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Relevant to me: the integration of other people into the self-concept happens and depends on their current relevance

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Abstract

In an environment, in which we are not only constantly surrounded by a vast amount of objects but also by other people most of the time, the interaction with others is inevitable and also very helpful. The 'self' seems to be a stable center in social contexts and whatever is associated with this self seems to influence the selection and processing of information. Hence, mechanisms of defining the "self" are an important topic in cognitive and social sciences. While previous studies already indicated that an integration of a potential partner into the self is possible, here the necessary conditions of such a partner-integration were put to test. A well-established paradigm was used, in which simple neutral stimuli were instructed to be related to a partner, who was also part of the experiment. Of particular interest was whether these newly formed partner-associations were also prioritized just like the associations including the self. The results of a first experiment indicated that partner-integration depended significantly on the perceived closeness to this person. A second experiment replicated this effect and extended it by revealing the independence of partner-integration on the presence of the partner. In sum, the results expand previous findings by demonstrating that the integration of another person is possible even if the setting does not foster it and by demonstrating the unimportance of physical presence. Partner-prioritization is discussed in social contexts and assumptions are formulated about how the self is represented and how it interacts with the representation of others.

1 Introduction

What are the processes involved in making a self? This everlasting question has been addressed from various angles, disciplines, and with various kinds of methods like explicit and implicit measures as well as neurological and body-in-space investigations. Self-relevant stimuli have been discussed to be preferentially processed guiding us through the flood of information we are confronted with on a daily basis [7, 25, 38, 49]. Additionally, self-relevance is supposed to enhance memory (e.g. [3, 43], for a review [46], suggesting that the content, which is associated with ourselves, becomes more strongly anchored in our memory. Occupying such a central position in the processing of our everyday surrounding, it has been of particular interest to understand the mechanisms of representing the self.

A theoretical model about the self and in particular about the self in social-interactive contexts is the self-expansion model [1]. This model was developed to provide an idea of basic processes of human experiences and behaviour in relationships with others. It makes the assumption that people continuously seek to expand their self in the sense that they aim at increasing their efficiency and widening their perspective. According to the model, one way—actually, a major way—to expand the own self is to "include others in the self" in order to include their resources, perspectives, and

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identities. Thereby, self-expansion is supposed to be the desired end state (motivation) and the integration of others is the *way* to reach the end state. Against the background of both aspects, it seems highly plausible that previous research indicated that people tend to blur the boundaries between themselves and others—even strangers.

In that regard, some studies have investigated people's endeavour to include other people into their own self. Research about the integration of others into the self in terms of the influence of others on a person's actions has been shown to occur and to be significantly influenced by the relationship to the other person (e.g., [20], see [8] for a review [36]). One important aspect in previous views was to focus on the influence of a mental representation of one's own and another person's actions. However, a different approach to investigate self-other integration takes into account the recent theoretical approaches, which distinguish between different components of the self. Following those approaches, the self can be seen as divided into the "minimal self" on the one hand and the "narrative self" on the other hand [11, 19, 26]. The minimal self, refers to an immediate sense of "self vs. non-self" and can be differentiated from a more elaborate, knowledge about oneself, which has been amassed over years and relates to others (i.e., the narrative self [11].

In a recently implemented paradigm [41], effects of the minimal self on cognitive processing can be investigated and results so far revealed interesting aspects about the self-concept and its effects of cognitive processing (see, e.g., [21, 42] for a conceptualization of the self,see, e.g., [14, 22, 34] for descriptions about the effects). To state this more clearly, note that, in this paradigm, new associations between formerly neutral stimuli and the self are formed in such a way that neutral stimuli—for example geometric shapes—are associated with different labels referring to the identity of different persons. Hence, the participants learn sentences like "You are a triangle. A friend is a square. A stranger is represented by a circle". After a short initial learning phase, participants are instructed to judge whether various combination of the shapes and labels match the previously learned association or not. Interestingly, participants robustly respond faster and more accurate on newly formed self-associated matching combinations (specifically, in the given example, combinations of the label "you" and a triangle) than on other-associated matching combinations (i.e., the "friend" and square or "stranger" and circle). This self-prioritization effect (SPE) is interpreted in terms of an integration of formerly neutral material into the self-concept [34, 42]. Hence, due to the mere association of a stimulus with the self by simple task instruction, the cognitive processes underlying the integration of newly gained aspects of the self (as evident in the SPE) can be directly studied without recruiting long-term memory processes underlying the familiarity of previously known stimulus material (like, e.g., the very familiar own face or name). What is already known is that this effect is easily replicable [51], generalizes to different stimuli (see, e.g., [24, 40] as well as to different sensory modalities [9, 33, 35] and can be found in various paradigms [5, 6, 13]. Moreover, it seems to depict a rather simple distinction between self and not-self because very fast responses in a simple response-time task are significantly influenced by it (as this is measured with the SPE). Interestingly, the self-bias which is measured with the SPE seems to be independent of more elaborate, complex ideas of the self, for example the explicit self-esteem [32], also presenting it as a basic self-other distinction.

