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Partner reactions and task set selection: Compatibility is more beneficial in the stronger task

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ABSTRACT

Anticipated reactions performed by a partner affect action planning but it is unclear how they affect the selection of task sets. Therefore, four experiments varied partner reaction compatibility while subjects performed two tasks of asymmetric strength. Experiment 1 used an attentional selection paradigm that required reacting to endogenously or exogenously cued targets. The standard benefit for compatible partner reactions was only observed in the stronger task, whereas in the weaker task incompatible reactions reduced distractibility by irrelevant stimulus features. Experiment 2 replicated this interaction between task type and compatibility in a picture-word interference paradigm. It was hypothesized that the weaker task requires shielding the current goal from distraction by incompatible partner reactions, which leads to a generalized reduction of distractor interference. To test this hypothesis, Experiment 3 replicated Experiment 2 but forced subjects to attend to partner reactions. The interaction between task type and compatibility disappeared. To test whether task asymmetry is a necessary condition for this interaction, Experiment 4 used an attentional selection paradigm but reduced the difference in task strength. Compatibility benefits were found in both tasks. Taken together, the results suggest that while anticipated partner reactions can affect task set selection, their specific effects depend on selection demands.

1. Introduction

Our actions are influenced by the actions of others. On the level of specific movements, this has been studied extensively in the literature on automatic imitation (Heyes, 2013): It is easier to perform a movement when observing a corresponding movement performed by another person. In most studies the partner's action served as a stimulus, and it was investigated how its perception affects a person's own performance. In contrast, in many social contexts the actions of two people are interdependent: Partners react to what we do, and often these reactions are quite predictable. For instance, when we hand an object to a partner, this will usually lead him or her to reach for it, and the anticipation of this reaction will affect our own action planning (Kourtis, Sebanz, & Knoblich, 2010). If such links between actions and reactions are sufficiently consistent, partner reactions can be interpreted as contingent action effects (for a recent review and theoretical discussion see Kunde, Weller, & Pfister, 2017). According to ideomotor theory, the anticipation of contingent action effects guides action control processes (Greenwald, 1970; Hommel, Müsseler, Aschersleben, & Prinz, 2001; James, 1890). Consequently, when action effects are compatible with the actions producing them, performance is facilitated (Kunde, 2001, 2003; Kunde, Koch, & Hoffmann, 2004). The same principle can be transferred to joint action: When people know that an action will trigger a corresponding reaction by their partner, it is easier to perform this action than when it triggers a non-corresponding reaction (Müller, 2016; Pfister, Dignath, Hommel, & Kunde, 2013). Thus, social action effects (i.e., contingent partner reactions) influence our behavior just like inanimate action effects do.

1.1. Can anticipated partner reactions affect task set selection?

So far, the influences of contingent partner reactions have only been studied in the context of selecting specific actions within a single task (e.g., performing a button press of long or short duration, performing a swipe gesture slowly or quickly). Thus, currently it is unclear how they affect the selection between multiple task sets. However, in many joint action settings a partner will not produce the exact same action (i.e., imitate the actor) but perform a corresponding or non-corresponding task. What happens if the task selected by a partner either matches your own task or reminds you of a currently irrelevant task? Imagine you have to perform a task (e.g., clean the kitchen) while ignoring other possible tasks that compete for your attention. Whenever you do this,

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your partner performs a competing task (e.g., plays with the cat). It might be hard to stay focused and refrain from performing the competing task as well. When looking at this situation from a common coding perspective (Hommel et al., 2001; Prinz, 1997), the following mechanism could be at work: While planning their own task, people anticipate the partner's forthcoming task, which leads to an activation of the features of this task. As perceiving (or imagining) and acting share the same representational codes, the activation spreads to the person's own task set selection process, leading to cross-task priming. Two lines of research suggest that partner reactions may affect performance on the level of task sets.

First, in individual performance evidence for cross-task priming stems from studies of intentional weighting (Memelink & Hommel, 2006, 2013): Task-relevant feature dimensions can be primed by just having experienced another task, thereby influencing performance in the current task. For instance, when subjects had been planning a grasping action, they were better at subsequently detecting a size oddball in a sequence of visual stimuli, whereas when they had been planning a reaching action, they were better at detecting a location oddball (Fagioli, Hommel, & Schubotz, 2007b). With regard to the present study, the most interesting finding is that such selective priming of task features even occurred when subjects did not actively plan the reaching or grasping action themselves but merely observed another person carrying it out (Fagioli, Ferlazzo, & Hommel, 2007a). This suggests that mentally representing a partner's task has the potential to guide people's attention in their own task.

