A Role for Set in the Control of Automatic Spatial Response Activation

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Abstract. Spatial stimulus-response (S-R) compatibility effects are widely assumed to reflect the automatic activation of a spatial response by the spatial attributes of a stimulus. The experiments reported here investigate the role of the participant's *set* in enabling or interacting with this putatively automatic spatial response activation. Participants performed a color discrimination task (Experiment 1) or a localization task (Experiment 2). In each experiment, two different S-R mappings were used and a task-cue indicated the appropriate mapping on each trial. S-R compatibility and the time between the task-cue and target were manipulated, and compatibility effects were assessed as a function of (a) the time between the task-cue and the stimulus, and (b) whether the S-R mapping repeated or switched on consecutive trials. Critically, whether response mappings repeated or switched on consecutive trials determined the relation between compatibility effects and the time between task-cue and stimulus. These results are discussed in terms of an interaction between automatic spatial response activation and the participant's set.

Keywords: automaticity, control, task-cuing, stimulus-response compatibility, spatial processing

Stimulus-response (S-R) translation is typically better (faster and less error prone) if stimulus and response are spatially compatible (e.g., stimulus appearing on left → left key) as opposed to spatially incompatible (e.g., stimulus appearing on left → right key; Kornblum, Hasbrouq, & Osman, 1990). Spatial S-R compatibility effects are observed even when the location of the stimulus is completely irrelevant to the participant's task (Simon & Rudell, 1967). Thus, spatial S-R compatibility effects are widely assumed to reflect the automatic activation of a spatial response (e.g., De Jong, Liang, & Lauber, 1994; Eimer, 1995; Hommel, 1993, 1995, 1998; Kornblum et al., 1990). For example:

> "Spatial information, relevant or irrelevant to the task, automatically activates corresponding responses, thus producing facilitation, interference, or both" (Hommel, 1995, p. 773).

When the automatically activated response is the correct response, performance is facilitated relative to when the automatically activated response is not the correct response. One of the defining characteristics of an automatic process is that it operates independent of the observer's intentions (Kornblum et al., 1990). Presentation of the stimulus thus initiates processing that proceeds in a ballistic fashion independently of the observer's intentions.

Numerous demonstrations exist that challenge the view that spatial S-R translation is independent of the observer's intentions in this strong sense (Eimer & Schlaghecken, 1998; Marble & Proctor, 2000; Proctor & Vu, 2002; Valle-Inclan & Redondo, 1998). Instead, these findings suggest that S-R compatibility effects are influenced by the participant's set, where set can be defined as a state of "preparedness" determined by a person's context (Gibson, 1941). For example, a masked arrow activates its corresponding response only if the participant is set to perform a localization task (Eimer & Schlaghecken, 1998). Also, the magnitude of the spatial compatibility effect is dependent on other currently active sets (Marble & Proctor, 2000). These and other findings (Valle-Inclan & Redondo, 1998) suggest that if a spatial stimulus can automatically activate its corresponding response, the participant's set plays some part in enabling or modulating this automatic response activation. Here, we further investigate the role of the participant's set in relation to automatic spatial response activation using the task-cuing paradigm.

Task-Cuing Paradigm

In most experimental paradigms the participant knows in advance of the imperative stimulus what task has to be performed (the participant is "set" to perform the task). Studying the role of set in the context of these standard paradigms is therefore problematic. In the task-cuing paradigm, two different sets are used and a task-cue signals the relevant set on each trial. Thus, one can manipulate the point in time at which the participant receives the task information relative to the imperative stimulus being presented.

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Two conditions are typically contrasted in the present variant of the task-cuing paradigm (Ansari & Besner, 2005; Besner & Care, 2003; Besner & Risko, 2005). In one condition the task information precedes the stimulus; here it can be argued that the participant is appropriately set prior to stimulus presentation. In another condition, the task information and the imperative stimulus appear simultaneously. Given that it takes time to decode and implement the set signaled by the cue, this latter condition produces cognitive slack (see Pashler, 1994). In this condition, the imperative stimulus is present but the participant is not yet set to perform the required task. The amount of stimulus processing that occurs during this slack period can be indexed by manipulating a factor that influences stimulus processing and comparing the magnitude of that manipulation's influence as a function of the temporal proximity between task-cue and stimulus.