To sum up, the SPE is the consequence of a differentiation between self-related artificial matching pairs and non-self-related artificial matching pairs. However, how is this self-bias integrated in everyday social interaction? Human interactions are, by default, social and they are perceived to imply positive interdependence, which motivates people to engage with others [29]. First evidence for a non-self, social component in self-other representation comes from the previous studies with the matching task, in which usually a familiar other (e.g., the mother or a friend) is used as one of the non-self-related conditions. This familiar-other condition typically causes a weak prioritization as well, although smaller than the prioritization of the self (see, e.g., [33, 35, 41]. Further, in another study, participants formed a 'group' with virtual others based on previous group-induction procedures. In detail, participants were assigned to groups either via the information that another person preferred the same paintings like the participant or via arbitrary assignments mentioned by an experimenter. Integration of the partner was measured by the amount of prioritization of newly formed associations with the partner. The results indicated a prioritization of the own group (including the partner and the self) against an unrelated group [5, 6]. In a different approach, the idea of a 'relevant other' was incorporated even more directly in a study, in which the task was equally divided between a pair of participants in a Go/NoGo fashion. Specifically, in this study, pairs of two participants worked on the task in parallel. Here, one of the two participants in each pair was instructed to respond to red trials, while the other one of the two participants had to respond to green trials, for example. The matching associations ('self', 'partner', and 'stranger') were identical for both. Partner-prioritization in terms of faster and more accurate responses for partner's trials was obvious when this partner was sitting alongside the participant. However, if the task was introduced as a joint task, but the partner was not yet present, no partner-prioritization occurred, indicating that the joint task setting was not sufficient for the integration of a partner [4].

So far, previous results hint at the possibility that the integration of another person in the self-concept as measured by the SPE seems to be possible. When viewing these results in the context of current theoretical frameworks, for example the self-expansion model suggests that self-other integration depends on specific aspects [1]. If self-other integration is done for the purpose of increasing one's own efficiency, then it could possibly depend on the relevance of the other person—whether someone else is integrated into one's own self depends on how relevant this person is for the self. Similarly, a recently published theoretical framework depicts self- and other-representations on the basis of simple feature-binding mechanisms and states the similarities between how we perceive ourselves and how we perceive objects [19]. According to this framework, the overlap we perceive between our self and other people depends on the degree that they share features *and* on the degree the shared features are particularly relevant. Hence, this consideration also suggests that relevance-base mechanisms influence the overlap between our self and others. Also in accordance with this assumption, Tsakiris [44] summarized a number of social processes that might result in changes of the self-other boundary indicating its flexibility. A current meta-analysis goes in line with this,it highlights the interplay of internal and external information as well as the individual interpretation of the connection between internal and external components [30], see also [28]. Taken together, previous research indicates a functionality or flexibility of self-other integration in terms of individual processes influencing or determining the way we integrate information of other people in our personal self-concept.

Building on those previous results and theoretical assumptions about self-perception and self-other integration, we conducted a study to further understand the mechanisms and necessary conditions of partner-prioritization. Therefore, the present study implemented a real-life team scenario before the matching task was performed individually (i.e., not as a shared task). In order to gain further insights into how a real-life interaction partner shapes the mechanisms underlying self-other integration, two experiments were conducted varying the physical and social distance between the participants. Hence, while previous studies already indicated that an integration of a potential partner into the self is possible, here the necessary conditions of such a partner-integration were put to test. In detail, the dependence of possible partner-integration on the perceived closeness to the partner was tested as well as its dependence on the physical presence of the partner.

2 The current research

In two experiments, we implemented a task setup in which two physically present participants were introduced as partners for the experiment and in which the matching task was performed by each participant individually in the full extent. Hence, importantly, a shared-task setting (i.e., sharing the task) was not implemented. Thus, in contrast to previous studies, partner-prioritization was put to another, more implicit test in a non-fostering (i.e., non-shared) setting. We included a partner-relevant condition ("your partner") in addition to the mandatory self-relevant condition in order to have a direct measure of the prioritization of this partner. Further, we varied the perceived closeness to the partner in two ways: In Experiment 1, the perceived closeness was manipulated by the physical distance between both participants; in Experiment 2, it was manipulated by the social distance in form of a cooperative task setting or not.

Both experiments followed exactly the same logic. The matching task was used to measure the prioritization of another real person and it was carried involving a pair of participants so that a partner-prioritization effect (PPE) could occur, which goes beyond the existing reports of a familiar-other prioritization (e.g., of a mother or a close friend). The two experiments were run in two independent labs so that the robustness of the postulated effect can be examined. For both experiments, we hypothesized a significant PPE (alongside with a significant SPE) as previous studies have already indicated it. Such an effect would replicate and strengthen previous findings of an integration of a real-life partner in the self-concept. Additionally, based on theoretical frameworks about self-other integration, we postulate this PPE to depend on the relevance of this other person to the self. In other words, the stronger the perceived closeness is, the larger the PPE should be. This would be indicated by a significant influence of the two different manipulations of the perceived closeness on the PPE.

3 Experiment 1

Experiment 1 was conducted to investigate the prioritization of a second person who is present during the whole experiment and has been introduced as a team member. Additionally, we investigated the dependence of the assumed partner prioritization on the perceived closeness between the two participants as manipulated by spatial distance. Thus, we used the typical matching paradigm including an association with a second person ("your co-partner") participating at the experiment and varied whether the participants sat closer together or further apart (i.e., in peri- or extrapersonal space, e.g., [18].

We postulated the integration of the partner in the given setting, indicated by a significant PPE. Moreover, based on previous work regarding the spatial distance between two participants in a joint task setting (e.g., [15, 48] and based on the assumption that self-other integration should depend on the relevance of this other person for the self, the PPE was hypothesized to decrease with increasing spatial distance between the participants.

3.1 Methods

3.1.1 Participants and design

Fifty students from University of Trier (37 female) took part in the experiment receiving course credit. Median age was 20 years (ranging from 18 to 42) and participants had normal or corrected-to-normal vision. The data of two participants was discarded before analysis because of far too many wrong responses (i.e., far-out error values according to [45] indicating that these participants did not follow the instructions and thereby did not generate valid data. Thus, the total sample size was $N = 48$ (23 in the 'close' condition, 25 in the 'distant' condition).

The experiment comprised technically a 2 (perceived closeness: *close* vs. *distant*) × 2 (matching condition: *matching* vs. *non-matching*) × 4 (association: *self* vs. *partner* vs. *acquaintance* vs. *stranger*) repeated-measures design with 'closeness' as a between-subject factor. However, as hypotheses are formulated within the matching condition (see Sect. 3.2) and non-matching trials only serve as filler trials, the hypothesis-relevant design is a 2 (perceived closeness: *close* vs. *distant*) × 4 (association: *self* vs. *partner* vs. *acquaintance* vs. *stranger*) mixed-measures design.

