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BRIEF REPORT

Increasing self–other integration through divergent thinking

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Abstract Increasing evidence suggests that people may cognitively represent themselves and others just like any other, nonsocial event. Here, we provide evidence that the degree of self–other integration (as reflected by the joint Simon effect; JSE) is systematically affected by the control characteristics of temporally overlapping but unrelated and nonsocial creativity tasks. In particular, the JSE was found to be larger in the context of a divergent-thinking task (alternate uses task) than in the context of a convergent-thinking task (remote association task). This suggests that self–other integration and action corepresentation are controlled by domain-general cognitive-control parameters that regulate the integrativeness (strong vs. weak top-down control and a resulting narrow vs. broad attentional focus) of information processing irrespective of its social implications.

Keywords Control state · Joint Simon effect · Joint action · Self–other integration

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Increasing evidence suggests that the degree to which people construe their self as independent from their social environment can vary. Evidence for interindividual variability comes from intercultural studies, which have revealed that collectivistic cultures tend to lead to strong interdependence, while individualistic cultures are likely to induce strong independence of self and other (for an overview, see Triandis, 1989). This flexibility of self-construal, the way people construe their perceived self, demonstrates that the concrete implementation and configuration of a self-concept is not a mere by-product of being a member of a social group but, rather, a construction that reflects cultural biases and constraints. Evidence for intraindividual variability comes from studies showing that the degree of self–other inclusion is sensitive to situational factors. For instance, Kühnen and Oyserman (2002) had participants circle all relational pronouns in a text (such as "we," "our," or "us") or all pronouns referring to the self as independent from others (such as "I," "my," or "me") to induce a context-dependent and a context-dependent self-focus, respectively. As indicated by the performance profiles in two attentional tasks carried out after the induction, the context-dependent focus led to a broader, more global attentional focus than did the context-independent focus. Using the same induction technique, Colzato, de Bruijn, and Hommel (2012) showed that inducing a context-dependent self-focus increases the size of the joint Simon effect (Sebanz, Knoblich, & Prinz, 2003)—an effect that, as we will discuss below, reflects the degree to which people relate their own action to others.

Taken together, these observations suggest that the self-concept is a rather volatile, dynamic construction that adapts to the situation at hand. In particular, whether an individual integrates or discriminates between self and other does not reflect a trait, or an overlearned cultural bias, that he or she may or may not have but, rather, a cognitive state that can vary. As was suggested by Hommel, Colzato, and van den Wildenberg (2009), the cognitive system may represent an individual in the same way as any other event (Hommel, Müsseler, Aschersleben & Prinz, 2001)—that is, as an integrated network of codes representing the individual's features: how he/she is looking, acting, makes one feel, and so forth. If so, there would be no principled difference between representing oneself and representing another person, except that some sensory channels (those underlying interoception in particular) would be more informative about the self, while others are often more informative about the other (e.g., vision). Accordingly, there would be no reason to assume that the process of self–other integration or discrimination is any different from the process of integrating or discriminating between two objects or other kinds of events. Hence, if we would find a way to make individuals more integrative or more discriminative in general (i.e., even in a manner that is unrelated to self-construal), we should be able to show that this also affects self–other integration and discrimination.

In the present study, we tried to induce integrative and exclusive cognitive-control states by means of task priming. Cognitive-control states are notorious for being robust and inert (Allport, Styles, & Hsieh, 1994; Meiran, Hommel, Bibi, & Lev, 2002; Memelink & Hommel, 2006), so that they often tend to outlive the task context they were established for. Accordingly, they often bias subsequent control states in systematic ways. For instance, Memelink and Hommel had participants work through a two-dimensional Simon task, in which stimulus and response could correspond or not correspond on the vertical or the horizontal dimension. The Simon task was interleaved with another task, in which participants were to attend to either the vertical or the horizontal location of a stimulus. It turned out that the vertical Simon effect was more pronounced if the interleaved task called for the processing of the vertical, rather than the horizontal, location, while the opposite was the case for the horizontal Simon effect. This is a clear demonstration that the control parameters for one task intruded into a temporally proximate but logically unrelated other task and systematically biased processing therein. In other words, the parameters of overlapping tasks prime each other.