In addition to the temporal proximity between task-cue and stimulus, the task-cuing paradigm also allows for an assessment of the effect(s) of *set switching* on stimulus processing (Meiran, 1996). Numerous studies have used the task-cuing paradigm to study the "switch-cost" typically associated with switching between sets (Mayr & Kliegl, 2003; Monsell, 2003; Meiran, 1996; cf. Logan, 2003). Switching sets on consecutive trials has proven to be an important factor in determining the degree to which parallel processing of the task-cue and target occurs in the context of task-cuing experiments. Besner and Risko (2005) found evidence consistent with the parallel processing of stimulus contrast and task-cue in a localization task when the task set *repeated* but not when task set *switched* on consecutive trials. In the present investigation, we extend this line of research by exploring the role of set in modulating the temporal dynamics of spatial S-R compatibility effects.

Present Experiments

If spatial S-R translation is *automatic* in the specific sense that it is *independent of the participant's set,* spatial responses should be activated in parallel with task-cue processing. We investigated this prediction both when location was *irrelevant* to the task (Experiment 1) and when location was *relevant* to the task (Experiment 2). The relevancy of location information to the task has important implications for the temporal dynamics of S-R compatibility effects.

When location is *irrelevant* to the task automatic response activation is believed to increase rapidly and then decay. The decay of automatic response activation is argued to be due to the fact that location information is irrelevant to the task (De Jong et al., 1994; Hommel, 1993, 1997). Consistent with this claim, when location is irrelevant the magnitude of the S-R compatibility effect decreases as the time to respond to the relevant dimension increases (De Jong et al., 1994; Hommel, 1993, 1997; McCann & Johnston, 1992).

Conversely, when location is *relevant* to the task automatic response activation should be maintained. Now, the magnitude of the S-R compatibility effect should *not* decrease as the time to respond to the relevant dimension increases. Evidence consistent with this claim has been reported previously (Hommel, 1997, 1998; Simon, 1982).

Experiment 1

In Experiment 1 participants performed a color discrimination task. Stimuli appeared on the left or right of the display and responses were made by pressing a key with either the left or right hand. Thus, stimulus and response could be either spatially compatible or incompatible. Two different S-R mappings were used and a task-cue, presented either at the same time as the target or 750 ms before the target, signaled the appropriate mapping on each trial.

If the stimulus automatically activates its spatially corresponding response then the S-R compatibility effect should be absorbed into the slack created by task-cue processing. That is, we should find a *smaller* compatibility effect at the 0 than at the 750 ms stimulus onset asynchrony (SOA). This prediction is based on the assumption that when location is irrelevant to the task response activation decays rapidly with time. On the other hand, if the *activation* of the spatial response must wait until the participant is set (i.e., until task-cue processing has finished) additive effects of SOA and compatibility are expected (i.e., the S-R compatibility effect should be of equal magnitude at the 0 and 750 ms SOA).

In addition, according to Besner and Risko (2005), evidence for automatic processing should be present on repeat but not switch trials. In the context of the locus of slack logic adopted here, it is somewhat counterintuitive to predict more absorption on repeat trials, given that the slower switch trials should produce more cognitive slack and thus more time to absorb the effect of spatial S-R compatibility. However, Oriet and Jolicouer (2003) reported that participants were unable to use the time taken to switch between tasks to absorb a stimulus quality effect. Thus, task switching may create a "hard" bottleneck.

Method

Participants

Forty undergraduate students were paid $4 each for their participation. All participants reported normal or corrected-to-normal vision.

Apparatus

Micro Experimental Lab (MEL 2.0; Schneider, 1988) software controlled timing and presentation of stimuli and logged responses and response times (RTs). Stimuli were presented on a standard 17-inch SVGA color monitor. The CPU's speaker played the tones. The CPU was located behind the monitor.

