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The Task-Switch Cost Is Still Absent After Selectively Stopping a Response in Cued Task Switching

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The task-switch cost is one of the most robust phenomena in human task performance, but it can disappear after nogo trials where the actors decide not to respond to the target. According to the response-selection account, it is the occurrence of response selection that generates a task-switch cost on the subsequent trial, and the absence of a switch cost after nogo trials has been attributed to a nonoccurrence of response selection on nogo trials. However, an alternative account is that a task-switch cost is generated but is abolished on nogo trials because of the interference from the nogo signal with the activated task set, suggesting that the absence of a task-switch cost does not necessarily imply the nonoccurrence of response selection. The present study tested these competing accounts by using selective go/nogo procedures for which withholding a response would require selecting a response and inhibiting the selected response. Bayes factors in five experiments provided evidence for the absence of a task-switch cost after selective nogo trials, indicating that the occurrence of response selection does not necessarily result in a task-switch cost on the subsequent trial. The present results are consistent with the task-set interference account that a task-switch cost could be generated on nogo trials but is abolished because a nogo signal interferes with the activated task-set.

Keywords: cued task switching, go/nogo task, response inhibition, selective inhibition, cognitive control

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Task performance is more efficient when people perform the same task repeatedly than when they must switch between different tasks. This advantage of repeating the same task, or the cost of switching between tasks, is observed in a *cued task-switching procedure* (e.g., Meiran, 1996). In this procedure, two or more tasks are intermixed in an unpredictable sequence, and participants select one of these tasks according to a *task cue* presented at the beginning of a trial indicating which task should be performed on that trial. Response time (RT) is usually faster, and response accuracy is usually higher, when the same task is cued on two consecutive trials (*task-repeat trial*) than when different tasks are cued (*task-switch trial*). The difference between task-repeat and task-switch trials is termed a *task-switch cost* (see Monsell, 2003; Vandierendonck et al., 2010, for reviews). Although the task-switch cost is one of the most robust effects observed in human task performance, the cost can disappear in rare conditions. In one such condition, cued task switching is combined with a go/nogo procedure where participants are given an additional nogo signal that informs them of whether a response should be made to the target on a given trial (Hoffmann et al., 2003; Schuch & Koch, 2003). It has been found that the task-switch cost is absent on trials that immediately follow a nogo trial. Given the robustness of task-switch cost, this finding constitutes an important phenomenon that hints at where and how the task-switch cost emerges in human task performance.

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The absence of a task-switch cost after nogo trials was taken as evidence supporting the *response-selection account* (Koch & Philipp, 2005; Schuch & Koch, 2003). This account states that a task-switch cost originates from response selection, so the task-switch cost is not generated after nogo trials because response selection does not occur on such trials. The importance of response selection for the task-switch cost was also inferred from Verbruggen et al.'s (2006) study, which used a "selective" stop-signal task in which participants were given a stop signal on a subset of the trials, for which they had to withhold responding to the target *only if* the target required one of the two responses, but not if it required the other response. This necessitated response selection to decide whether to make a response or to withhold it when a stop signal occurred. The researchers found that a task-switch cost was still obtained after trials for which participants successfully inhibited their response.

However, the original form of the response-selection account that attributed the task-switch cost solely to response selection was challenged by Philipp et al. (2007), in which an onset delay of a go/nogo signal (to the target onset) was introduced in cued task switching. With their (nonselective[1]) go/nogo procedure, the researchers included short (100 ms) and long (1,500 ms) delays in the onset of a go/nogo signal after the target. They assumed that for response selection to occur, the short delay would not be sufficient, but the long delay would be sufficient. The response-selection account would then predict that a task-switch cost should be absent after nogo trials with a short delay but should be present after nogo trials with a long delay. Their results were largely consistent with the prediction, but they also showed that the task-switch cost was reduced significantly after nogo trials with the long delay as compared to the cost obtained after go trials. Philipp et al. proposed that because nogo trials rendered unnecessary not only response selection but also response execution, their finding of a significant but reduced task-switch cost after nogo trials with long delays indicated that both response selection and response execution contributed to the generation of a task-switch cost.

Both Schuch and Koch's (2003) and Philipp et al.'s (2007) reasoning assumed that the absence of a task-switch cost after a nogo trial reflected the absence of processes that were responsible for the generation of a task-switch cost. However, an alternative way to understand the absence of a task-switch cost after nogo trials is that a task-switch cost is generated on a nogo trial but is abolished by the occurrence of a nogo trial itself. Lenartowicz et al. (2011) proposed an alternative view in this line of reasoning. They suggested that task preparation can take place as usual on a nogo trial, which activates a task set to be used for the trial, but the occurrence of a nogo signal interferes with the activated task set. They suggested two possible ways a nogo signal could interfere with the activated task set. First, it could inhibit the activation of a task set. Second, it could "flush" working memory and remove the task set. Although the researchers favored the second possibility more, they did not provide an experiment to differentiate between them. Instead, they used *cue-only trials*, which were terminated after the task cue was presented. On these trials, there could not have been response selection or response execution as the target never occurred, *and* there was no nogo signal to interfere with the activated task set either. The researchers found that a task-switch cost was obtained after cue-only trials. This finding suggests that a task-switch cost can be generated without response selection or response execution and can be observed on a subsequent trial if a nogo signal does not occur. It also suggests that when a nogo signal occurs (on a nogo trial), the activated task-set can be interfered with, which explains why the task-switch cost on the subsequent trial can be abolished. This *task-set interference account*, thus, assumes a different locus for the task-switch cost and a different mechanism for the absence of the task-switch cost after nogo trials, than the response-selection account does.

The Present Study

If the task-set interference account is correct, the reduced task-switch cost after nogo trials with long onset delays in Philipp et al.'s (2007) study may reflect not a partial task-switch cost generated by response selection in the absence of response execution, but instead the effect of interference from a nogo signal that modulated the generated task-switch cost. However, it still remains unclear why the task-switch cost was not abolished in that study. A possibility is that, as the researchers intended, the long onset delay allowed for the occurrence of response selection, and that response selection had the effect of protecting the activated task set from the interference by a nogo signal. If so, the response selection account may be retained in that the occurrence of response selection determines the presence of a task-switch cost on the subsequent trial, even though it is not the sole process that generates a task-switch cost. Therefore, to test whether the occurrence of response selection predicts a task-switch cost on the subsequent trial, we used selective go/nogo trials and designed our experiments such that response selection would be required to decide whether a response should be made or withheld, as in Verbruggen et al.'s (2006) selective stop-signal task.

Another important issue is that Philipp et al.'s (2007) and Verbruggen et al.'s (2006) studies only used one task cue per task, so they could not distinguish between the cost of switching the task cue (*cue-switch cost*) and the cost of switching the task (*task-switch cost*). It is, thus, unclear as to which of these costs their findings could be attributed (Logan & Bundesen, 2003). It is possible that nogo trials only prevented the task-switch cost, but not the cue-switch cost (or vice versa), resulting in the reduced, but still significant, overall "switch costs" after nogo trials in these studies. Thus, it is important to evaluate which of these switch costs are present or absent after selective nogo trials.

Furthermore, the present study also examined the switch costs after selective nogo trials both without an onset delay of the go/nogo signal and with an onset delay. A reason to use the selective go/nogo procedure with an onset delay is that it was an integral part of Verbruggen et al.'s (2006) stop-signal task and Philipp et al.'s (2007) delayed go signal procedure. Regardless of whether we find a task-switch cost after selective nogo trials without a delay in the first two experiments, it is important to follow up the results with an onset delay to examine whether the delay was necessary for a switch cost to emerge after trials for which a response was inhibited, as these two studies reported. Another reason is that a delayed signal would provide an advantage by allowing the target to be processed early. That is, it is more likely that response selection would take place on any given nogo trial than if the target and signal occur simultaneously, allowing for a strong test of

[1] Here we emphasized "nonselective" nogo that required withholding a response regardless of what response was required, as opposed to "selective" go as in the present study or in Verbruggen et al. (2006) that required withholding a response only when a specific response was required.

whether response selection leads to a task-switch cost after selectively stopping responses.