Hommel, Akbari Chermahini, van den Wildenberg, and Colzato (2012) made use of this cross-task priming effect to induce more integrative or more exclusive cognitive-control states. They had participants perform particular cognitive tasks interleaved with, or right after having carried out, a prime task that required either convergent thinking (Mednick, 1962) or divergent thinking (Guilford, 1967). As was predicted, performance in tasks calling for a strong degree of top-down control, such as the Navon global–local task, the Stroop task, and the Simon task, benefited more from a convergent-thinking prime. In contrast, tasks that suffer from too much top-down control, like the attentional blink task, benefited more from a divergent-thinking prime. This pattern suggests that convergent-thinking tasks induce a more focused, "exclusive" control mode that zooms in on the relevant information at the cost of less relevant information, whereas divergent-thinking tasks induce a less focused, more "integrative" control mode that reduces top-down control (Hommel, 2012). Along the same lines, Fischer and Hommel (2012) had participants perform two tasks concurrently after having carried out a convergent-thinking or divergent-thinking prime task. As was expected, the convergent-thinking task prime induced a more serial processing mode, which led to reduced cross-talk between the two concurrent tasks.

Taken altogether, these considerations suggest that it should be possible to increase or reduce self–other integration by biasing participants toward a more integrative or exclusive cognitive-control mode. We tested this prediction by having participants perform a joint Simon task (modeled after that in Colzato, de Bruijn & Hommel, 2012) that was interleaved with either a divergent-thinking task or a convergent-thinking task. The classical Simon effect shows that left and right responses are carried out faster if they spatially correspond to the stimulus signaling them (Simon, 1969). Interestingly, this is the case even when the two actions are carried out by two different people—the joint Simon effect (JSE). Originally, this effect was thought to reflect the automatic integration of coactors and/or their actions into one's own self-concept (Sebanz et al., 2003). More recent findings suggest a more complex interpretation, however. On the one hand, there is evidence that JSE-like effects do not require the presence of another acting human but can also be obtained in the presence of an inactive (or not perceivably active) human (Dolk et al., 2011; Vlainic, Liepelt, Colzato, Prinz, & Hommel, 2010) or an "active" object, like a Japanese waving cat or a metronome (Dolk, Hommel, Prinz, & Liepelt, 2013). In other words, the JSE relies more on the action that another agent is producing (the "eventhood" of the situation) than on the kind of agent (the "sociality" of the situation). And yet, the JSE has repeatedly been shown to be sensitive to social factors: For instance, it seems to systematically increase in size from inanimate objects to human agents (Dolk et al., 2013; Tsai & Brass, 2007; Tsai, Kuo, Hung, & Tzeng, 2008), it is more pronounced in Buddhists (a religion promoting the mental inclusion of others) (Colzato, Zech, et al., 2012) and participants primed to consider their social context (Colzato, de Bruijn, & Hommel, 2012), and it even disappears altogether if the affective relationship between actor and coactor is disturbed (Hommel et al., 2009). These observations are consistent with the claim that cues and hints provided by other humans attract more attention than does information provided by inanimate objects (Langton, Watt, & Bruce, 2000). Hence, even though the JSE is not restricted to social situations and to human "others," it does indicate that the agent considers the "other's" presence and/or action in the spatial coding of his or her own action—which we take as a minimal criterion for self–other integration.