Stimuli

The stimulus display consisted of a fixation symbol (|) that appeared in the center of the screen and extended 1 cm vertically and 0.2 cm horizontally. The target was a filled disc (●), 0.5 cm vertically and horizontally, that was either green (MEL: 0, 20, 0) or purple (MEL: 20, 0, 20) and appeared against a black background. Targets appeared 1.2 cm to the left or right of the fixation symbol and were equally likely to appear in either location. A 100 ms tone [2150 Hz or 400 Hz], was used to signal the S-R mapping on each trial. Assignment of tone to S-R mapping was counterbalanced across participants.

S-R Mappings

Two S-R mappings were used. The "outer" mapping, used the [z] and [/] keys with the middle fingers of the left and right hands respectively, and the "inner" mapping, used the [x] and [>] with the index fingers of the left and right hands respectively (see Figure 1). The left keys (i.e., the [z] and [x] keys) were assigned to one color and the right keys (i.e., the [/] and [>] keys) to the other color. Assignment of color to response side was counterbalanced across participants.

Design

The experimental design consisted of a 2 (Compatibility: compatible vs. incompatible) × 2 (SOA: 0 ms vs. 750 ms) × 2 (Repeat/Switch: switch vs. repeat) within-subject design. A trial was considered "compatible" if the target appeared on the same side as the required response and "incompatible" otherwise. The repeat/switch factor was calculated post hoc.

Procedure

Each trial began with the presentation of the fixation symbol. After 500 ms, the tone sounded for 100 ms. On 0 ms SOA trials the target and the tone were presented simultaneously, and on 750 ms SOA trials the target was presented 750 ms after the tone. The target remained on the screen until a response was made. Following a response an intertrial interval of 1000 ms ensued in which the fixation symbol was presented. The fixation symbol disappeared for 250 ms and reappeared to signal the beginning of a new trial. Thus, the response-to-cue interval was 1750 ms.[1]

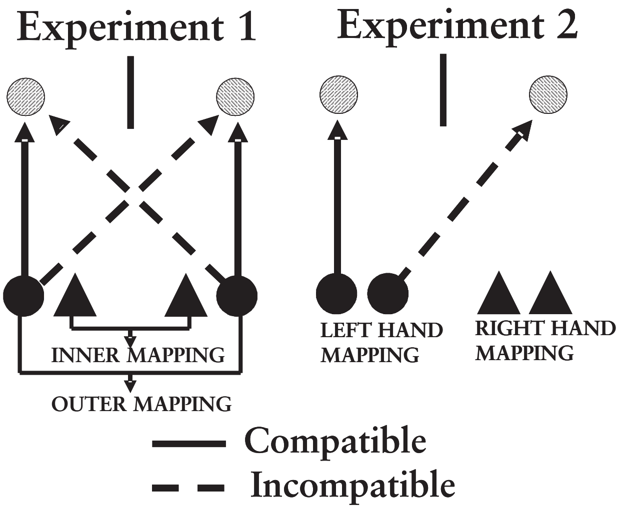

Figure 1. Response mappings used in Experiments 1 and 2. Arrows depict S-R compatibility for the outer mapping in Experiment 1 and the left-hand mapping in Experiment 2.

Participants performed 320 experimental trials and one block of 32 practice trials. If a participant did not achieve 29/32 correct in the practice block they repeated the block until the criterion was met.

Results

Response time (RT) analysis was conducted on trials in which the response was correct and the response on the previous trial was not a task error (i.e., participants performed the incorrect task). The first trial after the practice block was also removed. The remaining data were subjected to a recursive trimming procedure that removed outliers based on a criterion cut-off set independently for each participant in each condition by reference to the sample size in that condition (Van Selst & Jolicoeur, 1994). Given the number of observations per cell the standard deviation cut-off was approximately 3.6. This trimming procedure resulted in the exclusion of 2.4% of the data. The data from Experiment 1 are presented in Figure 2.

Reaction Times

The main effects of compatibility (faster responses on compatible than incompatible trials), SOA (faster responses at 750 than 0), and repeat/switch (faster responses on repeat than switch trials) were all significant [F values > 11, p values < .002]. The interaction between compatibility and

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[1] Given the long response-to-cue interval it is unlikely that an effect of SOA (if observed) reflects the passive dissipation of interference from the previous task-set (Meiran, Chorev, & Sapir, 2000).