In the present study, four experiments were initially carried out, which examined three main factors. First, we manipulated the predictability of the to-be-withheld response between the experiments to examine the influence of the readiness to inhibit a response: The to-be-withheld response was fixed within a given block of trials and was predictable in Experiment 1, but it was varied between trials randomly and was unpredictable in Experiments 2–4. With the fixed to-be-withheld response, participants could proactively prepare to inhibit the response, so that the decision that occurred with a go/nogo signal might involve selection between go and nogo decisions but might not involve response selection. With a variable to-be-withheld response, such proactive inhibition could not occur, increasing the chance for response selection to occur. Verbruggen et al. (2006) only tested a fixed to-be-held response, so the variable to-be-held response was novel in the present study. Second, we manipulated the onset delay of a go/nogo signal to examine the influence of target processing prior to the go/nogo signal (or decision): In Experiments 1 and 2, there was no onset delay of a go/nogo signal, but there was an onset delay in Experiments 3 and 4, which allowed target processing to start before a go/nogo signal occurred. If target processing could occur earlier than processing of a go/nogo signal, there would be a higher chance that response selection had occurred before a nogo decision was made. Hence, a task-switch cost should be more likely to occur with a delayed signal in Experiments 3 and 4 than with no delay in Experiments 1 and 2. Third, we manipulated the presentation of the target with a go/nogo signal and examined the influence of target processing during the go/nogo decision: In Experiments 1–3, the target was present when a go/nogo signal occurred, but the target was erased before a go/nogo signal occurred in Experiment 4. Because the target is erased quickly in the latter condition, participants would have to process quickly and retain the target in their mind, which would require target processing to be initiated before a go/nogo decision, whereas target processing might not have been necessary when the target was still present as a go/nogo signal occurred in Experiments 1–3. Erasing the target before the onset of a go/nogo signal should encourage early processing of the target and increase the chance that response selection starts as early as possible. An additional experiment (Experiment 5) was carried out to follow up the onset delay manipulations across the first four experiments.

In the next section, we first describe the general method of the four experiments as they used the same basic design. We then describe the unique manipulations used in the respective experiments within the Method section. The procedures of the four experiments are illustrated in Figure 1. The final experiment is then reported after the initial four experiments.

Method

Participants

Participants were recruited from the Prolific subject pool (https://prolific.co) in all four experiments. The selection criteria included (a) having normal or corrected-to-normal vision without color blindness, (b) being fluent in English, (c) being at the age between 18 and 45, and (d) having submitted more than 20 responses on the Prolific platform with an approval rate of at least 95%. We aimed to recruit 60 participants per experiment and achieved a minimum of 55 participants in each of the four experiments, which is sufficient to achieve a statistical power of .9 to detect a medium effect size (Cohen's f = .25 or η_p^2 = .06) in a fully within-subject design. In Experiment 1, 65 participants completed the experiment, but six were removed for a low accuracy rate (below 70%), leaving 59 participants (33 females, 25 males, one nonbinary; M_{age} = 33.00, SD = 7.55, range = 19–45) in the analysis. In Experiment 2, 74 participants completed the experiment, but 14 participants were removed for a low accuracy rate, leaving 60 participants (38 females, 22 males; M_{age} = 32.05, SD = 6.36, range = 20–45). In Experiment 3, 74 participants completed the experiment, but 19 were removed for a low accuracy rate, leaving 55 participants (40 females, 15 males; M_{age} = 30.35, SD = 7.65, range = 18–45). In Experiment 4, 76 participants completed the experiment, but 20 were removed for a low accuracy rate, leaving 56 participants (32 females, 22 males, two nonbinary; M_{age} = 31.63, SD = 7.96, range = 18–45). All participants gave informed consent for participation online. The experimental protocol was approved by the Research Ethics Committee of the Department of Psychology at the University of Essex.

Apparatus and Stimuli

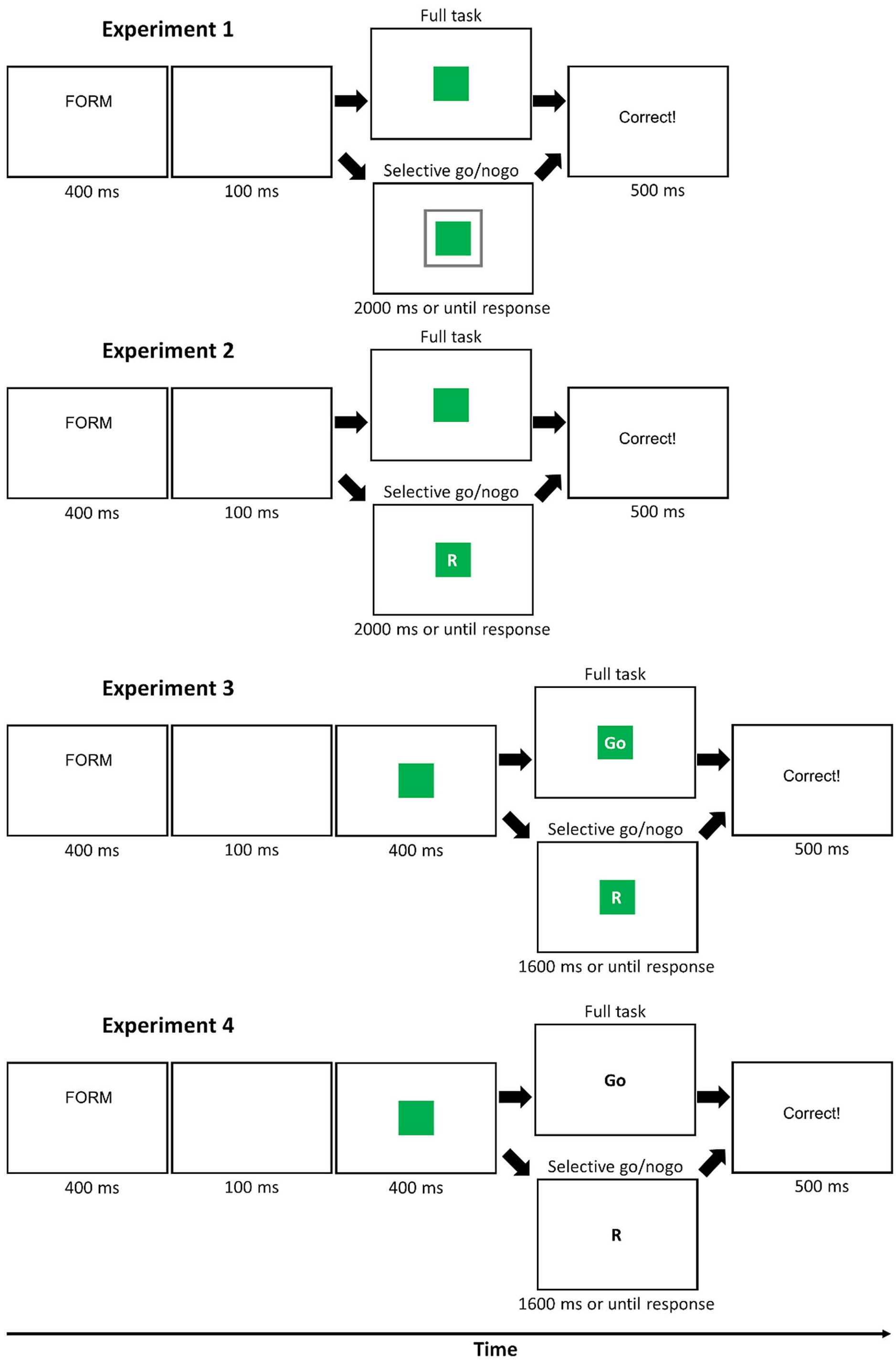
Experiments 1–4 were all conducted online when in-person interactions were restricted due to the global pandemic. All experiments were developed and controlled by Inquisit 6 (Millisecond Software, LLC). Participants downloaded Inquisit Player to their own computers and completed the experiment. They were required to use either a Windows or Macintosh computer, and no mobile devices (e.g., tablet or smartphone) were allowed. The sizes of stimuli varied depending on participants' monitor size. The measures of visual stimuli reported in this section were based on a screen resolution of 1,920 × 1,080 on a 13-in laptop monitor.