Two creativity tasks were used to induce integrative and exclusive cognitive-control states. According to Guilford (1950, 1967), divergent thinking is taken to represent a style of thinking that allows many new ideas being generated in a context where more than one solution is correct, such as in the case of brainstorming. In Guilford's (1967) alternate uses task (AUT), our divergent-thinking task, participants are presented with a particular object, such as a pen, and they are to generate as many possible uses for this object as possible. In contrast, convergent thinking is considered a process of generating one possible solution to a particular problem. In Mednick's (1962) remote associates task (RAT), our convergent-thinking task, participants are presented with three unrelated words, such as *time*, *hair*, and *stretch*, and are to identify the common associate (*long*). If the AUT induces a more integrative control state, while the RAT induces a more exclusive control state, and if these states bias the representation of self and other in the unrelated joint Simon task, one would expect that the JSE is more pronounced in the context of the AUT than in the context of the RAT.

Method

Participants

Forty healthy young adults, with a mean age of 21.5 years (*SD* = 2.0; range, 18–30), participated for partial fulfillment of course credit or a financial reward. Written informed consent was obtained from all participants after a detailed explanation of the study procedures. The protocol was approved by the local ethical committee (Leiden University, Faculty of Social and Behavioral Sciences).

Apparatus and stimuli

Remote association task (convergent thinking)

In this task adapted from Colzato, Ozturk, and Hommel (2012), participants were presented with three words (such as *time*, *hair*, and *stretch*) and were asked to find a common associate (*long*). Our Dutch version comprised 30 items (Cronbach's alpha = .85; see Akbari Chermahini, Hickendorff, & Hommel, 2012), which were to be responded to within 10 min.

Alternate uses task (divergent thinking)

In this task modeled after Colzato, Zech, et al. (2012), participants were asked to list as many possible uses for six common household items (brick, shoe, newspaper, pen, towel, bottle) within 10 min. The results can be scored in several ways with flexibility, the number of different categories used being the most consistent and reliable one (Akbari Chermahini & Hommel, 2010).

Joint Simon task

The experiment was controlled by a Switch computer attached to a Philips 17-in. monitor. In the joint Simon task, participants made speeded discriminative responses to the color (green or blue) of circles by pressing one of two keys, while the other key was operated by another participant. From a viewing distance of about 60 cm, circles (diameter of 1.38°) were equiprobably presented to the left or right of a central (0.38° × 0.38°) fixation point (the center of the target was horizontally aligned with the fixation, 1.60° to the left or right) until the response was given or 1,500 ms had passed.

Intervals between subsequent stimuli varied randomly, but equiprobably, from 1,750 to 2,250 ms in steps of 100 ms. Participants were to ignore the location of the stimulus and to base their response exclusively on its color. Responses were to be given as quickly as possible while keeping error rates below 15 %, on average; feedback was provided at the end of a trial block. The task consisted of one practice 60-trial block and three experimental 60-trial blocks.

Procedure and design

Convergent and divergent conditions were created by presenting participants with one out of two paper-and-pencil creativity tasks (a convergent-thinking task and a divergent-thinking task). Ten pairs of participants were asked to constantly switch between performing the RAT (based on Mednick, 1962, and translated into Dutch) for 2 min to induce convergent thinking (the prime task) and completing a block of the joint Simon task. The other 10 pairs of participants constantly switched between carrying out the AUT (Guilford, 1967) for 2 min to induce divergent thinking (the prime task) and performing a block of the joint Simon task. Given that the experiment was composed of one practice and three experimental blocks, participants were to switch between the prime and the probe task 4 times in total. Due to technical failure, the data of one pair of participants in the divergent condition were not recorded.

Statistical analysis

A significance level of $p < .05$ was adopted for all tests. Mean reaction times (RTs) and (square-rooted) error rates were analyzed by means of ANOVAs as a function of control state group (convergent vs. divergent) as a between-participants factor and spatial stimulus–response correspondence (correspondence vs. noncorrespondence) as a within-participants factor.

