there was no group induction whatsoever. Participants only saw the labels during the association phase, and they were not told specifically that they were a part of a defined group. Thus, group membership was

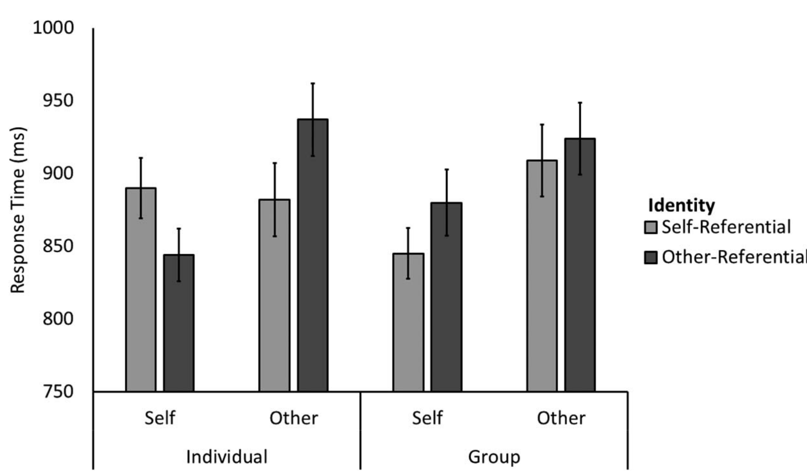

Figure 5. Reaction time for mismatch trials by reference (Self/Other), entity (Individual/Group), and label (Self/Other). Error bars represent standard error.

defined by arbitrary links between shapes and the familiar meaning of personal pronouns.

Results

The data were analyzed as in the previous experiments. Accuracy was generally high (M = 88.67%, SD = 7.74) with participants performing more accurately on self-trials than other-trials. Trials 3 SD above or below the participants mean and trials on which no response was made (1.66%) were removed prior to analysis. As with Experiment 1, d' was calculated with corrections to extreme values (Hautus, 1995; Makowski, 2018).

Match trials. A 2 (Reference) × 2 (Entity) repeated measures ANOVA was conducted on matching trials. A main effect of Reference, $F(1, 27) = 17.87$, $p < .001$, $\eta^2 = .40$ emerged. Participants responded faster on Self trials (774 ms) than on Other trials (852 ms). A main effect of Entity also emerged, $F(1, 27) = 35.01$, $p < .001$, $\eta^2 = .57$, with participants responding faster on Individual (760 ms) than on Group trials (863 ms). These main effects were qualified by an interaction, $F(1, 27) = 7.32$, $p = .01$, $\eta^2 = .21$. The source of this interaction was a larger self-advantage for Individual trials (112 ms) than for Group trials (40 ms), $t(27) = 2.71$, $p = .01$, $d_{av} = .62$, 95% CI [0.02, 0.13]. Again, the presence of we-prioritization was confirmed with a t test, $t(27) = 2.07$, $p = .048$, $d_{av} = .30$, 95% CI [3.783e^{-4}, 0.08]. The pattern of results indicates that pronouns referring to a generic group one belongs to are sufficient to induce we-prioritization (see Figure 6).

Mismatch trials. A 2 (Reference: Self/Other) × 2 (Entity: Individual/Group) × 2 (Label: Self/Other) repeated measures ANOVA was performed on the data for Mismatch Trials. The only significant main effect observed was that of Label, $F(1, 27) = 56.83$, $p < .001$, $\eta^2 = .68$, with participants responding faster on trials with a self-label (Me or We) than on trials with an other-label (He/She, or They), 855 ms and 915 ms, respectively. Main effects associated with Reference and Entity did not reach significance, $F(1, 27) = .13$, $p = .72$, $\eta^2 = .005$ and $F(1, 27) = 1.03$, $p = .32$, $\eta^2 = .037$, respectively. Because the three-way interaction was significant, $F(1, 27) = 12.27$, $p = .002$, $\eta^2 = .31$, we followed up the interaction by focusing on Individual trials and Group trials separately.