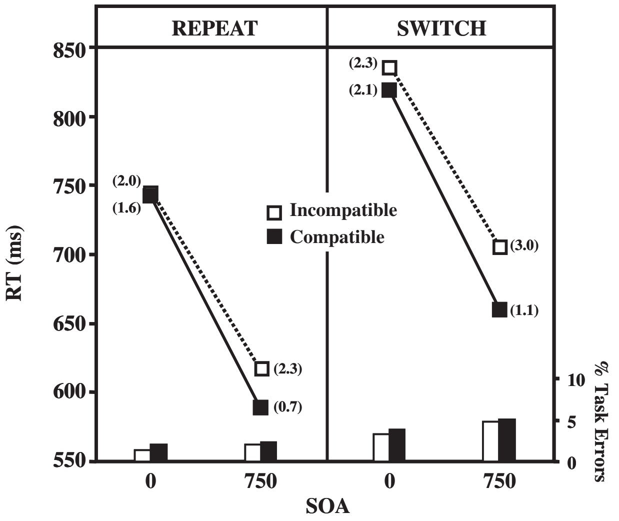

Figure 2. Mean RT (ms), percentage discrimination errors (in brackets), and percentage task errors (bars) for Experiment 1.

repeat/switch was significant, *F*(1, 39) = 4.00, *MSE* = 1471.09, *p* = .05, such that the compatibility effect was smaller on repeat trials (16 ms) than switch trials (33 ms). Importantly, the compatibility by SOA interaction was significant, *F*(1, 39) = 4.82, *MSE* = 3233.31, *p* = .03, such that the compatibility effect was smaller at the 0 ms SOA (10 ms) than at the 750 ms SOA (38 ms). No other effects were significant (*F* values < 1).

Errors

There were two types of errors: (a) discrimination errors in which participants responded with the correct S-R mapping but the wrong color response and (b) task errors in which participants responded with the wrong S-R mapping.

Discrimination Errors

The main effect of compatibility was significant, *F*(1, 39) = 10.35, *MSE* = 8.41, *p* = .003, such that more discrimination errors were made on incompatible trials (2.4%) than compatible trials (1.4%). Consistent with the RT data, the compatibility by SOA interaction was significant, *F*(1, 39) = 7.56, *MSE* = 5.10, *p* = .009, such that the compatibility effect was smaller at the 0 ms SOA (0.3%) than at the 750 ms SOA (1.7%). No other effect was significant (*F* values < 2.3).

Task Errors

The main effects of SOA, more task errors at the 750 ms SOA (3.5%) than at the 0 ms SOA (2.6%), and switch, more task errors on switch (4.2%) than repeat trials (1.9%), were significant, *F*(1, 39) = 7.95, *MSE* = 8.91, *p* < .007; *F*(1, 39) = 35.81, *MSE* = 12.10, *p* < .001, respectively. No other effects were significant (*F* values < 2.3). Given the large SOA effect in RTs (142 ms), the small (0.9%) reverse SOA effect in task errors is unlikely to undermine the interpretation of the former effect.

Discussion

Participants responded faster and were less error prone on compatible than on incompatible trials. Importantly, the compatibility effect was smaller at the 0 ms SOA than at 750 ms SOA in both RTs and discrimination errors. This pattern of results is consistent with the standard claim that the spatial response was automatically activated but decayed during task-cue processing. In addition, the decay of automatic response activation was not modulated by switch. This result differs from that reported by Besner and Risko (2005) where participants processed stimulus contrast and task-cue in parallel on repeat trials but not switch trials. Overall, the results of Experiment 1 suggest that spatial response activation can occur in parallel with task-cue processing in the context of the task-cuing paradigm.

Experiment 2

In Experiment 2 participants performed a localization task. Thus, stimulus location was relevant to the task and should therefore be maintained during task-cue processing. If automatic response activation is so maintained then we should no longer find an underadditive interaction between compatibility and SOA. If response activation is *not* maintained during task-cue processing then results similar to Experiment 1 are expected.

Methods

Methods were the same as Experiment 1 except where noted.

Stimuli

The target was a filled white disc (❍; MEL: 63, 63, 63).

S-R Mappings

Two S-R mappings were used. The left hand mapping used the [z] (left response) and [x] (right response) keys with the middle and index finger of the left hand and the right hand mapping used the [>] (left response) and [/] (right response) keys with the index and middle finger of the right hand.