3.1.2 Materials and apparatus

The experiment was conducted using standard PCs with standard TFT monitors, German QWERTZ keyboards, and by using E-Prime 2.0 software. The words were written in Courier New and all words as well as shapes were presented in white on black background. To show the combinations, a shape was presented above a central fixation cross and a label below. With a viewing distance of about 60 cm throughout the experiment, stimuli were presented subtending 3.3° × 3.3° visual angle for the shapes and 0.6° font height for the labels. We used the German words *Ich* [I] as the self-relevant label and the German words *Mein Mitspieler/Meine Mitspielerin* [gendered term for the partner; see below] as label for the other participant in the lab. Above that, two neutral others were instructed in order to have two neutral (i.e., neither self- nor partner-relevant) control conditions. We used the German words *Bekannter* [acquaintance] and *Fremder* [stranger] as neutral labels. As shapes, a circle, a square, a triangle, and a cross were used.

3.1.3 Procedure

Participants were invited into the lab as pairs of two participants and seated next to each other (Fig. 1). Both participants signed informed consent and specified their gender (male or female). Based on that, we gendered the instructions during the experiment so that a female participant was called a "Mitspielerin" [German female term for a partner] and a male participant was called a "Mitspieler" [German male term for a partner] to make the reference as accurate as possible. Instructions were summarized by the experimenter (and later also given on the screen) and participants were instructed not to talk to each other anymore during the experiment. They indicated their age and waited until the experimenter gave them the signal to start the experiment at the same time.

Some instructions were given to implement a general connection between the two participants. Hence, the instruction on the screen informed the participants that they were supposed to cooperate with the other participant, which was sitting next to them for the whole experiment. This cooperation was further emphasized by the information that the two participants were given a joint score for their both performance at the end of the experiment ("For the entire experiment, your speed and number of errors will be added to the other person's speed and number of errors for a total score"). Additionally, the physical distance between the two participants was modified as follows: The two participants were seated next to each other, but the distance between them varied: either with a distance of 1 m between the two screens (resulting in about 0.5 m distance between the two participants' adjacent shoulders; 'close' condition) or with a distance of 1.9 m between the two screens ('distant' condition; see Fig. 1). Thus, while all participants were instructed to cooperate with the other person in the lab, half of the participants were sitting close to each other and half of them farer away from each other.

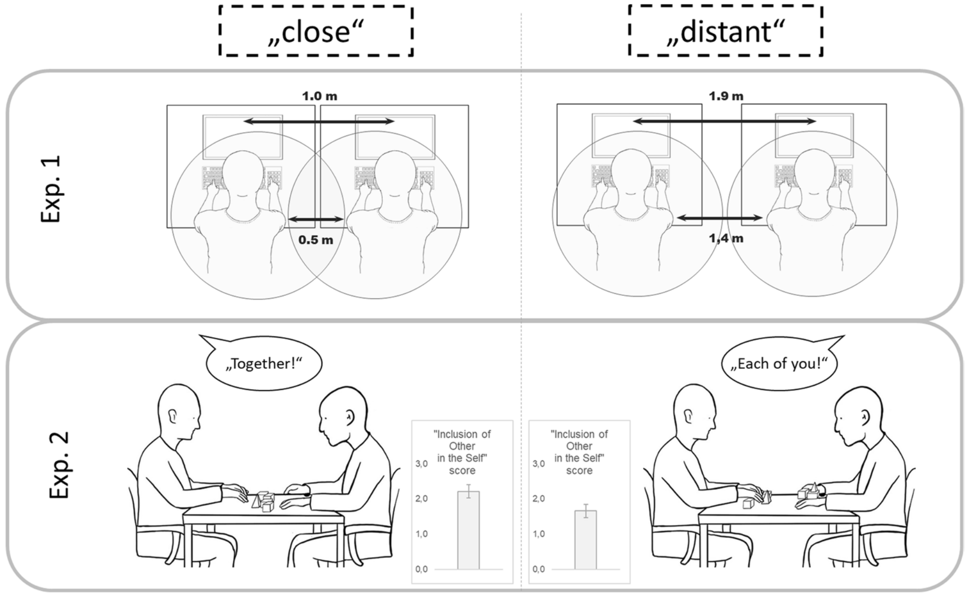

Fig. 1 Schematic presentation of the either spatial (Exp. 1) or social (Exp. 2) setting in the close and distant perceived-closeness condition

The experiment started with a learning phase, in which the to-be-learned associations were shown on the screen for 60 s. Each participant learned four label-shape associations. For one participant, this might read “I am the circle. My partner [male or female term] is the square. An acquaintance is the cross. And a stranger is the triangle.” After the learning phase, the matching task began. Participants were told to place the index finger of the left hand on the S-key (non-matching response) and the index finger of the right hand on the L-key (matching response). Each trial started with a 500 ms presentation of a black screen, followed by a fixation cross for 500 ms. Then a label-shape combination was shown for 100 ms, followed by a black screen until the participant responded or 1500 ms had elapsed. Participants' task was to judge whether the displayed combination corresponded to one of the initially learned assignments or not. One experimental session consisted of a short practice block with 48 trials (in which feedback was given on the screen) and an experimental block with 504 trials (without feedback). During the experimental phase, each label was presented in 126 trials and half of the trials depicted matching, half non-matching combinations. The same proportions were realized in the practice phase. All trials were presented in random order. At the end of the experiment, participants were debriefed, informed that there was no total performance score at the end because this was actually not essential for the study, and thanked for their participation.

3.2 Results

Only correct responses with RTs above 200 ms and below 3 interquartile ranges above the third quartile of the overall RT distribution [45] were used for the RT analysis.