The task instructions emphasized both speed and accuracy of responding. All experiments consisted of two different tasks (color vs. shape). In the color task, one key was assigned to red stimuli and the other key to green stimuli; in the shape task, one key was assigned to squares and the other key to diamonds. The assignments of the colors and the shapes to the two response keys were counterbalanced across participants. These two tasks were intermixed randomly in each block. One of the tasks was indicated by the task cue at the beginning of each trial; the task cue for the color task was either *COLOUR* or *HUE*, and that for the shape task was either *SHAPE* or *FORM*. The cues were presented in the Arial font and appeared 3.5 cm above the screen center.

There were two types of trials: *full-task trials*, for which participants responded to the target on every trial; and *selective go/nogo trials*, for which participants responded only to the targets assigned to one response key (*selective go*) and withheld responding to the targets assigned to the other response key (*selective nogo*). The four experiments differed with respect to how and when these trial types were cued to participants. The stimulus display and timing are illustrated in Figure 1.

Each trial started with a task cue that stayed on the screen for 400 ms, followed by a 100-ms blank screen. The target stimulus appeared for 2,000 ms in Experiments 1–3 and for 400 ms followed by a blank display for 1,600 ms in Experiment 4, or until a response was made. The target stimuli were green and red squares (2 cm on each side) and diamonds (the square stimuli tilted 45°), which appeared at the center

Figure 1
Illustrations of the Stimulus Presentation and Timing in Experiments 1–4



Note. In all experiments, a trial started with a task cue, followed by a 100-ms blank. Experiments 1 and 2 presented the target and go/nogo signal simultaneously, and Experiments 3 and 4 first presented the target and then a go/nogo signal 400 ms after the target. See the online article for the color version of this figure.

of the screen. On full-task trials, participants were shown a target and responded to it as quickly as possible before the trial ended. In Experiments 1 and 2, the target appeared alone on full-task trials. In Experiments 3 and 4, the word "Go" was presented to indicate that participants were to make a response to the target regardless of the hand to be used. On selective go/nogo trials, participants were presented with a target along with a selective go/nogo signal and responded to the target when the target feature assigned to one response key appeared but withheld responding until the trial ended when the target feature assigned to the other response key appeared. In Experiment 1, the selective go/nogo signal was a grey square frame (3.2 cm on each side) surrounding the target. In Experiments 2–4, it was a letter "L" or "R." As the latter indicated which hand was to be used to make a response, we call it the *hand cue*.

Responses were registered by pressing the "S" and "L" keys on a keyboard, which were referred to as the left and right response keys in the instructions. For full-task and selective go trials, the message "Correct!" was presented if participants made the correct response; otherwise, the message was "Error!" for an incorrect response and "Faster!" for no response. For nogo trials, the message was "Correct!" if no response was made, or "Don't respond!" if either response key was pressed. The message stayed on the screen for 500 ms. RT was measured as the interval between the onset of the target stimulus (Experiments 1 and 2) or the go/nogo signal (Experiments 3 and 4) and the depression of a response key. The next trial started with another task cue.

In Experiment 1, each participant performed two phases, each consisting of one block of 15 practice trials and three blocks of 120 test trials each. Half of the test trials were full-task trials where participants were presented only with the target and responded to it regardless of the required response. The other half were selective go/nogo trials where a grey frame was presented around the target, and participants responded to the target only if the target required a designated response (selective go trials) and withheld responding to the target that required the other response (selective nogo trials). In one phase, the designated response was the left response, and in the other phase, it was the right response. Participants were informed of the designated response in the instructions before the respective blocks started. The order of the designated responses was randomly determined for each participant.

In Experiment 2, the responding hand on selective go/nogo trials varied on a trial-by-trial basis. On these trials, the target appeared with a hand cue. When the hand cue was "L," participants were to respond to the target only if the target required the left response (selective go trials), but to withhold responding if it required the right response (selective nogo trials); when the hand cue was "R," they were to respond if the target required the right response but to withhold responding if it required the left response. The two letters could appear randomly with equal probability. Full-task trials were the same as those in Experiment 1. Each participant performed two blocks of 16 practice trials, followed by six blocks of 120 test trials each. Half of these trials in each block were full-task trials, and the other half were selective go/nogo trials.

In Experiment 3, the only change from Experiment 2 was that there was a 400-ms delay between the target and a go/nogo signal. Selective go/nogo signals were the same hand cues as those used in Experiment 2, but the signal "Go" was presented in the place of the hand cue for full-task trials, which prompted responding to the target regardless of the required hand. RT was the interval between the onset of one of these signals (rather than that of the target) and a keypress. Thus, when participants pressed a response key before the hand cue or go signal occurred, RT was recorded as a negative value, but participants still saw the same feedback messages for correct ("Correct") or error responses ("Error") on these responses as they would have for a response that followed the signal. These trials with negative RTs were not included in the analysis. There were three blocks of 12 practice trials, followed by six blocks of 120 test trials each.

In Experiment 4, the target was erased after 400 ms and replaced by a go/nogo signal ("Go" for full-task trials and "L" or "R" for selective go/nogo trials). The go/nogo signal was now presented in black. The procedure followed Experiment 3 in all other respects.

Data Analysis

The main analyses focused on RT and percentage of error trials (PE) on full-task trials. The number of selective go/nogo trials was not sufficiently large to warrant separate analyses, but we report the analyses of selective go and nogo trials in the Supplemental Materials. The analyses and visualization were carried out in R Studio (R Core Team, 2021) with the following packages: tidyverse (Wickham et al., 2019), BayesFactor (Morey & Rouder, 2022), afex (Singmann et al., 2023), multcomp (Hothorn et al., 2008), emmeans (Lenth, 2022), and ggpubr (Kassambara, 2022).

Trials were discarded when no response was made or when the response was incorrect on the immediately preceding trial. In Experiments 1 and 2, trials were also discarded when RT was shorter than 200 ms. This resulted in 13.56% of trials being discarded in Experiment 1 and 15.23% in Experiment 2. For Experiments 3 and 4 for which there was a 400-ms delay of a go/nogo signal onset, trials were discarded when RT was a negative number (i.e., participants responded before the hand cue/go signal occurred) rather than when RT was less than 200 ms; this resulted in 17.02% being discarded in Experiment 3, and 13.47% in Experiment 4. Mean RT for correct responses and PE were computed for each participant. They were submitted to separate 3 (Previous Trial: full-task vs. selective go vs. selective nogo) × 3 (Trial Sequence: cue-repeat vs. cue-switch vs. task-switch) analyses of variance (ANOVAs), with both variables being within subject. For Trial Sequence, c*ue-repeat trials* were those for which the task cue was the same as that on the preceding trial, and participants performed the same task as on the preceding trial (e.g., "COLOUR" → "COLOUR"). On *cue-switch trials*, the task cue was different from that on the preceding trial, but participants still performed the same task as on the preceding trial (e.g., "COLOUR" → "HUE"). On *task-switch trials*, the task cue was different from that on the preceding trial, and participants performed a task different from that on the preceding trial (e.g., "COLOUR" → "SHAPE"). These three types of task transition occurred with an equal probability (.33) on each trial and in a random order.

Because the main purpose of the present study was to examine the presence or absence of switch costs after different types of trials, multiple comparisons were carried out to evaluate the *cue-switch* and *task-switch costs*. We report p values that were not corrected for multiple comparisons and adopted a Bonferroni-corrected α (= 0.05/2 = .025) to decide whether these costs were statistically significant. The cue-switch cost was computed by subtracting RT and PE for cue-repeat trials from those for cue-switch trials, and the task-switch cost was computed by subtracting RT and PE for cue-switch trials from those for task-switch trials. For each of these switch costs, we computed the Bayes Factor (BF) based on a two-tailed one-sample *t* test against the null hypothesis that a switch cost was absent (= 0). The default prior to the BayesFactor package was used for all calculations of BFs. BF greater than 1 would indicate evidence supporting the presence of a switch cost, whereas BF less than 1 would indicate evidence supporting the absence of a switch cost. For the presence of a switch cost, BF greater than 3 was taken as moderate evidence and BF greater than 10 as strong evidence; for the absence of a switch cost, BF less than .33 was taken as moderate evidence and BF less than .10 as strong evidence. BF between .33 and 3 was taken as inconclusive evidence for either the absence or presence of a switch cost.