Individual trials. A 2 (Reference) × 2 (Label) repeated measures ANOVA was conducted on the mismatch trials where the shapes represented only one person. Consistent with the three-way Omnibus ANOVA, a main effect of Label was observed, $F(1, 27) = 12.51$, $p < .001$, $\eta^2 = .32$. No effect of Reference was observed, $F < 1$. However, the main effect of Label was qualified by an interaction between Reference and Label, $F(1, 27) = 14.34$, $p < .001$, $\eta^2 = .35$. Follow up t tests revealed that the self-advantage (44 ms) was only present when the label was other-related, $t(27) = 2.31$, $p = .03$, $d_{av} = .37$, 95% CI [0.005, 0.082]. When the label was self-related a significant self-disadvantage (−48) was observed, $t(27) = -2.41$, $p = .02$, $d_{av} = -.44$, 95% CI [−0.089, −0.007].

Group trials. A 2 (Reference) × 2 (Label) repeated measures ANOVA was conducted on the mismatch trials where the shapes represented groups. Consistent with the three-way Omnibus ANOVA, a main effect of Label was observed, $F(1, 27) = 48.73$, $p < .001$, $\eta^2 = .64$, with participants responding faster on self-labeled trials (851 ms) than on other-labeled trials (941 ms). Consistent with Experiment 1, neither the main effect of shape nor the interaction reached significance, Fs < 1. Overall, the results suggest that in the case of group trials the label is a primary driver of self-processing benefits (see Figure 7).

Sensitivity. We conducted a 2 (Reference) × 2 (Entity) repeated measures ANOVA. A main effect of Reference was observed, $F(1, 27) = 9.44$, $p = .005$, $\eta^2 = .26$, such that participants exhibited greater sensitivity to self-stimuli than other-stimuli. A main effect of Entity was also observed, $F(1, 27) = 29.58$, $p < .001$, $\eta^2 = .52$, such that participants exhibited greater sensitivity on Individual trials than on Group trials. The interaction did not reach significance, $F(1, 27) = 2.82$, $p = .10$, $\eta^2 = .10$. This pattern of results mirrors those obtained in Experiment 2. Similar to Experiment 1, the interaction observed in RT was not observed in sensitivity. We suggest this might be the result of ceiling level performance for many subjects.

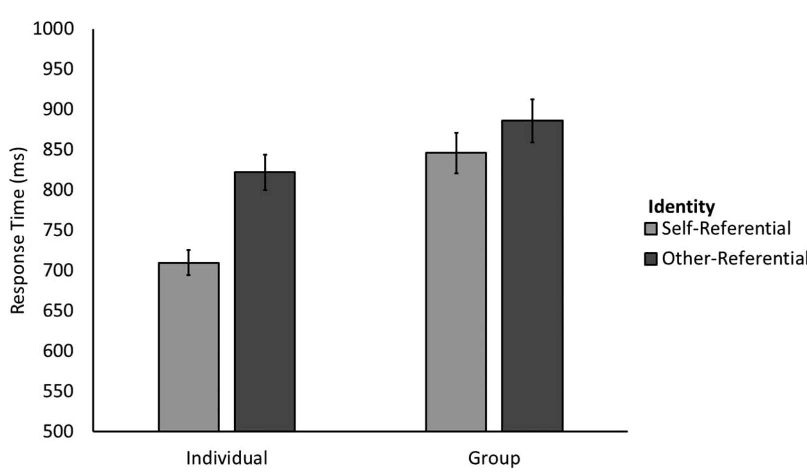

Figure 6. Reaction times for match trials by reference (Self/Other) and entity (Individual/Group). Error bars represent standard error.