Thus, within hand response mappings were always spatially compatible (i.e., the left finger of each hand was the "left" response and the right finger was the "right" response). The spatial compatibility effect emerges from a greater S-R correspondence when the target appears on the side compatible with response hand (e.g., a right side stimulus will be responded to faster with the right finger of the right hand than a left side stimulus with the left finger of the right hand). Thus, the compatibility effect is Simon-like, yet location is relevant to the task.

Results

The outlier procedure resulted in the exclusion of 2.7% of the data. The remaining data are presented in Figure 3.

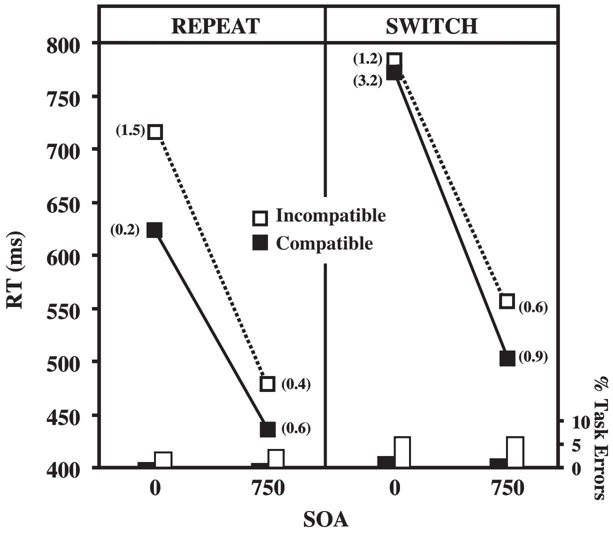

Figure 3. Mean RT (ms), percentage discrimination errors (in brackets), and percentage task errors (bars) for Experiment 2.

Reaction Times

The main effects of compatibility, SOA, and repeat/switch were all significant [all *F* values > 38, *p* values < .001]. The two-way interactions between SOA and repeat/switch and compatibility and repeat/switch were significant, *F*(1, 39) = 7.56, *MSE* = 4296.31, *p* = .009; *F*(1, 39) = 7.93, *MSE* = 3751.84, *p* = .007, respectively. The three way interaction between compatibility, SOA, and repeat/switch was also significant, *F*(1, 39) = 10.53, *MSE* = 3136.27, *p* = .002. The three-way interaction was assessed in terms of the magnitude of the compatibility effect as a function of SOA and repeat/switch.

The compatibility effect on *repeat* trials was *larger* at the 0 (92 ms) than at the 750 ms SOA (46 ms), *t*(39) = 2.29, *SED* = 19.77, *p* = .03. The compatibility effect on *switch* trials was *smaller* at the 0 (12 ms) than at the 750 ms SOA (48 ms), *t*(39) = 2.44, *SED* = 14.79, *p* = .02.

Errors

Discrimination Errors

There were very few discrimination errors (1.0%). The three way interaction between compatibility, SOA, and switch was significant, *F*(1, 39) = 6.98, *MSE* = 7.06, *p* = .01. The pattern of compatibility effects in discrimination errors was qualitatively similar to that found in RTs (0 ms repeat: 1.3%; 0 ms switch: –2.0%; 750 ms SOA repeat: –0.2%; 750 ms SOA switch: –0.3%). Thus, nothing in the analysis of the discrimination errors undermines the interpretation of the RT data.

Task Errors

The main effects of compatibility and switch were significant, *F*(1, 39) = 30.25, *MSE* = 32.40, *p* < .001; *F*(1, 39) = 19.77, *MSE* = 17.88, *p* < .001, respectively. These main effects were qualified by a two-way interaction between compatibility and switch, *F*(1, 39) = 5.27, *MSE* = 10.45, *p* = .03, such that the compatibility effect was larger on switch trials (4.3%) than on repeat trials (2.7%).