Transparency and Openness

The raw trial data, the analysis scripts, and the experimental programs are available on the Open Science Framework project page at https://osf.io/c8hw7/ (Yamaguchi & Swainson, 2024). We reported how we determined our sample size in the Participants section in the Participants section above. The design and its analyses were not preregistered. All data in Experiments 1–4 were collected between February 2022 and March 2022. Experiment 5 (reported in a later section) was conducted in February 2024 as per a reviewer's suggestion.

Results

The ANOVA results are summarized in Table 1, and RT and PE are summarized in Table 2. Figures 2 and 3 show cue-switch and task-switch costs in RT and PE, respectively, with BFs as a function of the previous trial (full task, selective go, and selective nogo).

Experiment 1

Experiment 1 intermixed full-task and selective go/nogo trials, and the latter trials were cued with a grey frame surrounding the target. The response to be withheld on selective nogo trials was fixed within each block of trials.

For RT, the ANOVA showed significant main effects of Previous Trial and of Trial Sequence, and a significant interaction between them. Responses were generally fastest after full-task trials ($M = 729$ ms), intermediate after selective go trials ($M = 772$ ms), and slowest after selective nogo trials ($M = 805$ ms). Responses were also fastest on cue-repeat trials ($M = 740$ ms), intermediate on cue-switch trials ($M = 753$ ms), and slowest on task-switch trials ($M = 813$ ms). After full-task trials, the cue-switch cost was 31 ms ($p < .001$, BF > 100), and the task-switch cost was 125 ms ($p < .001$, BF > 100). After selective go trials, the cue-switch cost was 12 ms ($p = .278$, BF = .25), and the task-switch cost was 83 ms ($p < .001$, BF > 100). After selective nogo trials, the cue-switch cost was −4 ms ($p = .693$, BF = .15), and the task-switch cost was 11 ms ($p = .416$, BF = .24).

For PE, the main effect of Previous Trial was not significant, but the main effect of Trial Sequence and its interaction with Previous Trial was significant. Responses were most accurate on cue-repeat trials ($M = 5.36\%$), intermediate on cue-switch trials ($M = 5.55\%$), and least accurate on task-switch trials ($M = 9.52\%$). After full-task trials, the cue-switch cost was −0.28% ($p = .68$, BF = .15), and the task-switch cost was 5.28% ($p < .001$, BF > 100). After selective go trials, the cue-switch cost was .37% ($p = .652$, BF = .16), and the task-switch cost was 5.13% ($p < .001$, BF > 100). After selective nogo trials, the cue-switch cost was −0.50% ($p = .425$, BF = .19), and the task-switch cost was 2.10% ($p = .030$, BF = .52).

Overall, the task-switch cost was significant after full-task and selective go trials both in RT and PE, and the corresponding BFs

Table 1
ANOVA Results for Response Time (RT) and Percentage Errors (PE) on Full-Task Trials in Experiments 1–5

			RT				PE			
Experiment	Factor	*df*	*MSE*	*F*	*p*	η_p^2	*MSE*	*F*	*p*	η_p^2
1	Previous Trial (PT)	2, 116	**6552.58**	**39.27**	**<.001**	**.404**	28.31	<1	.660	.007
	Trial Sequence (TS)	2, 116	**6902.23**	**39.05**	**<.001**	**.402**	**29.27**	**33.45**	**<.001**	**.366**
	PT × TS	4, 232	**3261.40**	**15.86**	**<.001**	**.215**	**21.64**	**3.53**	**.008**	**.057**
2	PT	2, 118	**6398.20**	**49.75**	**<.001**	**.457**	**22.90**	**9.58**	**<.001**	**.140**
	TS	2, 118	**4718.94**	**43.40**	**<.001**	**.424**	**25.47**	**29.87**	**<.001**	**.336**
	PT × TS	4, 236	**3748.28**	**16.90**	**<.001**	**.223**	**30.58**	**8.77**	**<.001**	**.129**
3	PT	2, 108	**3966.23**	**59.20**	**<.001**	**.523**	38.84	2.22	.114	.039
	TS	2, 108	**3214.44**	**21.20**	**<.001**	**.282**	**31.57**	**20.58**	**<.001**	**.276**
	PT × TS	4, 216	**1899.75**	**8.99**	**<.001**	**.143**	**25.97**	**5.05**	**<.001**	**.086**
4	PT	2, 110	**3670.41**	**59.60**	**<.001**	**.520**	16.09	2.29	.106	.040
	TS	2, 110	1531.16	4.23	.071	.017	**31.12**	**24.95**	**<.001**	**.312**
	PT × TS	4, 220	**1594.92**	**14.90**	**<.001**	**.213**	**14.61**	**7.29**	**<.001**	**.117**
5	Block Type (BT)	1, 56	**14727.33**	**399.73**	**<.001**	**.877**	**23.49**	**4.02**	**.050**	**.067**
	PT	2, 112	**6364.34**	**61.56**	**<.001**	**.524**	36.01	1.13	.327	.020
	TS	1, 56	**8666.09**	**25.32**	**<.001**	**.311**	**69.76**	**22.92**	**<.001**	**.290**
	BT × PT	2, 112	4347.54	<1	.976	<.001	30.79	<1	.641	.008
	BT × TS	1, 56	3246.86	<1	.849	<.001	23.86	<1	.623	.004
	PT × TS	2, 112	**3759.68**	**20.28**	**<.001**	**.266**	**26.36**	**9.34**	**<.001**	**.143**
	BT × PT × TS	2, 112	2942.55	<1	.648	.008	38.18	<1	.801	.004

Note. Bold represents a significant effect. ANOVA = analysis of variance; *MSE* = mean squared error.

Table 2
Mean Response Time (RT) and Percentage of Error Trials (PE) in Experiments 1–4

		RT			PE		
Experiment	Previous trial	Cue-repeat	Cue-switch	Task-switch	Cue-repeat	Cue-switch	Task-switch
1	Full task	676 (20.64)	708 (20.81)	802 (22.24)	4.90 (.63)	4.62 (.66)	10.17 (.93)
	Selective go	740 (21.91)	752 (23.41)	823 (22.56)	5.24 (.80)	5.62 (.74)	10.38 (1.12)
	Selective nogo	802 (21.10)	798 (24.47)	814 (23.92)	5.92 (.83)	6.42 (.89)	8.02 (.98)
2	Full task	717 (14.76)	744 (14.51)	844 (16.76)	3.31 (.44)	3.45 (.50)	9.08 (.97)
	Selective go	790 (17.00)	804 (18.05)	850 (16.89)	4.79 (.78)	3.53 (.68)	9.69 (1.05)
	Selective nogo	845 (15.87)	858 (16.53)	853 (18.73)	7.87 (1.18)	7.45 (.98)	7.03 (1.10)
3	Full task	525 (11.49)	537 (12.32)	591 (15.99)	4.17 (.47)	4.78 (.73)	10.01 (.91)
	Selective go	586 (12.71)	604 (14.36)	633 (15.99)	5.92 (.90)	4.79 (.73)	9.43 (1.16)
	Selective nogo	616 (15.21)	630 (16.51)	623 (15.65)	7.06 (.93)	7.91 (1.36)	8.16 (1.16)
4	Full task	524 (12.51)	538 (11.77)	579 (14.18)	2.84 (.37)	3.13 (.37)	7.34 (.80)
	Selective go	605 (14.90)	610 (14.41)	611 (15.91)	3.52 (.59)	2.57 (.45)	8.58 (1.15)
	Selective nogo	621 (17.11)	613 (15.48)	567 (14.55)	4.36 (.57)	5.54 (.69)	6.22 (.83)

Note. Values in the parentheses are standard error of the means.

supported the presence of the cost. The cue-switch cost was also significant after full-task trials only in RT, but not in PE or after selective go trials, the corresponding BFs supporting the absence of the cost. After selective nogo trials, BFs provided evidence for the absence of the cue-switch and task-switch costs in RT and for the absence of the cue-switch cost in PE. The task-switch cost in PE was marginal (note that the α for the multiple comparisons was .025), with BF being inconclusive.

Experiment 2

In Experiment 2, participants were presented with a hand cue on selective go/nogo trials that indicated which hand was to be used to respond to the target. Thus, unlike Experiment 1, participants could not anticipate the to-be-withheld response prior to the target onset. However, the results were similar to those of Experiment 1.