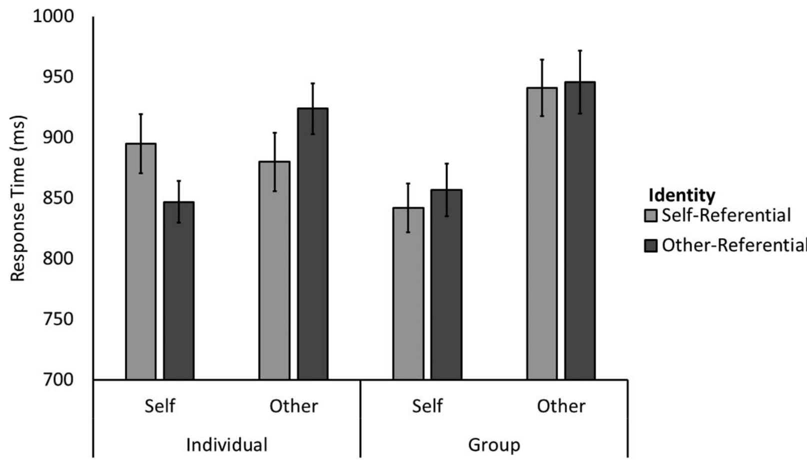

Figure 7. Reaction time for mismatch trials by reference (Self/Other), entity (Individual/Group), and label (Self/Other). Error bars represent standard error.

Decision criterion. We systematically tested each condition for response bias against the test value of 0. No bias was observed for self-stimuli (Individual: $t(27) = -1.09$, $p = .29$, $d = -0.21$, 95% CI [−0.17, 0.05], Group: $t(27) = -0.97$, $p = .34$, $d = -0.18$, 95% CI [−0.13, 0.05]). No significant bias was observed for You stimuli either, $t(27) = 0.86$, $p = .40$, $d = .16$, 95% CI [−0.06, 0.15] but They trials did produce a significant bias in favor of the Match response, $t(27) = 3.02$, $p = .005$, $d = .57$, 95% CI [0.04, 0.20]).

Experiment 4

Experiments 1, 2, and 3 demonstrated reliable we-prioritization that was generally smaller in magnitude than self-prioritization. We-prioritization was even observed when there was no indication of who the pronouns referred to (Experiment 3). Evidence of a consistent we-prioritization effect then begs the question of whether we-prioritization extends to individual members of the group. Previous work has suggested that the mother- and best-friend prioritization that is occasionally observed stems from the fact that close personal others are integrated into the self. If we-prioritization can be characterized as stemming from self-prioritization because the group includes the self, prioritization should be observed for the assigned team-member's stimulus because the team-member should also fit the assumption of an extended self through being incorporated into the 'we.' On the other hand, if we-prioritization stems from a general tendency to prioritize information relevant for collaboration, then only information that is relevant for the self or the group should be prioritized ("self" and "team" but not "assigned team-member"). To this end, participants were told that they were in a team together (Blue or Yellow Team) and that they would be performing the task together. In order to test the above hypotheses, we adapted the matching task such that one participant in a dyad responded to Match trials and the other to Mismatch trials. Therefore, the two participants in a dyad performed complementary go/no-go tasks. We evaluated responses to Self, assigned team member (henceforth Coactor), and Stranger stimuli. We also evaluated responses to Own Team and Other Team separately to confirm the existence of we-prioritization. A second aim of Experiment 4 was to generalize the findings of the previous experiments to a go/no-go task that was more akin to real-world transitory groups that are formed in order to complete a task via complementary actions.

Method

Participants. Twenty adult pairs aged 20 to 36 ($M = 25.43$, $SD = 3.76$) volunteered to participate in the study in exchange for supermarket vouchers (1,500 HUF). Fourteen were male and 26 were female. All participants had normal or corrected-to-normal vision and could speak English. Based upon the critical comparison of interest (RT toward coactor vs. stranger stimuli), 20 participants (who respond on match trials) will provide an implied power of 81% power for the medium effect sizes ($d_z = .5$) that we-prioritization demonstrated.

Procedure.

Shape assignment and training. Pairs were instructed that they would be performing a task together. They were told that Person 1 and Person 2 (as indicated by a card in front of them) would be represented each by a given shape. They were also told that a stranger would be represented by a given shape, and that their team (the pair of participants, Blue/Yellow team counterbalanced) and another team (Blue/Yellow team, counterbalanced) would be represented each by a given shape. The shapes (Triangle, Diamond, Circle, Pentagon, and Star) were randomly allocated to each individual or team.