Averaged across participants, 89% of the trials were selected for RT analysis; 10.5% of the trials were excluded because of erroneous responses and 0.5% due to the RT-outlier criteria.[1] Error rates and mean RTs for the 2 (perceived closeness: *close* vs. *distant*) × 4 (association: *self* vs. *partner* vs. *acquaintance* vs. *stranger*) design are shown in Table 1.

Corroborating previous results in the paradigm, self-prioritization is supposed to emerge in the matching condition and no hypotheses are drawn for the non-matching condition (see, e.g., [31, 32, 41, 50]. As one usually finds the SPE in the matching trials, indicated by faster or more accurate responses in the self-associated matching trials compared to the mean performance in non-self-relevant matching trials, the analyses focused on the matching condition.

Because we found the significant results in the error rates, we report these data first (for a similar finding of significant effect in accuracy only, see [4]). An overall 2 (perceived closeness: *close* vs. *distant)* × 4 (association: *self* vs. *partner* vs. *acquaintance* vs. *stranger*) mixed-measures MANOVA (for the use of MANOVA analyzing repeated-measures designs, see [27] in the matching condition and with error rates as the dependent variable revealed a significant main effect of

[1] Of course, all measures, manipulations, and exclusions, which have been done at any point during the scientific process, are disclosed here and data collection was quit before any analysis had been conducted. The same holds true for Experiment 2.

Table 1 Error rates in % and mean RTs in ms as a function of association and perceived closeness (standard error of the mean in brackets)

	Association	Exp. 1 (spatial distance)		Exp. 2 (social distance)	
		Perceived closeness			
		Close	Distant	Close	Distant
Error rates	Self	3.7 (1.0)	3.2 (0.8)	6.94 (1.2)	8.0 (1.5)
	Partner	8.1 (1.2)	8.2 (1.5)	20.6 (3.1)	23.0 (3.5)
	Acquaintance	18.2 (2.6)	11.9 (1.6)	30.6 (3.3)	27.0 (3.6)
	Stranger	19.7 (2.8)	15.1 (2.0)	30.7 (3.3)	27.0 (3.9)
RTs	Self	493 (14)	503 (17)	723 (14)	799 (22)
	Partner	592 (19)	593 (23)	866 (21)	942 (28)
	Acquaintance	644 (22)	624 (20)	911 (22)	966 (24)
	Stranger	622 (18)	633 (25)	888 (18)	964 (29)

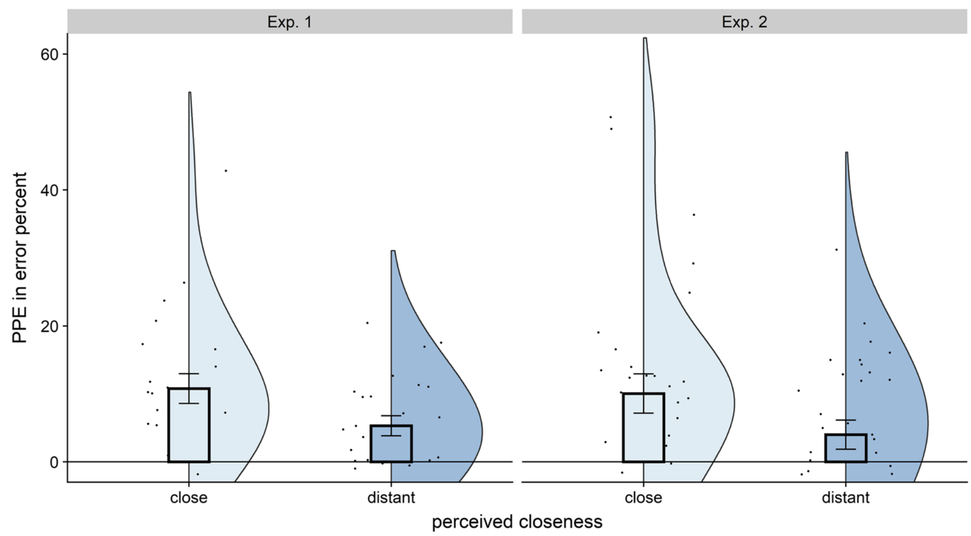

Fig. 2 Raincloud plots and mean bars (error bars depict standard errors of the mean; plotted using R version 4.0.4) of the partner-prioritization effects as the difference in error-% separate for the close and distant condition in both experiments

the association, $F(3, 44) = 25.00$, $p < 0.001$, $\eta_p^2 = 0.63$, indicating an influence of the previously learned associations, no main effect of perceived closeness, $F(1, 46) = 2.47$, $p = 0.123$, $\eta_p^2 = 0.05$, and no interaction effect, $F(3, 44) = 1.45$, $p = 0.240$, $\eta_p^2 = 0.09$ (Table 1). A significant SPE (as the difference between the self- and the mean of partner-, acquaintance-, and stranger-associated trials; 10.3 ± 1.3 SEM was found, $t(47) = 8.47$, $p < 0.001$, $d = 1.22$.