For RT, there were significant main effects of Previous Trial and of Trial Sequence and a significant interaction between them. Responses were fastest after full-task trials ($M = 768$ ms), intermediate after selective go trials ($M = 815$ ms), and slowest after selective nogo trials ($M = 852$ ms). Responses were also fastest on cue-repeat trials ($M = 784$ ms), intermediate on cue-switch trials ($M = 802$ ms), and slowest on task-switch trials ($M = 849$ ms). After full-task trials, the cue-switch cost was 27 ms ($p < .001$, BF > 100), and the task-switch cost was 127 ms ($p < .001$, BF > 100). After selective go trials, the cue-switch cost was 14 ms ($p = .154$, BF = .38), and the task-switch cost was 60 ms ($p < .001$, BF > 100). After selective nogo trials, the cue-switch cost was 13 ms ($p = .246$, BF = .27), and the task-switch cost was 9 ms ($p = .596$, BF = .15).

For PE, there were also main effects of Previous Trial and of Trial Sequence, as well as the interaction between them. Responses were most accurate after full-task trials ($M = 5.28\%$), intermediate after selective go trials ($M = 6.00\%$), and least accurate after selective nogo trials ($M = 7.45\%$). Responses were also most accurate on cue-switch trials ($M = 4.81\%$), intermediate on cue-repeat trials ($M = 5.32\%$), and least accurate on task-switch trials ($M = 8.60\%$). After full-task trials, the cue-switch cost was .15% ($p = .730$, BF = .15), and the task-switch cost was 5.77% ($p < .001$, BF > 100). After selective go trials, the cue-switch cost was −1.26% ($p = .164$, BF = .36), and the task-switch cost was 4.90% ($p < .001$, BF > 100). After selective nogo trials, the cue-switch cost was −.42% ($p = .715$, BF = .15), and the task-switch cost was −.84% ($p = .541$, BF = .15).

Consistent with Experiment 1, the task-switch cost was significant after full-task and selective go trials in both RT and PE, and the cue-switch cost was significant only after full-task trials in RT. After selective nogo trials, neither the cue-switch nor task-switch costs were significant, BFs supporting the absence of these costs in both RT and PE.

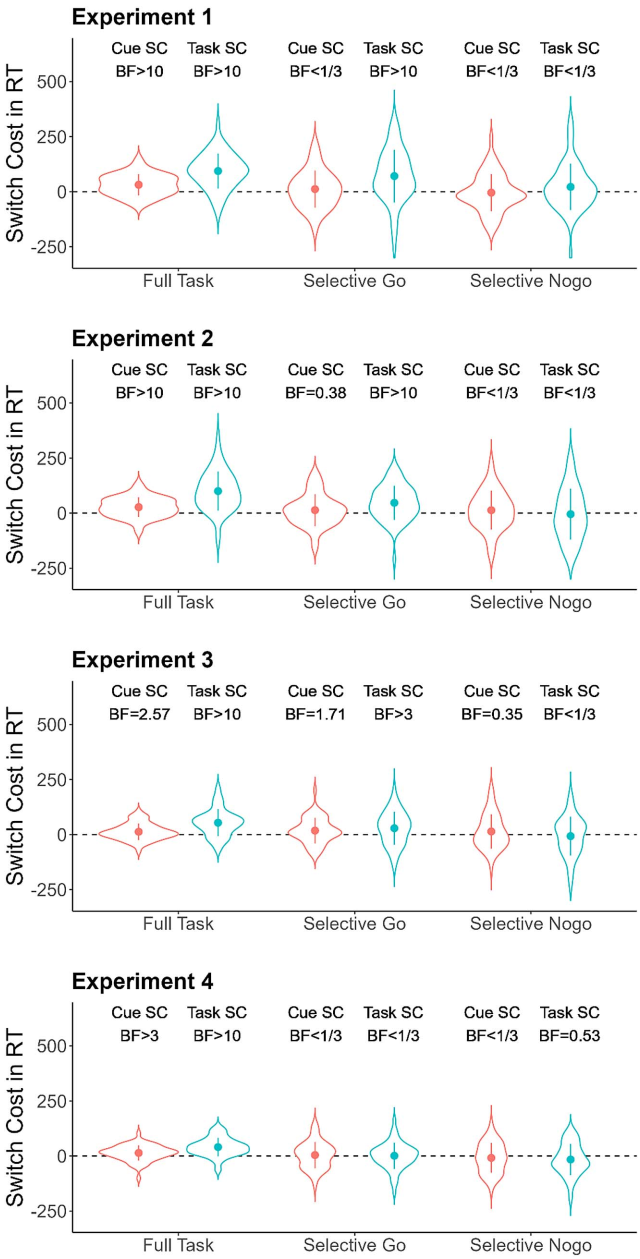
Experiment 3

In Experiment 3, there was a 400-ms onset delay of the hand cue (i.e., a selective go/nogo signal) from the target onset, leaving more time for the target to be processed before a go/nogo decision to be made. The aim of this change was to increase the chance that response selection occurred on every trial.

For RT, there were significant main effects of Previous Trial and of Trial Sequence and a significant interaction between them. Responses were fastest after full-task trials ($M = 551$ ms), intermediate after selective go trials ($M = 607$ ms), and slowest after selective nogo trials ($M = 623$ ms). Responses were also fastest on cue-repeat trials ($M = 551$ ms), intermediate on cue-switch trials ($M = 603$ ms), and slowest on task-switch trials ($M = 623$ ms). After full-task trials, the cue-switch cost was 13 ms ($p = .015$, BF = 2.57), and the task-switch cost was 67 ms ($p < .001$, BF > 100). After selective go trials, the cue-switch cost was 18 ms ($p = .024$, BF = 1.71), and the task-switch cost was 47 ms ($p < .001$, BF = 5.29). After selective nogo trials, the cue-switch cost was 14 ms ($p = .183$, BF = .35), and the task-switch cost was 7 ms ($p = .468$, BF = .17).

For PE, the main effect of Previous Trial was not significant, but the main effect of Trial Sequence and its interaction with the previous trial were significant. Responses were most accurate on cue-repeat trials ($M = 6.31\%$), intermediate on cue-switch trials ($M = 6.71\%$), and least accurate on task-switch trials ($M = 7.71\%$). After full-task trials, the cue-switch cost was .56% ($p = .321$, BF = .24), and the task-switch cost was 5.84% ($p < .001$, BF > 100). After selective go trials, the cue-switch cost was −1.14% ($p = .218$, BF = .31), and the task-switch cost was 3.51% ($p = .002$, BF > 100). After selective nogo trials, the cue-switch cost was .85% ($p = .466$, BF = .19), and the task-switch cost was 1.10% ($p = .396$, BF = .15).

Figure 2
Cue- and Task-Switch Costs in Response Time (RT)



Note. BF > 3 indicates the presence of SC. BF < 1/3 indicates the absence of SC. Error bars within violin plots are 1 standard error of the mean. SC = switch cost; BF = Bayes factor. See the online article for the color version of this figure.

Again, largely consistent with Experiments 1 and 2, the task-switch cost was significant after full-task and selective go trials, with BFs supporting the presence of the cost in RT and PE. The cue-switch cost was no longer significant after full-task or selective go trials in PE, with BFs supporting the absence of the cost. After selective nogo trials, neither the cue-switch nor the task-switch costs were significant, with BFs supporting the absence of these costs in RT and PE.

Experiment 4

Experiment 4 involved a 400-ms onset delay of the hand cue from the target onset as in Experiment 3, but the target was erased when the cue occurred, requiring target processing to occur before a go/nogo signal and, therefore, more strongly encouraging response selection on every trial.

For RT, there were significant main effects of Previous Trial and of Trial Sequence and a significant interaction between them. Responses were fastest after full-task trials ($M = 547$ ms), intermediate after selective go trials ($M = 609$ ms), and slowest after selective nogo trials ($M = 610$ ms). Responses were also fastest on cue-repeat trials ($M = 583$ ms), intermediate on cue-repeat trials ($M = 587$ ms), and slowest on task-switch trials ($M = 596$ ms). After full-task trials, the cue-switch cost was 14 ms ($p = .004$, BF = 8.00), and the task-switch cost was 55 ms ($p < .001$, BF > 100). After selective go trials, the cue-switch cost was 4 ms ($p = .579$, BF = .17), and the task-switch cost was 6 ms ($p = .394$, BF = .15). After selective nogo trials, the cue-switch cost was −8 ms ($p = .358$, BF = .22), and the task switch cost was −24 ms ($p = .007$, BF = .53).