Second, in the joint action literature it has been shown that performing a task together with a partner can change people's own performance. For instance, when two co-actors share a Simon task so that each of them is responsible for half of the task (i.e., responding to one stimulus and operating one response key), performance resembles that of individuals performing the entire task (Sebanz, Knoblich, & Prinz, 2003): Responses are affected by the stimuli's task-irrelevant spatial features, while they are not when performing only half of the task in the absence of a partner. While some authors have interpreted these results as evidence that people co-represent a partner's task (Sebanz, Bekkering, & Knoblich, 2006), alternative accounts do not rely on task co-representation but suggest that a partner is only represented as a salient spatial event (Dolk et al., 2014) or that subjects merely represent whose turn it is (Wenke et al., 2011) and when the partner is going to act (Liepelt, Stenzel, & Lappe, 2012). Although the mechanisms underlying the influences of a partner's performance still are a matter of debate, their existence is well-established. However, in the majority of studies participants share one and the same task instead of performing either the same or different tasks. The latter has been investigated for instance in a Navon paradigm that required subjects to attend to global or local stimulus features (Böckler, Knoblich, & Sebanz, 2012): Either both participants attended to local features, or one attended to local and the other to global features. Responses were slowed down when the participants attended to different features, indicating that a partner's task set can interfere with a person's own task set selection processes.

The aim of the present study was to find out whether task-feature transfer between the tasks performed by different people can affect performance when the partner's task set selection is merely anticipated. If this anticipation puts additional weight on the associated task features within the person's own task, this should improve performance when expecting the partner to perform the same task relative to situations in which the partner is expected to perform a competing task.

1.2. Selection difficulty modulates the influence of action effects and other people's actions

If anticipated partner reactions affect task set selection, their influence is likely to depend on how difficult it is to select one task set and ignore the other. Imagine you need to select between two tasks of asymmetric strength, a stronger one that involves automatic reactions to highly overlearned stimuli (e.g., word reading), and a weaker one that requires you to withhold these reactions and perform a less automatic action instead (e.g., colour naming). Thus, the stronger task is characterized by higher connection strengths between stimuli and responses (Cohen, Dunbar, & McClelland, 1990), while the weaker task has lower connection strengths and thus requires cognitive control to bias processing along the required pathways.[1] While it is likely that the influence of anticipated partner reactions will be different for the two tasks, the nature of this dependence is far from clear: Will compatible partner reactions be more beneficial in the stronger task or in the weaker task? In fact, there are arguments for both possibilities.

On the one hand, compatible partner reactions might be more beneficial in the weaker task. Imagine that each time you select this weaker task, the partner performs it as well. This might make it easier to refrain from accidentally performing the stronger task as the anticipation of compatible partner reactions puts additional weight on the weaker task's features. In contrast, for successfully selecting the stronger, automatic task it might not matter what the partner will do. Previous research indeed shows that action-effect compatibility facilitates performance only when a task is sufficiently difficult (Wolfensteller & Ruge, 2014). In a version of the two-phase action effect induction paradigm (Elsner & Hommel, 2001), subjects acquired action-effect associations, and response selection difficulty was manipulated by presenting response cues superimposed on the stimuli. Accordingly, selection was easy in trials that contained spatial response cues which automatically activated the correct response, and hard in trials that contained no or non-spatial response cues. Action-effect compatibility only improved performance in the harder tasks. This also fits with a standard finding from the action effects literature, namely that compatibility effects are stronger for trials with longer reaction times (Kunde, 2001; Kunde, Lozo, & Neumann, 2011). The typical explanation is that effect representations need time to build up. A possible consequence is that compatibility will also be more beneficial in the weaker (i.e., slower) task. Note, however, that previous paradigms studied how the impact of action effects was modulated by absolute difficulty or response latency within one task, not task set selection difficulty as a function of between-task conflict. Therefore, it is unclear whether their findings will transfer to the selection between asymmetric tasks.

On the other hand, compatible partner reactions might be less beneficial in the weaker task. This is because asymmetric tasks differ in their requirements for mobilizing cognitive control. Task set selection requires goal shielding, and the amount of such goal shielding depends on the presence of conflict (Goschke & Dreisbach, 2008). As the weaker task is subject to high conflict and thus requires the shielding of goals from external stimulation, this might make partner reactions ineffective, namely if subjects ignore what the partner is doing. Such ignoring might be possible as the use of action-effect associations is at least partly strategic: Subjects can refrain from being influenced by non-helpful action effects (Hommel, 2004), and response-effect compatibility influences performance more strongly when the effects are attended (Janczyk, Yamaguchi, Proctor, & Pfister, 2015). Although no studies so far have investigated the role of task demands on the influence of anticipated partner reactions, there is some evidence from studies of automatic imitation: When subjects observed another person's actions and concurrently had to perform a visual secondary task, the influence of observed actions disappeared (Saucedo Marquez, Ceux, & Wenderoth, 2011). These findings suggest that compatible partner reactions might be less beneficial in the more demanding, weaker task

[1] Note that the distinction between stronger and a weaker tasks (e.g., Meuter & Allport, 1999; Monsell, Yeung, & Azuma, 2000) is not identical with a distinction between easy and difficult tasks. Tasks of asymmetric strength differ in their relative (instead of absolute) difficulty, because they exert different amounts of conflict on each other. To assess whether the present findings generalize to situations where tasks only differ in their difficulty (but not in the amount of between-task conflict), future research will be needed.