Participants then performed a training session (50 trials) to ensure that all stimulus mappings were committed to memory. Participants were posed with the question "Who does this stimulus represent?" and the shape (in text) appeared below the question. Participants indicated if the type of stimulus represented "Person 1," "Person 2," their team (e.g., "Yellow Team"), the "Stranger" or the stranger team (e.g., "Blue Team) using the *c*, *v*, *b*, *n*, and *m* keys (response mappings randomized and displayed on screen). Pronouns were no longer used because five different pronouns that would account for all identities were not available and it was necessary to distinguish between the two participants in the dual task (Me would be ambiguous). Participants were asked to decide on the answer together and confirm with each other before making a response. On average, pairs achieved high accuracy on this task (M = 97.60%, SD = 3.70%).

Matching task. Using the above labels rather than original pronouns, a given trial proceeded the same as in the other three experiments but for the fact that one participant was required to respond on match trials and one was required to respond on mismatch trials (using *z* and *number pad 3* keys, counterbalanced between pairs). If both participants responded, the first key press was taken as the response and feedback was given accordingly. After 21 or 41 practice trials (depending on the pair's confidence in the task) the practice was terminated, and participants completed eight blocks of 80 trials. Participants were given feedback regarding the percentage of trials on which they (as a pair) answered correctly after each block. The factors of location, stimulus, label, were fully counterbalanced and randomized within a block. The whole experiment was conducted in English.

Results

Both the raw data, and data submitted to inferential statistics have been uploaded to the OSF.

Accuracy and sensitivity cannot be accurately determined in a dual task where the individual task requires the participant to either initiate a response or inhibit a response and the coactor's responses could disrupt the determination of hits, misses, false alarms, and correct rejections. Therefore, our analyses are only on the mean RT from correct trials for both individual (self, coactor, stranger) and group (Self Team, Stranger Team) trials separately.

Individual entities. In line with previous experiments, response times for match and mismatch trials were submitted to two separate one-way ANOVAs.

Match participant. A main effect of identity was revealed, $F(2, 38) = 6.88$, $p = .003$, $\eta^2 = .27$. Follow-up comparisons revealed that response times to self-stimuli (670 ms) were significantly faster than both Coactor (744 ms), $t(19) = 3.26$, $p = .004$, $d_{av} = .59$, 95% CI [0.03, 0.12] and Stranger stimuli (728 ms), $t(19) = 2.50$, $p = .02$, $d_{av} = .50$, 95% CI [0.009, 0.11]. Coactor and Stranger stimuli were not observed to differ from each other, $t(19) = 0.97$, $p = .34$, $d_{av} = .12$, 95% CI [−0.02, 0.05], see Figure 8. In light of the null effect and the relevance to our hypothesis, we directly tested for the presence of "coactor-prioritization," which would be expected if the group was represented as a part of the extended self with a Bayesian paired t test (JASP Team, 2018). In actuality, the data were 7.71 times more likely under the hypothesis that participants would not respond faster to the coactor stimulus ($BF_{10} = 0.13$).

Mismatch participant. Responses to Self, Coactor, and Stranger trials did not significantly differ for the mismatch responding participant, $F(2, 38) < 1$. This result is consistent with the broader literature that employs the present matching task and generally demonstrates an absence of prioritization in Mismatch trials.

Group entities. Again, response times from the 'Match' participant and the 'Mismatch' participant were submitted to two separate paired t tests to confirm the existence of we-prioritization.

Match participant. Match participants demonstrated a significant we-prioritization effect (Own Team: 740 ms, Stranger Team: 792 ms), $t(19) = 2.65$, $p = .02$, $d_{av} = .27$, 95% CI [0.01, 0.09]. Therefore, Experiment 4 replicates the we-prioritization that was found in Experiments 1, 2, and 3.

Mismatch participant. Similarly to the mismatch trials for the individual entities, no difference in response time was observed for responses to Team and Stranger Team stimuli, $t(19) = 0.86$, $p = .40$, $d_{av} = .09$, 95% CI [−0.01, 0.03]. Thus, the pattern of results for mismatch trials is consistent with the broader literature that generally demonstrates an absence of prioritization in mismatch trials.