Discussion

Participants again responded faster and made fewer errors on compatible than incompatible trials. The *overadditive* interaction between compatibility and SOA on repeat trials is consistent with the interpretation that response activation accrued during task-cue processing. On trials where participants had to switch response sets, the SOA by compatibility interaction in Experiment 2 was not consistent with response activation being maintained during task-cue processing. As in Experiment 1, the compatibility effect was smaller at the 0 than at the 750 ms SOA. Thus, having location relevant to the task is not a *sufficient* condition for response activation to be maintained.

As noted in the introduction to Experiment 2, the spatial compatibility manipulations used in Experiment 1 and 2 are at least superficially different. Thus, it is possible that the spatial compatibility effects observed in Experiments 1 and 2 arise from different mechanisms and therefore might be expected to produce different results. This alternative account can be assessed via a reanalysis of Experiment 1 such that the S-R compatibility effects are produced by the same stimulus-response conditions.

In Experiment 1 compatible trials with the "outer" mapping and the incompatible trials with the "inner" mapping were the same as the compatible and incompatible trials in Experiment 2 (see Figure 1). A reanalysis of Experiment 1 with compatibility defined as compatible "outer" vs. incompatible “inner” revealed a significant Compatibility × SOA interaction, $F(1, 39) = 7.93$, $MSE = 3991.75$, $p < .05$, such that the compatibility effect was smaller at the 0 ms SOA (2 ms) than at the 750 ms SOA (42 ms). As in Experiment 1, the Compatibility × SOA interaction was not modulated by switch, $F(1, 39) = 1.27$, $MSE = 2772.05$, $p = .27$. Thus, even when the same stimulus-response conditions are used to compute compatibility effects across Experiments 1 and 2, qualitatively different patterns emerge as a function of switch.[2]

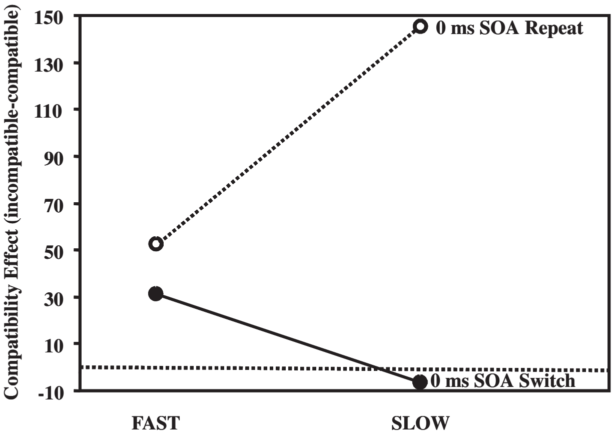

Figure 4. Compatibility effects (incompatible–compatible) at the 0 ms SOA on switch trials for “fast” and “slow” responses.

General Discussion

The experiments reported here investigated the role of set in modulating spatial compatibility effects using the task-cuing paradigm. In Experiment 1, when location was *irrelevant* to the task, the automatic activation of the spatial response is argued to have decayed during the time taken to process the task-cue. In Experiment 2, when location was *relevant* to the task, the automatic activation of the spatial response is argued to have been maintained during task-cue processing on repeat trials but to have decayed during task-cue processing on switch trials.

Our interpretation of the present results is based on two assumptions: (a) the set used on trial N-1 is carried over to trial N, remaining in place during task-cue processing on trial N until task-cue processing is finished (see Besner & Risko, 2005; Mayr & Kliegl, 2003) and (b) the irrelevant-decay/relevant-maintain characterization applies not only to the “global” task set (i.e., localization) but also to the “local” response set (i.e., the specific set in place). Specifically, responses that are part of the “active” response set are “relevant” and responses that are part of the inactive response set are “irrelevant.”

A straightforward explanation emerges from these two assumptions. Specifically, the maintenance of spatial response activation during task-cue processing is dependent on *both* the relevance of location information to the task and the “relevance” of the activated response with respect to the active response set. In other words, in addition to location being relevant, the participant must also be appropriately *set* prior to stimulus presentation in order to *maintain* automatic response activation during task-cue processing.