For PE, the main effect of Previous Trial was not significant, but the main effect of Trial Sequence and its interaction with the previous trial was significant. Responses were most accurate on cue-repeat trials ($M = 4.44\%$), intermediate on cue-switch trials ($M = 4.89\%$), and least accurate on task-switch trials ($M = 5.38\%$). After full-task trials, the cue-switch cost was .29% ($p = .48$, BF = .19), and the task-switch cost was 4.50% ($p < .001$, BF > 100). After selective go trials, the cue-switch cost was −.95% ($p = .203$, $BF = .32$), and the task-switch cost was 5.06% ($p < .001$, BF > 100). After selective nogo trials, the cue-switch cost was 1.18% ($p = .117$, BF = .48), and the task-switch cost was 1.86% ($p = .019$, BF = .18).

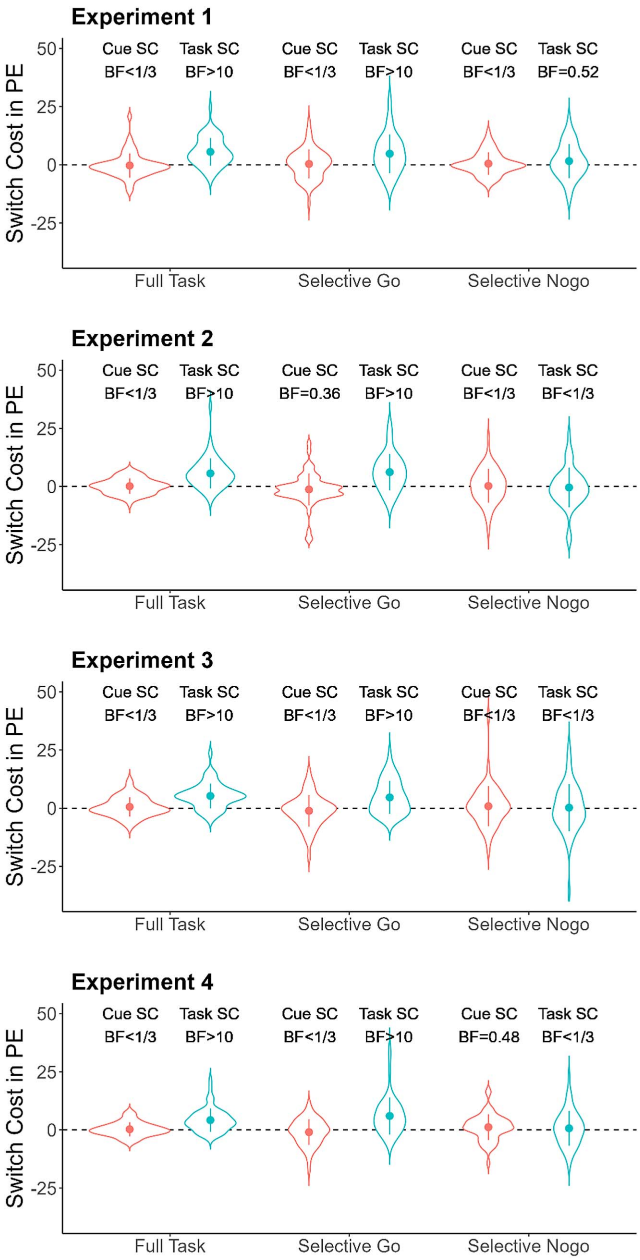
The task-switch cost was significant in RT and PE after full-task trials; the task-switch cost was no longer significant in RT after selective go trials, but it was still significant in PE. The cue-switch cost was only significant in RT after full-task trials. The significant switch costs were accompanied by BFs supporting the presence of the costs, whereas nonsignificant switch costs were accompanied by BFs supporting the absence of the costs. After selective nogo trials, there was a significant task-switch "benefit" (rather than cost) in RT, for which BF was inconclusive; the task-switch cost in PE was significant (note, again, that the Bonferroni-corrected α was .025) but with BF supporting the absence of the cost. The cue-switch cost was not significant in RT or PE but with BF supporting the absence of the cost for RT and being inconclusive for PE.

Experiment 5

The results of the four experiments consistently suggest that task-switch costs following nogo trials do not emerge even when response selection was strongly encouraged by (a) using a selective go/nogo procedure, which required the identification of the required response *or*, at least, the identification of the target stimulus associated with the required response, and (b) inserting a delay between the target and a go/nogo signal, which allowed a head start to process the target and identify the required response before a signal occurred. It is also worth noting that, as reported in Supplemental Materials, PE for selective go trials was much smaller than a chance level (50%) in all four experiments, whereas RT was no shorter than that on full-task trials. If response selection did not occur on

Figure 3

Cue- and Task-Switch Costs in Percentage of Error Trials (PE)



Note. BF > 3 indicates the presence of SC. BF < 1/3 indicates the absence of SC. Error bars within violin plots are 1 standard error of the mean. SC = switch cost; BF = Bayes factor; RT = response time. See the online article for the color version of this figure.

selective go/nogo trials, participants would have made a random response, which would have resulted in PE near 50%. Alternatively, it is possible that participants made a response indicated by the hand cue (in Experiments 2–4) without selecting a response for themselves, which would have resulted in very short RT because the task would have been reduced to a simple reaction rather than a choice reaction. However, such a strategy should also have led to a very high error rate on selective nogo trials because participants had no way of knowing that these trials required a to-be-withheld response without knowing which response was required in the first place. Hence, it is unlikely that participants performed selective go/nogo trials without selecting a response in these experiments.

Moreover, from an inspection of the results (see Table 2), responses appeared to be slower in Experiments 1 and 2, in which a go/nogo signal occurred simultaneously with the target, than in Experiments 3 and 4, in which a go/nogo signal was delayed and presented 400 ms after target onset. These outcomes indicate that target processing started before the go/nogo signal onset in the latter experiments. Hence, it is more likely that response selection occurred on selective nogo trials in the latter experiments than in the earlier experiments. To examine these conditions more directly, we carried out an additional experiment (Experiment 5). In this experiment, we compared the *immediate signal condition*, in which the target occurred with a Go signal or a hand cue (the letter *L* or *R*) as in Experiments 1 and 2, and the *delayed signal condition*, in which the target preceded a Go signal or a hand cue as in Experiments 3 and 4 (see Figure 4). In the immediate signal condition, a neutral stimulus (a grey shape combining the square and diamond) was presented in the place of the target, 400 ms before a signal, which bore no information about the incoming target to equate a possible warning effect of the advanced presentation of a target in the delayed signal condition. If target processing starts before a go signal in the delayed signal condition, RT should be shorter in that condition than in the immediate signal condition. Such an outcome would imply that response selection is more likely to have taken place prior to withholding a response in the delayed signal condition. It was expected that a task-switch cost would still be absent in the delayed signal condition if response selection was not sufficient to predict the presence or absence of a task-switch cost after nogo trials.

Method

Participants

Participants were recruited from the same subject pool with the same criteria as in Experiments 1–4. Sixty-two participants completed the experiment, and five were excluded (one made no response throughout the experiment, two responded to all nogo trials, and two failed to reach the 70% accuracy threshold), which left 57 participants (20 females, 36 males, one nonbinary; $M_{\text{age}} = 32.18$, $SD = 7.57$, range = 19–44) in the analysis.