Overall, the results from Experiment 4 are inconsistent with the notion that we-prioritization stems from self-prioritization through an extended self-framework, because if this were the case we would expect to see that any identity that was connected to the "we" would also be prioritized through links to the extended self. In fact, the coactor's stimulus was not prioritized over the stranger stimulus.

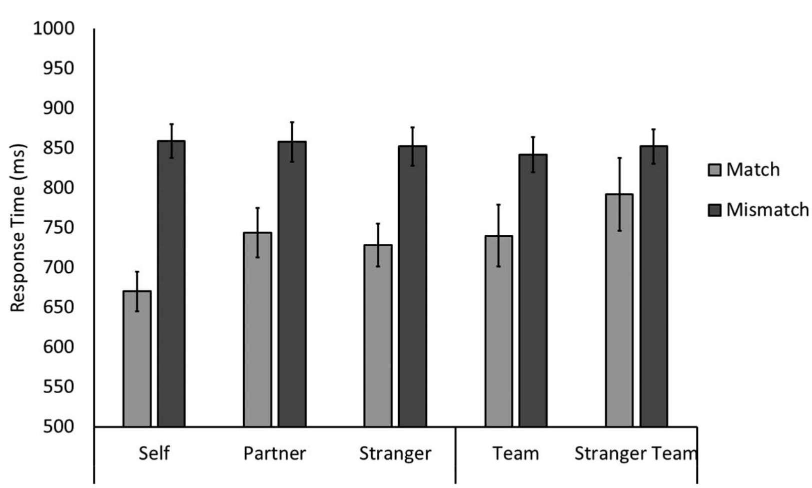

Figure 8. Reaction time for match and mismatch trials by identity (Self/Coactor/Stranger/Team/Stranger Team) and trial type (Match/Mismatch). Error bars represent standard error.

General Discussion

The aim of the present study was to investigate whether humans preferentially process information associated with a group they belong to. Across four experiments, we obtained robust effects of we-prioritization: participants were faster to report whether a label and a shape were matching when they referred to a group they belonged to (we) than when they referred to a group they did not belong to. The data also provided evidence of we-prioritization in sensitivity (d'). Interestingly, such we-prioritization did not extend to individual members of the group in Experiment 4. The finding that we-match trials elicited faster response times than they-match trials in all four experiments indicates that neither knowing individual group members of one's own group nor sharing preferences with these members was a necessary precondition for we-prioritization to occur. Rather, a reference to self being a member of a generic group (labeled *we*) was sufficient to enable prioritization of incoming information.

The results from Experiment 1, 2, and 3 can be accommodated within self-models of cognitive processing (Humphreys & Sui, 2016; Symons & Johnson, 1997) by viewing the collective as integrated within the self-representation (Ray et al., 2009; Schäfer et al., 2017) or connected to the self-representation (Bower & Gilligan, 1979; Symons & Johnson, 1997). The results from Experiment 4, however, seem to be inconsistent with these models. If "we" is represented as an extension of the self, as has been suggested about "mother" and "best friend" (Schäfer et al., 2017), then an assigned team member should also be prioritized because the team member (coactor in this case) is connected to or integrated with "we." Because coactor-prioritization was not observed, we suggest that we-prioritization may reflect the activation of an attentional control set established on the basis of prior expectations for motivationally relevant stimuli and this might occur independently of any self-association. This explanation is consistent with the idea that humans may have a predisposition to seek and respond to information that provides collaborative opportunities.

The absence of a coactor-prioritization effect in Experiment 4 suggests an interesting caveat for the extended self-framework. The extended-self-effect might only occur when there is a stable association between the self and the other identity. Regarding the present work, the participants' coactor is an individual who the participant is unlikely to meet or interact with again, and the "team" is not an established and continuing entity either. This other person (and team) may not be integrated into the self-semantic network because there is little reason to encode the person and group in memory as connected to the self. Such reasoning provides new hypotheses regarding established versus transient ad hoc teams. Specifically, for established stable teams or groups, such as a workplace or soccer team, team-member-prioritization and team-prioritization might manifest because the group and subsequently group members become well connected to the self within working memory. Indeed, it would be adaptive to strongly represent both information relevant to a stable and established long-term group as well as information relevant to the individual group members, because such information would be useful for ongoing repeated interactions. In this sense it would be interesting to determine if coactor-prioritization might begin to manifest over the course of an extended lab-based experiment that required repeated interactions and thus repeated opportunities to develop a strong representation of group representation within memory.