If response activation was maintained at the 0 ms SOA on repeat trials but decayed at the 0 ms SOA on switch trials an analysis of the RT data from Experiment 2 comparing participants “fast” and “slow” responses at the 0 ms SOA should reveal that (a) on repeat trials the compatibility effect is smaller on “fast” than “slow” trials and (b) on switch trials the compatibility effect is larger on “fast” than “slow” trials. To test this prediction participant’s response times at the 0 ms SOA were divided into “fast” (below or equal to their median) and “slow” (above the median) responses in each condition. A 2 (Compatibility) × 2 (Repeat/Switch) × 2 (Relative Response Speed: “Fast” vs. “Slow”) ANOVA was therefore conducted. The three-way interaction was significant, $F(1, 39) = 15.03$, $MSE = 5832.83$, $p < .001$. Consistent with the prediction, the compatibility effects increased with increasing response time at the 0 ms SOA on repeat trials, $t(39) = 3.17$, $SED = 29.96$, $p = .003$, but decreased with increasing response time at the 0 ms SOA on switch trials, $t(39) = 2.31$, $SED = 16.26$, $p = .03$ (see Figure 4). These results are consistent with the claim that at the 0 ms SOA on switch trials, response activation decayed during task-cue processing despite its relevance to the task.

The pattern of RTs for “fast” and “slow” responses also addresses an alternative account based on the idea that the irrelevant task set is suppressed or completely inactivated when not in use. According to this account, on switch trials at the 0 ms SOA, because the “correct” set is initially inactive the stimulus does not activate a response at all. This would produce qualitatively the same pattern of results. Evidence consistent with this account has been presented by Valle-Inclan and Redondo (1998) where they demonstrated that a spatial stimulus failed to activate a response, indexed electrophysiologically using the lateralized readiness potential, when the participant was presented with the appropriate set *after* the stimulus. In the present experiment, however, a compatibility effect was present for “fast” re-

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[2] A similar analysis can be used to address potential issues with the stimulus-response mappings in Experiment 1. Specifically, when the *inner* mapping is used, a compatible stimulus is compatible with the hand but incompatible with the finger and an incompatible stimulus is incompatible with the hand but compatible with the finger. When the outer mapping is used, a compatible or incompatible stimulus is compatible or incompatible with both hand and finger. Thus, the compatibility effect may be larger when the outer mapping is used. To test this prediction Mapping (inner vs. outer) was included as a factor in the analysis of Experiment 1. Mapping did not interact with either the magnitude of the compatibility effect or the compatibility by SOA interaction (both F values < 1.2).

sponses at the 0 ms SOA on switch trials. Thus, it appears unlikely that the spatial stimulus failed to activate a response.

Sequential Adjustment Effects

Spatial compatibility effects are larger following a compatible trial than an incompatible trial. Sturmer, Leuthold, Soetens, Schroter, and Sommer (2002) explained this sequential adjustment effect in terms of route suppression whereas Hommel, Proctor, and Vu (2004) explained it in terms of the retrieval of the previous trial's event file. While the present investigation was not designed to test between these two accounts, an analysis including previous trial compatibility may nevertheless provide interesting insights for future research. Thus, RT data from Experiments 1 and 2 were reanalyzed with previous trial compatibility as a factor. This analysis is post-hoc and the results should therefore be treated cautiously.

In Experiment 1, there was a significant previous trial compatibility by compatibility interaction (i.e., the sequential adjustment effect), *F*(1, 39) = 55.05, *MSE* = 2515.06, *p* < .01, such that the compatibility effect was larger following a compatible trial (54 ms) than following an incompatible trial (–5 ms). Previous trial compatibility also entered into a three-way interaction with compatibility and SOA, *F*(1, 39) = 14.35, *MSE* = 2282.81, *p* < .01, and compatibility and switch, *F*(1, 39) = 25.63, *MSE* = 2597.40, *p* < .01. The former interaction was due to a larger sequential adjustment effect at the 0 ms SOA (53 ms vs. –34 ms, for trials following compatible and incompatible trials respectively) than at the 750 ms SOA (55 ms vs. 24 ms), and the latter interaction was due to a larger sequential adjustment effect on repeat (65 ms vs. –35 ms) than on switch trials (43 ms vs. 25 ms).