To test for our hypothesis, we calculated the PPE as the difference between error rates in the partner-associated trials compared to the mean error rates in the acquaintance- and stranger-associated trials. This PPE was significant in both conditions, $t(22) = 4.93$, $p < 0.001$, $d = 1.03$ in the close condition and $t(24) = 3.63$, $p < 0.001$, $d = 0.73$ in the distant condition, indicating the prioritization of the partner-associated trials. Remarkably, while the SPE was not significantly modulated by the closeness manipulation, $t(46) = 1.70$, $p = 0.095$, $d = 0.49$, the PPE varied significantly in dependence of the perceived closeness as it was smaller in the 'distant' condition than in the 'close' condition, $t(46) = 2.10$, $p = 0.041$, $d = 0.60$ (Fig. 2).[2]

A comparable 2 (perceived closeness: *close* vs. *distant*) × 4 (association: *self* vs. *partner* vs. *acquaintance* vs. *stranger*) repeated-measures MANOVA in the matching condition and with mean RTs as the dependent variable supported the main effect of the association, $F(3, 44) = 56.19$, $p < 0.001$, $\eta_p^2 = 0.79$, indicating an influence of the previously learned associations, and did not show a main effect of perceived closeness or an interaction, both $Fs < 1$. As with error rates, there was a significant SPE, 120.5 ms ± 9.5 SEM, $t(47) = 13.04$, $p < 0.001$, $d = 1.88$, and a significant PPE, $t(47) = 5.57$, $p < 0.001$, $d = 0.80$ (Fig. 2). However, neither the PPE nor the SPE were significantly modulated by the closeness manipulation, $t < 1$,

[2] A corresponding analysis with the signal-detection-sensitivity index *d'* (correct responses in matching trials as hits, erroneous responses in non-matching trials as false alarms, to account for cases with 100% hits or 0% false alarms, following [17], 39, revealed exactly the same data pattern.

but the PPE was descriptively smaller in the 'close' condition than in the 'distant' condition, contradicting a possible speed-accuracy trade-off for the significant modulation of the PPE in error rates.

3.3 Discussion

Experiment 1 was conducted to test partner-prioritization in a setting, which does not foster the internal representation of the partner but which provides a physically present partner. Hence, we set out to test the integration of a partner, who was present all the time during the matching task, but whom the task was not shared with. Therefore, the matching task was performed by two participants in parallel, which were seated either close together or further apart.

The results confirmed, on the one hand, a significant SPE, which indicated that the self was prioritized against the non-self-relevant others even if a salient (sitting in the same room) and relevant (a cooperation partner) person is included. This finding goes in line with previous findings [4–6]. Further, this significant SPE indicated the reliable measurement of prioritization effects in the current adapted version of the matching task. Additionally, this effect was not modulated by perceived closeness. On the other hand, the results indicated, intriguingly, a significant PPE, demonstrating a prioritization of those stimuli, that were associated with a relevant partner. The PPE in both perceived-closeness conditions suggests that the presence of someone else and the introduction of this person as a team partner is sufficient for this person to be prioritized. Remarkably, the PPE was modulated by the manipulation of perceived closeness in such a way that a larger PPE was observed when sitting in the peripersonal space than when sitting in extrapersonal space. This finding goes well in line with previous research highlighting the border of the self in space at the end of peripersonal space [18]. In addition to that, it confirmes the assumptions of the self-expansion model [1] that self-other integration is done for the purpose of increasing one's own efficiency. Thus, Experiment 1 reveals first important hints about the underpinnings of partner-prioritization: the presence of someone else and their introduction as a team partner can cause a prioritization in the matching task, but, importantly, this prioritization depends significantly on the perceived closeness of this person to the self—the closer someone else is to me, the more I am going to prioritize them.

Note that the significant effects in Experiment 1 were found in error rates solely. As there is no accuracy-speed trade off in the data, this is not further remarkable. However, in the single study which also incorporated a 'relevant other' directly in the joint (go/no go-) variant of the matching task [4] and which is therefore most comparable to our studies, effects were larger or only significant in the accuracy measures (see Table 2 in [4]). We will further refer to this issue in the General Discussion.

4 Experiment 2

Experiment 1 provided first evidence for the existence of a PPE which was modulated by the physical distance between the pair of participants. Experiment 2 set out to conceptually replicate with a pure social distance manipulation the main finding of Experiment 1, namely that the PPE depends on the perceived closeness. Hence, the pair of participants was either instructed as a team through shared activities beforehand or the pair of participants was treated individually, strictly avoiding any joint activities between them.

Experiment 2 followed the same logic as Experiment 1 with the exception that we manipulated the perceived closeness by exposing several well-established team-building activities [16] to the pairs of participants in the close condition, while those activities were carried out by each participant individually in the distant condition. Other aspects were equal in the two perceived-closeness conditions. If a face-to-face introduction of someone as a team partner is enough for them to be prioritized and presence while working on the task is not necessary, then we should find a significant PPE again (also in accordance with [4]). Moreover, we hypothesize this PPE to follow functional mechanisms—as also postulated by the self-expansion model [1]. Specifically, we postulate—as already indicated in Experiment 1—a larger PPE in the condition with team-building activities (i.e., in the close condition) in comparison to the PPE in the condition with individual focus of the activities (i.e. the distant condition).

4.1 Methods

4.1.1 Participants and design

64 students (32 in the close condition, 32 in the distant condition) from Hildesheim University (44 female) took part in the experiment receiving course credit. Participants came to the laboratory in pairs unbeknown to one another before

the experiment. Mean age was 26.1 years (ranging from 19 to 61; five subjects did not inform about their age) and participants had normal or corrected-to-normal vision.

Like in Experiment 1, the hypothesis-relevant design was a 2 (perceived closeness: *close* vs. *distant*) × 4 (association: *self* vs. *partner* vs. *acquaintance* vs. *stranger*) mixed-measures design with 'perceived closeness' as a between-subject factor. The power to detect an effect of comparable size to the effect of perceived closeness in Experiment 1 ($d = 0.60$) was $1 - \beta = 0.77$ (one-tailed *t*-test for independent measures).

4.1.2 Materials and apparatus

Material and apparatus were the same like in Experiment 1 except the following specifications (simply due to the fact that the two studies were run at different labs). The experiment was conducted with standard CRT monitors and by using Presentation software (Neurobehavioral Systems, Version 18). The words were written in Times New Roman. With a viewing distance of about 60 cm throughout the experiment, stimuli were presented subtending 2.7° × 2.7° visual angle for the shapes and 0.6° font height for the labels.