Results

Performance in the two priming tasks was good and comparable to performance in similar studies (e.g., Akbari Chermahini & Hommel, 2010). Participants produced about seven correct responses, on average, in the RAT ($M = 7.2$ and $SD = 2.7$) and used about 26 different categories in the AUT ($M = 26.3$ and $SD = 7.3$).

A main effect of correspondence on RT, $F(1, 36) = 30.62$, $p < .0001$, $MSE = 109.90$, $\eta^2_p = .46$, indicated that responses were generally faster with stimulus–response correspondence than with noncorrespondence (310 vs. 324 ms). Overall, error percentages on corresponding trials (0.7 %) and noncorresponding trials (0.8 %) were comparable and did not differ between groups (Fs < 1). More important, a significant interaction indicated that the correspondence effect on RT differed between groups, $F(1, 36) = 6.16$, $p = .018$, $MSE = 109.90$, $\eta^2_p = .15$. Even though the correspondence effect was reliable in both the divergent, $F(1, 17) = 28.80$, $p = .0001$, $MSE = 116.43$, $\eta^2_p = .63$, and the convergent, $F(1, 19) = 5.19$, $p = .034$, $MSE = 104.06$, $\eta^2_p = .21$, groups, the JSE was significantly more pronounced in the divergent group (see Fig. 1).

Discussion

As was expected, the JSE was more pronounced in the divergent group than it was in the convergent group. This suggests that priming individuals to establish a control state suitable for divergent or convergent thinking has a systematic impact on the degree to which people corepresent the actions of a coactor. This provides additional evidence for the assumption that self–other integration is not a trait that a given person may or may not have but, rather, emerges from a particular cognitive state. The fact that we were able to modulate this state through a logically unrelated task suggests that there is nothing particular to it and that it is sensitive to the same cognitive-control parameters that other task states are using. In other words, the degree of self–other integration is apparently controllable in principle, and it seems controlled the same way as other cognitive operations are. This again supports the idea that representing oneself or another person does not differ much from representing other events, if it differs at all (Hommel et al., 2009).

Let us now consider the mechanism underlying the control of self–other integration. As was suggested by Hommel and colleagues (2009), people may represent themselves—their perceptual features and actions—just like any other event. According to the theory of event coding (Hommel et al., 2001), both perceived events and produced events (i.e., actions) are cognitively represented by codes for their perceptual or perceptually derived features. On this account, another person would be cognitively represented by coding the features that describe what he or she looks like, which perceivable action effects he or she is currently producing, how that makes one feel, and so forth. There is no reason why the same would not hold for representing oneself by coding one's looks, deeds, and feel. Since the represented codes will often vary on the same dimensions, this makes the representations comparable and creates different degrees of similarity between them.

Similarity is relative, however, and the same event can be coded as separate from or in relation to its context. While this is true for objects, which can be perceived in isolation or as a group, it also holds for social events: A man and woman