We also find group identity to be a promising area for future research concerning group-based prioritization and representations. Previous analyses on established teams have provided initial support for the notion that the level of identity fusion (Gómez et al., 2011) with a group might influence overlap in newly encoded self and team representations (Enock et al., 2018). Specifically, Enock and colleagues (2018) found that the difference between self-team and self-rival mismatching trials correlated with identity fusion measures. Nevertheless, the prioritization effect (match trials) did not correlate with identity fusion measures. More work will need to be conducted in order to determine if and how identity fusion might have an impact upon prioritization processes. For example, much of the identity fusion literature is discussed in terms of well-established groups that individuals experience over very long periods of time (e.g., nationality) or strong experiences that result in strong identification with group members (e.g., going on tour with the military). In this sense, it might be interesting to determine if we-prioritization and team-member-prioritization occur to the same level of self-prioritization in demonstrably highly fused individuals or whether the observed absence of coactor-prioritization is retained.

Not surprisingly, self-prioritization was observed across all four experiments. This validates our assumption that, despite the different materials (labels and language) and participant pool, all four experiments would provide clear replications of the self-prioritization effects observed in prior research (Sui et al., 2012). Intriguingly, in experiments where we controlled the labels in order to compare the magnitude of the self- and we-prioritization effects (Experiments 1, 2, and 3), the self-prioritization effect was generally larger than the we-prioritization effect (significant in Experiments 1 and 3), which is perhaps consistent with the notion that "we" stimuli are not benefiting from the host of self-benefits that have been theorized to result from the presence of self-stimuli.

The first three experiments also present a unique opportunity to evaluate the effects of self-shapes versus self-labels by looking at mismatch trials. Within the self-prioritization literature very little attention has been given to mismatch trials, likely because they typically do not show prioritization effects or inconsistent results. If we look specifically at the Group Mismatch trials, the results seem to converge upon the conclusion that the self-label facilitates processing. The results are less consistent in terms of the individual trials. In this case, it seems that the presence of a self-stimulus (whether it be a shape or a label) results in a boost to processing. The extra boost for the You shape when paired with the Me label might indicate that the Me label is a very potent stimulus for eliciting the self-prioritization effect over a self-related stimulus. Indeed, previous work has shown response time benefits for personal pronouns in isolation (Shi, Zhou, Han, & Liu, 2011). Nevertheless, recent work using both arbitrary labels and stimuli demonstrates that the self-prioritization effect cannot be distilled solely down to the self-association of the label (Woźniak & Knoblich, 2019).

The present series of experiments demonstrated a consistent we-prioritization effect that was generally smaller in magnitude than the self-prioritization effect. We-prioritization persisted even when the concept of "we" was minimally activated through only the use of a personal pronoun that did not specifically refer to a known group. The first three experiments could be interpreted in two ways. First, we-prioritization could have been an extension of self-prioritization by virtue of its close link to "me" within self-networks. Or, second, we-prioritization could have been associated with top-down facilitation for motivationally relevant stimuli. Experiment 4 specifically tested the first interpretation by evaluating responses to a coactor's stimulus. The observed absence of coactor-prioritization in the present data was inconsistent with an extended self-explanation because "coactor" is linked with the group that is linked with the self. Although the extended self-framework might explain team-prioritization very well in the context of stable long-term teams that have the opportunity to be well integrated with the "self," we suggest that the short-term ad hoc groups that humans create on a day-to-day basis may not have the opportunity to be grounded in terms of the self. Thus, we suggest that we-prioritization elicited in response to the present transitory teams is better grounded in terms of joint action processes that support collaborative opportunities.

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