In Experiment 2, there was a significant sequential adjustment effect (74 ms vs. 22 ms), *F*(1, 39) = 24.01, *MSE* = 4525.88, *p* < .01. Like Experiment 1, previous trial compatibility entered into a three-way interaction with compatibility and SOA, *F*(1, 39) = 5.75, *MSE* = 3114.83, *p* < .05, such that the sequential adjustment effect was larger at the 0 ms SOA (86 ms vs. 13 ms) than at the 750 ms SOA (61 ms vs. 30 ms). Unlike Experiment 1, previous trial compatibility also entered into a four-way interaction with compatibility, SOA, and repeat/switch, *F*(1, 39) = 8.08, *MSE* = 4364.97, *p* < .01. The sequential adjustment effect was largest at the 0 ms SOA on repeat trials (142 ms vs. 39 ms), intermediate at the 0 ms SOA (31 ms vs. –13 ms) and 750 ms SOA (77 ms vs. 17 ms) on switch trials, and smallest at the 750 ms SOA on repeat trials (45 ms vs. 44 ms). Overall, the results of the analysis including previous trial compatibility suggest that the sequential adjustment effect may be sensitive to both the time from the last trial (i.e., the interactions with SOA) and whether or not the same or different task is performed on consecutive trials (i.e., the interaction with repeat/switch). These results, while not inconsistent with the route suppression explanation, may be more consistent with Hommel et al.'s (2004) retrieval account seeing as both time from the previous trial and similarity between the previous trial and the current trial should affect the likelihood of retrieving the previous trial's event file.

With respect to the results of Experiment 1, the previous trial compatibility analysis suggests that the underadditive interaction between SOA and compatibility could be explained in terms of an interaction between SOA and the sequential adjustment effect. Specifically, if the compatibility effect is smaller following an incompatible trial and this sequential effect is larger at the 0 ms SOA, than we would expect the compatibility effect to be smaller at the 0 than at the 750 ms SOA overall, as we observed. This account, however, would also predict that following compatible trials (i.e., where the compatibility effect should increase) the compatibility effect at the 0 ms SOA would be larger than at the 750 ms SOA; this was not observed. The analysis of previous trial compatibility may also provide an account of the compatibility by switch interaction observed in Experiment 1. Specifically, the reduction in the magnitude of the compatibility effect following an incompatible trial was larger on repeat than switch trials. As noted earlier, this might be due to an increased likelihood of retrieving information from the previous trial when the tasks on consecutive trials were the same.

With respect to the results of Experiment 2, the overadditive interaction between SOA and compatibility on repeat trials appears due to a disproportionately large benefit on trials proceeded by a compatible trial rather than to the accrual of response activation with time. Critically, the account offered for the present data does not rest on the assertion that response activation accrued on repeat trials, but that response activation was maintained or at least did not decay on repeat trials where it did on switch trials. The analysis of previous trial compatibility does not, therefore, change the interpretation of the results of Experiment 2. Nonetheless, the results do suggest that sequential adjustments in performance can and do interact with the participant's set and that research directed at this specific issue will likely prove fruitful.

The Role of Set

The account offered for the present results suggests that the effect of the participant's set is postperceptual. This is not to say that the participant's set is limited to this form of influence (see Valle-Inclan & Redondo, 1998). Indeed, the debate over the locus of "set" effects has raged since the concept's introduction (Gibson, 1941). It is likely best to consider the question of where set has its effects on a case-by-case basis rather than making sweeping claims that set acts either "early" or "late."

More generally, across a range of studies, the set adopted by the participant has a large impact on putatively automatic processing (e.g., attentional capture, Folk, Remington & Johnston, 1992; masked priming, Neumann & Klotz, 1994; semantic priming, Stolz & Besner, 1996; Stroop; Bauer & Besner, 1997) and as a result, theoretical explanations of numerous phenomena have undergone revision (e.g., Folk et al. 1992; Hommel, 2000). Further study of the role of the participant's set in other domains (e.g., inattentional blindness; Most, Scholl, Clifford & Simons, 2005), promises to yield additional theoretical advances. The variant of the task-cuing paradigm used here (see also Besner & Care, 2003) provides one way to study set across a number of domains.

Conclusion

The present investigation has identified an important role for set in the maintenance of response activation in the context of S-R compatibility effects. The proposed account suggests an intimate link between the participant's set and "automatic" processing.

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