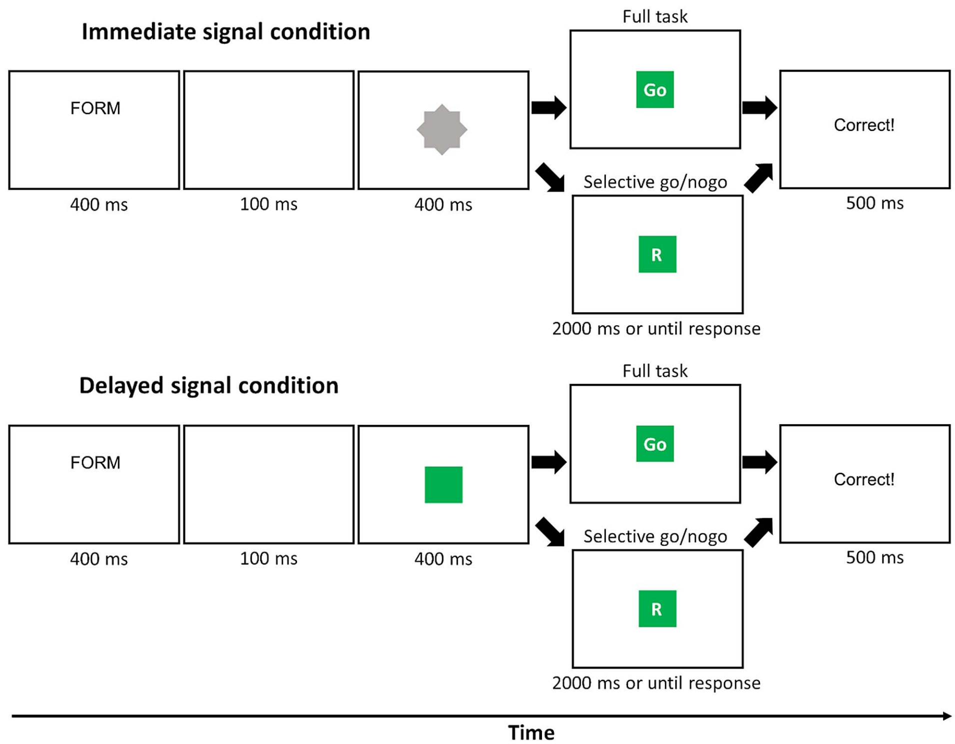
Apparatus, Stimuli, and Procedure

The experiment was essentially the same as Experiment 3, with the following changes. All participants performed both immediate and delayed signal conditions, which were given in separate blocks. After reading the instructions, participants performed four blocks of 12 practice trials each, followed by eight blocks of 120 test trials. The data from the practice trials were not included in the analysis. The immediate and delayed signal blocks alternated one after another in both the practice and test phases, and the order of the two condition blocks was randomly determined for each participant.

A trial started with a target cue for 400 ms, followed by a 100-ms blank display. A target occurred for 400 ms before a go/nogo signal was presented in the delayed signal condition, whereas a neutral

Figure 4

Illustrations of the Stimulus Presentation and Timing in the Immediate and Delayed Signal Conditions of Experiments 5



Note. The target occurred 400 ms before a go/nogo signal onset in the delayed signal condition. The immediate signal condition presented a neutral stimulus in the place of the target in the delayed signal condition. See the online article for the color version of this figure.

signal occurred for 400 ms before a go/nogo signal in the immediate signal condition. There was a 2,000-ms response window after go/nogo signal onset in both conditions. When a response was incorrect (i.e., pressing a wrong key or no key on a go trial or failing to withhold a response on a nogo trial), an error message was presented for 3,000 ms. When a response was correct, a feedback message was presented for 500 ms. The longer feedback duration for error was introduced in this experiment because we have learned from subsequent online studies that it would improve the data quality in an online experiment. To reduce the overall length of the experiment, cue-repeat trials were excluded because the cue-switch cost was never significant after selective nogo trials in Experiments 1–4. Hence, half of all trials were cue-switch trials, and the other half were task-switch trials. Consequently, the analysis focused on task-switch costs.

Results and Discussion

The data were processed in the same manner as in Experiments 3 and 4. Trials were also filtered in the same manner as in Experiment 3 (16.27% were discarded). RT and PE on full-task trials are summarized in Table 3, and task-switch costs are summarized in Figure 5. RT and PE were submitted to 2 (Block Type: immediate signal vs. delayed signal) × 3 (Previous Trial: full-task vs. selective go vs. selective nogo) × 2 (Trial Sequence: cue-switch vs. task-switch) ANOVAs. The results are summarized in Table 1.

For RT, there was a significant main effect of Block Type, which confirmed that responses were faster in the delayed signal block (M = 724 ms) than in the immediate signal block (M = 909 ms). There were also significant main effects of Previous Trial and of Trial Sequence, and these variables interacted. Responses were fastest after full-task trials (M = 769 ms), intermediate after selective go trials (M = 834 ms), and slowest after selective nogo trials (M = 846 ms). Responses were also faster on cue-switch trials (M = 799 ms) than on task-switch trials (M = 835 ms). We examined the task-switch costs after the three trial types in the immediate and delayed signal blocks (see Figure 5). The task-switch cost after full-task trials was 67 ms (p < .001, BF > 100) in the immediate signal block and 63 ms (p < .001, BF > 100) in the delayed signal block. The task-switch cost after selective go trials was 40 ms (p < .001, BF = 65.80) in the immediate signal block and 49 ms (p < .001, BF = 28.21) in the delayed signal block. The task-switch cost after selective nogo trials was −2 ms (p = .897, BF = .15) in the immediate signal block and −7 ms (p = .629, BF = .16) in the delayed signal block.

For PE, there was also a significant main effect of Block Type. Responses were more accurate in the delayed signal block (M = 7.46%) than in the immediate signal block (M = 8.20%). There was also a significant main effect of Trial Sequence and a significant interaction of Trial Sequence with Previous Trial. Responses were more accurate on cue-switch trials (M = 6.30%) than on task-switch trials (M = 9.36%). Again, we examined the task-switch

Table 3
Mean Response Time (RT) and Percentage of Error Trials (PE) in Experiment 5

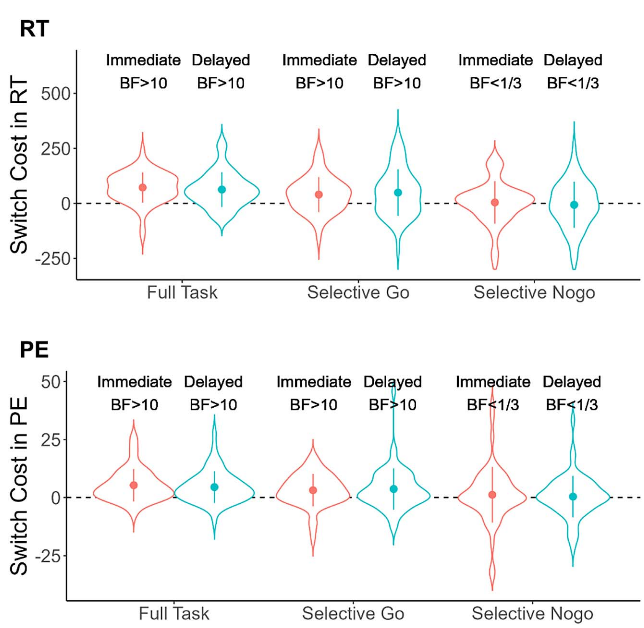
		RT		PE	
Block type	Previous Trial	Cue-switch	Task-switch	Cue-switch	Task-switch
Immediate	Full task	826 (18.35)	898 (18.90)	4.98 (.75)	10.32 (1.24)
	Selective go	907 (20.32)	947 (22.25)	6.85 (1.09)	10.03 (1.19)
	Selective nogo	941 (22.34)	939 (20.31)	7.90 (1.09)	9.12 (1.56)
Delayed	Full task	645 (20.25)	708 (21.57)	4.88 (.68)	9.39 (1.25)
	Selective go	718 (21.02)	766 (23.55)	6.18 (.97)	9.88 (1.49)
	Selective nogo	756 (23.77)	749 (23.54)	7.00 (1.21)	7.41 (1.31)

Note. Values in the parentheses are standard error of the means.

costs after the three trial types in the immediate and delayed signal blocks (see Figure 5). After full-task trials, the task-switch cost was 5.33% (p < .001, BF > 100) in the immediate signal block and 4.51% (p < .001, BF > 100) in the delayed signal block. After selective go trials, the task-switch cost was 3.18% (p < .001, BF = 65.80) in the immediate signal block and 3.70% (p = .003, BF = 28.21) in the delayed signal block. After selective nogo trials, the task-switch cost was 1.22% (p = .446, BF = .15) in the immediate signal block and .42% (p = .727, BF = .16) in the delayed signal block.