4.1.3 Procedure

Participants were invited to the experiment as pairs of two participants and seated next to each other. Before the matching task started, the manipulation of the social closeness took place in a room next to the lab. Following previous studies (e.g., [10, 12, 16], the following means were used to induce either close or distant perceived closeness (respectively): First, the pair of two participants was jointly addressed with "Ihr" [German plural term for familiar person] in order to refer to them as a team (i.e., close perceived closeness) or each of the two participants was individually addressed with "Jeder" [German term for "everybody"] to emphasize the individual nature of the setting (i.e., distant). Second, the two were told to find a team name for their two-participants team, which was then attached with a tape to each participant's shirt (close) or the individual name of each participant was attached to each participant's shirt (distant). Further, the two participants were asked to write down as much similarities as possible between both of them (close) or each of them was asked to write down features and skills highlighting themselves uniqueness against other people (distant), both for three minutes. Lastly, participants were instructed to construct an object using small building blocks either together (close) or each of them on their own (distant), both for 10 min.

Pairs of participants were randomly assigned to either the individual or the group condition. After the manipulation of perceived (social) closeness had been done, each of the two participants was placed in one of two separate sound-attenuated cabins to work through the matching task. Here, instructions were summarized by the experimenter and later also given on the screen. Before the team (vs. individual) activity as well as after the first and third block of the matching task, participants were asked to answer items to check whether the manipulation of the perceived closeness worked. They filled in the 'Inclusion of Other in the Self (IOS) Scale' [2], a single-item, pictorial measure of closeness to another person and they indicated on a scale how close they felt to the other participant. See Appendix 1 for the manipulation-check items which were carried out as paper & pencil version.

4.2 Results

The social closeness manipulation was effective as indicated by the fact that, after the manipulation, participants in the close condition had higher scores on the measures of perceived closeness than participants in the distant condition (see Appendix 2 for inferential statistics).

For RT analysis, only correct responses with RTs above 200 ms and below 3 interquartile ranges above the third quartile of the overall RT distribution [45] were used. Averaged across participants, 77.5% of the trials were selected for RT analysis. 9.3% of the trials were missing responses, 13.2% of the trials were excluded because of erroneous responses and 0.1% due to the RT-outlier criteria. Error rates and mean RTs for the 2 (perceived closeness: *close* vs. *distant*) × 4 (association: *self* vs. *partner* vs. *acquaintance* vs. *stranger*) design are shown in Table 1.

As in Experiment 1, we report the results of the mixed-measurement MANOVA with the within-subject factor 'association' and the between-subject factor 'perceived closeness' for the error rates and RTs in the matching trials only. In the error rates, a significant main effect of association, $F(3, 60) = 40.50$, $p < 0.001$, $\eta_p^2 = 0.669$, was yielded, indicating a significant influence of the newly learned label-shape associations. Further, neither the main effect of perceived closeness, $F < 1$, nor the overall interaction between both factors was significant, $F(3, 60) = 1.10$, $p = 0.356$. According to the prioritization effects, there was again a significant SPE (as the difference between self- and partner-/acquaintance-/stranger-associated trials; 26.47 ± 2.1 SEM), $t(63) = 10.94$, $p < 0.001$, $d = 1.37$, indicating that the self was again prioritized against all others including the partner. Moreover, and even more important, the PPE (as the difference between partner- and acquaintance/stranger-associated trials) was also significant, $t(63) = 3.86$, $p < 0.001$, $d = 0.48$, indicating, again, a prioritization of the partner-associated stimuli. Further replicating the data pattern of Experiment 1, not the SPE, $t(62) < 1$, but only the PPE was—at least one-tailed—significantly modulated by the closeness manipulation, $t(62) = 1.68$, $p = 0.049$ (one-tailed), $d = 0.42$, suggesting a larger PPE in the 'close' condition compared to the PPE in the 'distant' condition (Fig. 2).

A comparable MANOVA with RTs revealed a main effect of association, $F(3, 60) = 140.89$, $p < 0.001$, $\eta_p^2 = 0.88$, and of perceived closeness, $F(1, 62) = 5.57$, $p = 0.021$, $\eta_p^2 = 0.08$, indicating faster responses in the close condition as compared to the distant condition and thereby indicating a significant influence of the learned associations. Moreover, no significant interaction was found, $F(3, 60) = 1.20$, $p = 0.318$, $n_p^2 = 0.06$. There was a significant SPE, $t(63) = 19.79$, $p < 0.001$, $d = 2.47$, and a significant PPE, $t(63) = 3.59$, $p = 0.001$, $d = 0.45$. However, neither the SPE nor the PPE were modulated in their size by the social closeness manipulation, all $ts < 1$.

4.3 Discussion

Experiment 2 was conducted to investigate the prioritization of someone, who was initially introduced as a team partner but who was not present when the actual task was processed. Therefore, the matching task was performed by two participants in parallel and perceived closeness was manipulated by well-established team-building activities influencing the social closeness [16]. In detail, participants were either jointly addressed, told to find a team name, asked to write down similarities between both of them, and instructed to construct an object using small building blocks either together (close condition). Or they were individually addressed, told to find an individual name for themselves, asked to write down features and skills highlighting their uniqueness, and instructed to construct an object using each of them their own building blocks (distant condition).

Besides the typical SPE, we found a significant PPE in the accuracy data. This PPE was larger the greater the perceived closeness to the partner was. Hence, the data of Experiment 2 replicated the findings Experiment 1: a partner-prioritization in a setting that does not foster self-other integration and the dependence of this partner-prioritization on the relevance of this partner for the participant. Further, it extended the findings of Experiment 1 by showing that physical presence during the task was not mandatory for this kind of partner-prioritization. In other words, partner-prioritization was possible even if the partner was absent during the task but if the emphasis of the other one as a partner was only strong enough.