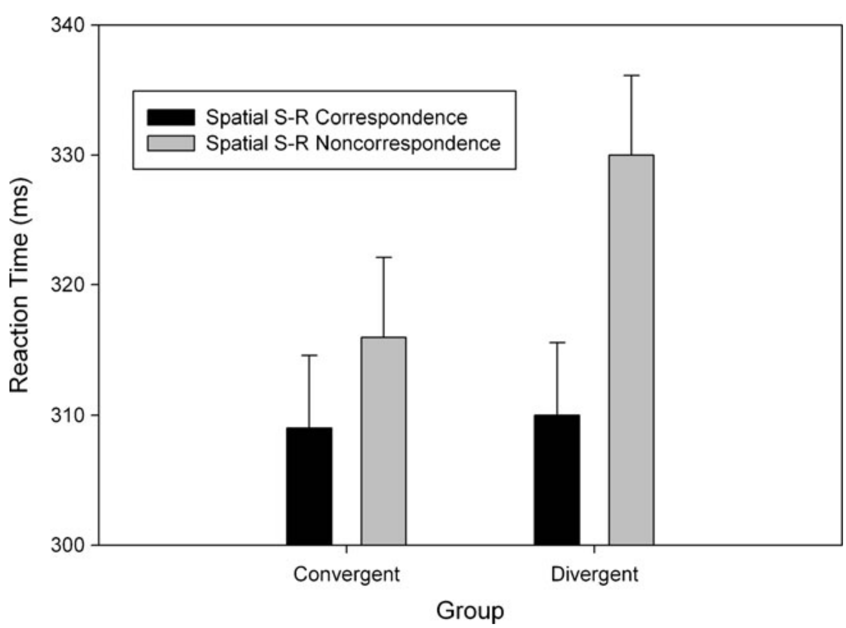

Fig. 1 Mean reaction time as a function of group (convergent vs. divergent) and spatial stimulus–response (S–R) correspondence. Error bars show standard errors of the means

walking side-by-side can be perceived as two individuals or as a couple. To account for the fact that we can switch between more local and more global interpretations of the same perceptual input, attentional control models assume that one of the cognitive-control parameters' executive functions are operating on relates to the integrativeness of perceptual segmentation processes (e.g., Logan, 1996; Navon, 1977). We suggest that the same parameter is used to fine-tune the cognitive system for performing convergent- and divergent-thinking tasks: While divergent thinking would call for a global, integrative setting that allows for freely and easily jumping from one memory entry to the next, convergent thinking would benefit from a more local, focused setting that allows identifying the one possible target word. Given that the creativity task and the Simon task were interleaved, the parameter values established to optimize the former spilled over into the latter, thus increasing and decreasing the JSE accordingly. Given that we did not use a neutral condition (which in some sense may not exist, since participants do not bring empty parameter spaces to an experiment), we are unable to determine whether the impact of creativity tasks on the JSE was driven by an increase produced by divergent thinking, a decrease produced by convergent thinking, or both. Nevertheless, it is clear that the type of thinking had a systematic impact on the JSE.

It is true that the JSE is not a process-pure measure of self–other integration, since the effect is sensitive to the manipulation of both social and nonsocial factors (e.g., Dolk et al., 2011). In contrast to earlier, decidedly social interpretations of the JSE (Sebanz et al., 2003), more recent findings suggest that the effect reflects the spatial coding of the participant's own action with respect to any other, sufficiently salient event (Dittrich, Rothe, & Klauer, 2012; Dolk et al., 2013). Obviously, the presence of another person is particularly salient and, thus, likely to induce spatial response coding and a reliable JSE, but there is no reason to exclude the possibility that nonsocial events, like a rhythm-producing metronome, can also produce a JSE (Dolk et al., 2013). Doesn't this suggest that our findings are moot with respect to the issue of self–other integration? On the one hand, our approach perfectly fits with this saliency account in assuming that the mechanism underlying the JSE and determining its size is rather general and not restricted to the processing of social information. Hence, the JSE is not produced by a dedicated "social" mechanism. On the other hand, however, to the degree that the mechanism also processes information related to social events, like self and other, it can be considered to provide the basis for the representation of social aspects. And indeed, one can argue that it is difficult to draw a well-defined line between social and nonsocial events and relations. This has been demonstrated impressively by Heider and Simmel (1944), who showed that people spontaneously attribute goals and intentions to two triangles and a circle buzzing around a screen. In fact, the degree of "sociality" of the relationship that people entertain with particular animals, collectibles, tools, computers, or cars, the affective character of this relationship, and the kind of communication maintaining it can take many forms and are likely to depend more on the duration and history of the relationship than on the physical characteristics or animateness of the object involved. Accordingly, what makes a relationship social must be this shared history and the associations it produces, rather than the cognitive mechanism responsible for its representation. In other words, the social relevance of self-representation and self–other integration may derive not from the social specificity of the underlying mechanism but from the implications of these representations for regulating behavior in a social context.

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