The results showed that responses were not only faster but also more accurate in the delayed signal block than in the immediate signal block, which indicates that the target processing was started without waiting for a go/nogo signal in the delayed signal block. Given that target processing started earlier in the delayed signal block than in the immediate signal block, it is more likely that response selection occurred in the former than in the latter. Nevertheless, the task-switch costs were still absent after selective nogo trials in both the immediate and delayed signal blocks for RT and PE. We also note that the immediate signal block had a longer cue-target interval (900 ms) than the preceding experiments had, but the increased cue-target interval did not result in a task-switch cost after selective nogo trials in that block. Therefore, the present experiment provides strong support that the absence of a task-switch cost after a nogo trial does not depend on whether response selection occurred on a preceding trial.

Figure 5
Task-Switch Costs in Response Time (RT) and Percentage of Error in the Immediate and Delayed Signal Conditions of Experiment 5



Note. BF > 3 indicates the presence of SC. BF < 1/3 indicates the absence of SC. Error bars within violin plots are 1 standard error of the mean. SC = switch cost; BF = Bayes factor; PE = percentage of error trials. See the online article for the color version of this figure.

General Discussion

The response-selection account proposes that the occurrence of response selection determines whether a task-switch cost is obtained on the subsequent trial (Schuch & Koch, 2003). Although subsequent studies have already shown that response selection could not be the sole factor that generated a task-switch cost, they still suggest that the occurrence of response selection resulted in a significant task-switch cost after nogo trials (Philipp et al., 2007; Verbruggen et al., 2006). In the present study, we used selective go/nogo procedures to test whether the occurrence of response selection would result in a task-switch cost after nogo trials. In each of Experiments 1–4, however, the results provided evidence for the absence of a task-switch cost after selective nogo trials, even when response selection was strongly encouraged by (a) making the to-be-withheld response unpredictable and unpreparable, (b) delaying the onset of a go/nogo signal from the target onset and allowing advance processing of the target, and (c) erasing the target when a delayed go/nogo signal occurred and requiring the target to be processed before the signal onset. Experiment 5 followed up the influence of delaying a go/nogo signal directly and showed that responses were faster and more accurate when the signal was delayed than when it occurred with the target, which implies that the target was indeed processed before a go/nogo signal occurred. Nevertheless, the task-switch cost was still absent after selective nogo trials. Hence, the present results indicate that response selection is not sufficient to predict a task-switch cost in the subsequent trial. It should be noted that these results do not refute the proposal that response selection is a possible source of a task-switch cost (also see Swainson et al., 2024), but they strongly suggest that the occurrence of response selection does not determine whether a task-switch cost is obtained on a following trial. It is possible that it is the occurrence of response execution, rather than response selection, that determines the presence of a subsequent task-switch cost (see Philipp et al., 2007) so that a task-switch cost always follows response execution. Our data were equivocal on this point because the task-switch cost after selective go trials was not present in RT but was present in PE in Experiment 4. Hence, this aspect of the response-execution account still requires further scrutiny.

An alternative to the response-selection account (Schuch & Koch, 2003) and its extended version by Philipp et al. (2007) is the task-set interference account by Lenartowicz et al. (2011). The latter account proposed that a task-switch cost is generated on a nogo trial (by task preparation alone) but is "modulated" by a nogo signal. As mentioned earlier, the response-selection account may be correct in saying that response selection generates a task-switch cost, but the present results could only be explained if the generated task-switch cost was abolished after nogo trials. According to this account, the absence of a task-switch cost after nogo trials is not because response selection did not generate a task-switch cost as the response-selection account suggests. Instead, it proposes that a nogo signal interferes with the activated task set. This account can readily explain the results of the present study. Despite our efforts to encourage response selection in these experiments, a task-switch cost was not obtained after selective nogo trials. This can be the case if a potential task-switch cost generated is abolished by a nogo signal. It is consistent with the idea that deciding to withhold responding to the target interferes with the activated task set and removes task inertia to eliminate the task-switch cost.

Although the present results are more consistent with the task-set interference account than the response-selection account, the task-set interference account is still ambiguous regarding the mechanism underlying the interference of the activated task set. Lenartowicz et al. (2011) suggested that a nogo signal might inhibit the activated task set or reset it by removing it from working memory, but they did not examine directly which of these mechanisms abolishes a task set after nogo trials. The account is also ambiguous as to the extent to which nogo trials could interfere with the activated task set. Verbruggen et al. (2006) and Philipp et al. (2007) both found a significant switch cost after nogo trials (or successfully inhibited stop-signal trials), indicating that nogo signals do not always abolish switch costs. The present study used two task cues per task to dissociate between cue-switch and task-switch costs and showed that both types of switch costs were absent after selective nogo trials. Hence, it is not the case that nogo trials only interfere with one or other type of switch cost. Therefore, the previous findings of a significant switch cost after nogo trials seem to indicate that there were different degrees of interference by nogo trials, which sometimes allow a significant switch cost to occur. For example, after nogo trials, the cue-target interval was 100 ms followed by a 100-ms onset delay of a go signal in Philipp et al.'s study, whereas it was 300 ms followed by variable stop-signal onset delay in Verbruggen et al.'s study. The cue-target interval in the present experiments was slightly longer at 500 ms (in Experiments 1–4), with either no onset delay (Experiments 1 and 2) or 400-ms delay of a go signal (Experiments 3 and 4 and the delayed signal condition of Experiment 5). It was even longer in the immediate signal condition (900 ms) of Experiment 5. Switch costs were absent regardless of the onset delay of a go signal in the present study, but the cue-target interval might have been an important factor in determining whether a switch cost was obtained after selective nogo trials. It is possible that nogo trials can interfere with the activated task-set and abolish the task-switch cost but that the task cue representation in short-term memory may not be removed immediately and may continue to generate a significant switch cost on subsequent trials with a short cue-target interval. Further investigations would be required to examine the extent to which nogo trials interfere with the task set and what might allow a significant switch cost to emerge after nogo trials.

The task-set inference account and the response-selection account propose different loci of a task-switch cost and mechanisms responsible for the absence of a task-switch cost after nogo trials, but they seem to agree that the cognitive processes underlying task switching involve switching between task sets, mental representations of certain task parameters, although what these mental representations constitute is still far from clear. In contrast, a more recent model of cued task switching asserts that the effects of switching multiple contextual features contribute to the eventual switch cost (Schmidt et al., 2020). These contextual features include, but might not be limited to, the target and nontarget stimulus attributes, the task cue, and the response. When the current contextual features match those of previous episodes, the corresponding episodic memory is retrieved along with the response made in that episode. This retrieval of a prior episode facilitates responding if the response associated with the episode is the one required for that trial, but it interferes with responding if it is different from the required response. These repetitions and alternations of contextual features are confounded with task switching, making it difficult to determine whether the "task-switch" cost reflects underlying cognitive control settings (e.g., the activation of a task set) or repetition/alternation of contextual features. Hence, according to the model, the cost of switching between different tasks emerges largely from changes in contextual features, and not necessarily from switching between mental representations of different tasks, as assumed by the task-set interference account and the response-selection account. The prediction from this episodic retrieval model for the present study is not straightforward because how go/nogo decisions would influence the effect of contextual feature repetition/alternation is unclear. However, we acknowledge that switching between full-task and selective go/nogo trials could potentially constitute a form of contextual feature alternation and could also influence task performance (see Supplemental Materials for some indications of such influences). More systematic evaluations of the roles of contextual feature repetition/alternation in switch costs after nogo trials are required in future investigations.

Concluding Remarks

The present study examined whether response selection determined the presence of a task-switch cost on a subsequent trial. The selective go/nogo procedure required participants to decide whether a response should be made on a given trial, based on which response was required to the target. All five experiments provided Bayes factors supporting the absence of a task-switch cost after selective nogo trials. These results provided novel demonstrations that a task-switch cost after nogo trials is not determined by the occurrence of response selection on those trials. Both the original response-selection account (Schuch & Koch, 2003) and its revised version (Philipp et al., 2007) propose that a task-switch cost after nogo trials is at least partly determined by response selection, and the present results indicate that an alternative explanation is needed to understand this intriguing phenomenon that a robust task-switch cost is absent when a selected response is withheld on a preceding trial. The task-set interference account (Lenartowicz et al., 2011) offers a viable alternative explanation, but it still requires a greater clarification of the exact mechanism underlying the abolishment of a task-switch cost after nogo trials. A recent study using an individual difference approach has suggested that response selection and response inhibition are separable cognitive operations (Bender et al., 2016). The investigations in this line should help understand the relationship among components of cognitive control, including task switching, response selection, response inhibition, and others.

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