5 Comparison of the experiments

In order to test for the similarity of the data pattern, we conducted an analysis with the data of both experiments and 'experiment' as a further between-participants factor. More specifically, we tested for a difference of the PPE's dependence on the closeness manipulation in Experiment 1 vs. in Experiment 2. We conducted a 2 (experiment: *Exp.1/spatial closeness* vs. *Exp.2/social closeness*) × 2 (distance condition: *close* vs. *distant*) ANOVA with the PPE in error rates as the dependent variable. Remarkably, this analysis revealed only a significant main effect of distance, $F(1, 108) = 5.92$, $p < 0.017$, $\eta_p^2 = 0.05$, but neither a main effect of experiment nor an interaction, both $Fs < 1$, both $ps > 0.666$. Hence, partner-prioritization was larger in both 'close' conditions than in the 'distant' conditions and, moreover, the size of the PPE did not vary between the two experiments and its dependence on the perceived closeness (either by spatial distance or by social closeness) was similar in both experiments.

A corresponding analysis of Bayes factors (using JASP version 0.13.1), revealed a Bayes Factor $BF_{01} = 16.9$ for the interaction model (including both main effects and their interaction) in comparison to the best model which assumes only a main effect of distance. This Bayesian ANOVA indicates "extreme evidence" (based on the classification scheme for the interpretation of Bayes factors, [23], see also [47] for the null hypothesis according to the interaction and thereby indicates that the data pattern in the two experiments do not vary significantly. In other words, the analysis further emphasizes similar partner prioritization in both experiments and, even more important, a similar dependence of this prioritization on the perceived closeness to the partner.

6 General discussion

Two experiments were conducted to test for the prioritization of a partner in a setting that did not explicitly foster self-other integration. Moreover, the meaning of the partner's relevance for its integration was tested. For this purpose, two different means of manipulating the perceived closeness to this partner were used: either participants were seated close together or farer apart to manipulate spatial closeness between them or well-established team-building activities [16] were used to manipulate social closeness.

Overall, our experiments showed a robust PPE in both studies despite varying the presence of the partner in the task setup (i.e., present in Exp. 1 and absent in Exp. 2). Hence, the results replicate previous findings, which also indicated the integration and the prioritization [4–6] of a partner. Taken together, several empirical results now demonstrated self-other integration with a physically present partner and without.

In addition, a moderating factor of the PPE was identified. More specifically, the implementation of perceived closeness—either along spatial parameters within or outside peripersonal space or along social parameters implemented through shared group activities—modulated the PPE in the same fashion. In Experiment 1, partner-prioritization was significantly larger when perceived closeness was supposed to be high in comparison to when it was supposed to be weaker. While Experiment 2 was a conceptual replication of the manipulation of perceived closeness, the data emphasized the assumption that partner-prioritization depends on the closeness to this partner. These two effects point in the same direction and confirm assumptions, which have been suggested before: the integration of another person into the self-concept follows functional mechanisms. It can now be stated even more specifically, because two manipulations of perceived closeness caused the same effect on self-other integration. Hence, what has previously been termed as social processes [44] or the individual interpretation of the connection between internal and external components [30] can now be specified as the personal relevance of another person in a specific context. Future research might address more specific questions here. For example, the question raises how elaborated the definition of another person's relevance is. Does it just matter how close someone else is sitting or do more elaborate social-closeness indicators, like long friendship or even family ties influence self-other integration even stronger?

Note that, in Experiment 2, the test of the effect of the closeness manipulation was only one-tailed significant and it was descriptively smaller than the effect in Experiment 1 ($d=0.60$ in Exp. 1 and $d=0.42$ in Exp. 2). However, a comparison of the data pattern in both experiments indicated completely overlapping effects of both sorts of closeness manipulation and a manipulation check supported the effectiveness of the manipulation in Experiment 2. Nevertheless, further research could address the replicability and the size of the effect of the used manipulation.

The experimental setup in the two studies allowed for the checking of previous assumptions about self-other integration. First, processes of self-other integration have recently been investigated with the social Simon task, where a simple reaction-time task is shared between two participants in such a way that each one contributes equally to the task because different relevant stimulus features are assigned to each participant [37], for a review, see [8]. Even if "work" is completely split, studies with this task illustrate that the sharing of the task changed the mental representation to a joint representation including the other person [8]. Hence, the results in our study show that such a setting, which is known to foster the internal representation of a partner, is not necessary for the integration of a partner, and thereby also go beyond previous findings [4]. Second, obviously, the presence of the partner during the task was not necessary for them to be prioritized. Rather it seemed to be sufficient, even in a non-shared-task setup, to introduce someone in a face-to-face situation as a partner for this person to be prioritized.

However, this prioritization is not an all-or-nothing matter but follows certain mechanisms. While various factors can play a role for how close one person feels to another, among strangers, *obvious* factors like spatial and social distance determine the strength of the integration of a partner—integration increases systematically with increasing closeness. This systematic variation of the effect emphasizes that the PPE, which was measured in our as well as in previous studies, does not reflect a simple effect of concreteness. In other words, the fact that a partner is not always prioritized comparably strong but strength of prioritization depends on the perceived closeness to this person, indicates that partner-prioritization is not simply an effect current concreteness (because of the mentioning the partner in the task). Rather it depicts some kind of a "close-to-the self" measurement—the closer someone feels, the stronger the prioritization. Further, certain fixed benchmarks seem to determine self-other integration in everyday situations. Self-prioritization, at the same time, seems to be completely independent of it. Thus, one can assume that the PPE depicts the approximation of another person to the self. Consequently, what we call self-other integration does not mean the complete merge of the self and another person (because in such a case self-prioritization should be congruent to and not larger than partner-prioritization). Rather, if another person is currently important for a first person, the individual relevance centre of this first person seems to be expanded. The assumption of some kind of an inner circle, which can be widened (and potentially also narrowed meaning the *ex*clusion of particular aspects of the self), adds nicely to previous assumptions about self-relevance as a lens through which individuals process the world [5, 6]. In that regard, the question arises as to whether the way we process our surrounding is constantly influenced not only by what is inherently self-relevant but also by those newly formed self-relations.

Taken together, the data suggests that self-prioritization is not limited to our self, but it considers social contexts; this holds true for simple self-other differentiation as measured in the matching task. Partners can be prioritized as well even if they do not share the task set with oneself but this effect is modulated by the perceived closeness (be it spatial or social). Thus even basic self-prioritization processes that contribute to the 'minimal self' [11, 19] are influenced by social processes or an internal–external interplay (see above) and can thereby help humans to interact (and to orient) in their complex and social surroundings.

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Authors' contributions SS: conceptualization, methodology, software, validation, formal analysis, investigation, data curation, writing: original draft and review and editing, funding acquisition. PB: conceptualization, software, resources, formal analysis, writing: original draft. CF: supervision, conceptualization, validation, writing: reviewing and editing. All authors read and approved the final manuscript.

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Data availability Raw data and analysis scripts for all experiments reported can be found on the OSF: https://osf.io/ksxqm/?view_only=a5cf593507b24831bcd2227f34bb1b05 (this link will be replaced with the link to the public project after peer-review).

Declarations

Ethics approval and consent to participate All experiments were conducted in accordance with the research license of the University of Trier (Exp. 1) or Hildesheim University (Exp. 2) to conduct human studies. The procedures used in these experiments adhere to the tenets of the Declaration of Helsinki. All experiments were carried out on the basis of informed consent.

Competing interests The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix 1

Manipulation check—question 1 (referring to the diagrams in Fig. 3)

> "Welches der folgenden Diagramme stellt am besten dar, wie verbunden du dich jetzt in diesem Moment mit deinem Mitspieler fühlst? Bitte drücke auf der Tastatur den Buchstaben, der an dem von dir ausgewählten Diagramm steht."

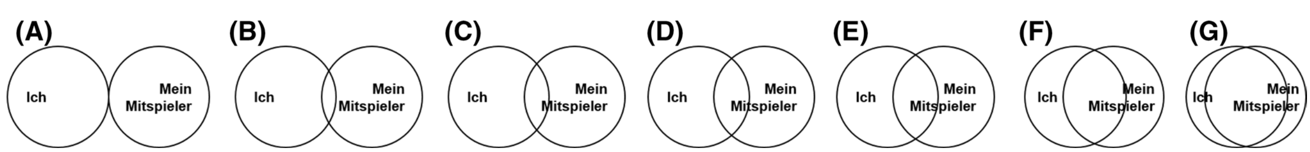

Fig. 3 Example of a diagram which was presented on the screen to rate the closeness to the partner. Note that the labels in the diagram as well as the reference in the text were either male or female according to the partner's gender

["Which of the following diagrams depicts best how close you feel at this moment to your partner? Please press the particular key on the keyboard, which belongs to the diagram you want to choose"].

Manipulation check—question 2 (referring to the diagram in Fig. 4)

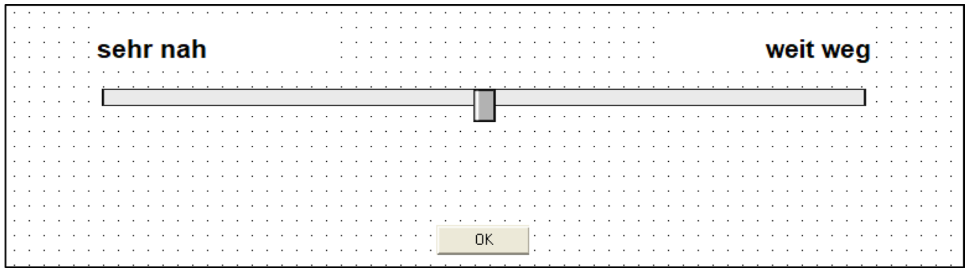

Fig. 4 Scale and controller to indicate the closeness to the partner ranging from "very close" to "very far away". The reference in the text was either male or female according to the partner's gender

"Hier siehst du einen Regler, den du mit der Maus auf der Skala nach links oder rechts bewegen kannst. Bitte gib auf dieser Skala an, wie nah du dich in diesem Moment deinem Mitspieler fühlst, bzw. wie weit weg du dich von deinem Mitspieler fühlst: je weiter du den Regler nach links schiebst, desto näher fühlst du dich, je weiter nach rechts, desto weiter entfernt fühlst du dich von deinem Mitspieler. (Drücke NACH Einstellen des Reglers bitte den OK-Button mit der Maus.)"

["Here you see a controller, which you can move with the mouse cursor to the left or right. Please indicate on this scale how close you feel at this moment to your partner or how far away you feel from your partner: the farer you move the controller to the left, the closer you feel; the farer you move it to the right, the farer away you feel from your partner. (Please press the OK-button AFTER putting the controller in the final position)"].

Appendix 2

A change of the social closeness before and after the manipulation (i.e., in the beginning of the experiment and after the first block of the matching task) are particularly interesting in order to test whether the group manipulation the closed perceived group was effective. As a pre measure, a t-tests for independent samples showed that no differences in the IOS (see Appendix 1, question 1) existed between the two groups before the manipulation, $t(62) < 1$, $p = 0.781$. However, after the first block of the matching task, larger values on the IOS were observed in the close condition (2.22 ± 0.17 SEM) compared to the distant condition (1.66 ± 0.19 SEM), $t(62) = 2.20$, $p = 0.031$ (note that larger values indicate more perceived closeness to the partner). Further, a difference between the groups after the manipulation (i.e. after the matching task) was also observed in the question of how closely they felt to the other person (see Appendix 1, question 2). Larger values were found for the close condition (2.84 ± 0.23 SEM) compared to the distant condition (1.97 ± 0.17 SEM), $t(62) = 3.10$, $p = 0.003$.

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