Supplemental Material

Table S1 presents all main effects and interactions for the Site X Congruency/Accuracy X Block Type ANOVA for the N2, ERN, and Pe.

Across Task Analysis

We conducted time-on-task analyses across the entire task, to rule out the possibility that the S-R reversal effect deteriorated as a function of time across the task. This was particularly important because our paradigm utilized six different stimulus sets made up of different letters (see main text for details). A 6 Stimulus Set ("MN", "FE", "OQ", "TI", "VU", "PR") X 2 Block Type (Non-Switch vs. Switch) ANOVA revealed that although RTs fluctuated throughout the task, the S-R reversal effect did last throughout the entire task. The main effect of Stimulus Set emerged (F (1, 66) = 22.53, $p < .001$, $\eta^2_p = .25$). The main effect of Block Type was also significant (F (1, 66) = 36.21, $p < .001$, $\eta^2_p = .35$), and the interaction between Stimulus Set and Block Type emerged (F (1, 66) = 2.63, $p < .05$, $\eta^2_p = .04$). As can be seen in Figure S1, RTs were always longer in Switch blocks compared to Non-Switch blocks. The interaction between Stimulus Set and Block Type was reduced to non-significance when the "OQ" block was removed (F (1, 66) = 1.35, $p = .26$, $\eta^2_p = .02$). The lack of a consistent decline in the switching effect across the task suggests that the response-switching manipulation was effective throughout the task. This interpretation also supports our claim that each Switch block stimulus elicited the previous (Non-Switch) block's S-R mapping (i.e., stimulus-primed response conflict).

Localization of the S-R Reversal Effect

Figure S2 presents the topographic maps of the ERP components by block type and congruency (for the N2) and accuracy (for the ERN and Pe).

Figure S3 depicts the localization of the S-R reversal effect for the N2 and the Pe. Because the Block Type X Accuracy X Site interaction was not significant in the ERN time window (see main text), this component is not depicted.

Independent Sources of Conflict

This analysis was aimed at examining whether or not response switching influenced performance above and beyond typical flanker-interference effects. Flanker stimuli create noise in the information processing stream (Eriksen & Eriksen, 1974), and evoke reliable flanker-related 'signatures': congruency effects, Gratton effects, and N2 difference waves have all been used to index conflict (Botvinick et al., 2001; Yeung, Botvinick, & Cohen, 2004). Congruency effects refer to increased RTs and error rates on incongruent trials compared to congruent trials (e.g., Botvinick et al., 2001). Gratton effects refer to the reduced RT and error rate on incongruent trials that follow incongruent trials (e.g., Gratton, Coles, & Donchin, 1992). The N2 is larger on

incongruent trials compared to congruent trials (e.g., Gehring, Gratton, Coles, & Donchin, 1992). We compared congruency, Gratton, and N2 difference wave effects between block types (Non-Switch vs. Switch). To examine congruency effects, RTs and error rates for congruent and incongruent correct trials were analyzed using separate 2 (Congruency; congruent vs. incongruent) X 2 (Block Type; Non-Switch vs. Switch) ANOVAs. Gratton effects were examined using a 2 (Previous Congruency) X 2 (Current Congruency) X 2 (Block Type) ANOVA for both RT and error rate. The primary N2 analysis is presented in the main text (see page 18-19), but follow-up t-tests are presented below.

Congruency Effects. For RT, the typical flanker-interference effect was observed in both block types: correct RTs were slower for incongruent trials (Non-Switch: $M = 451.45$; $SD = 41.40$; Switch: $M = 464.69$; $SD = 41.89$) than for congruent trials (Non-Switch: $M = 410.94$; $SD = 41.32$; Switch: $M = 425.72$; $SD = 43.96$; $F(1, 66) = 568.24$, $p < .001$, $\eta^2_p = .90$). However, the interaction between Congruency RT and Block Type was not significant ($F(1, 66) < 1$, $p = .53$, $\eta^2_p < .01$), indicating that the congruency RT effect was similar in both block types. The same pattern of results was found with respect to error rates, which were higher on incongruent trials (Non-Switch: $M = 11.68\%$, $SD = 7.52\%$; Switch: $M = 12.21\%$, $SD = 7.12\%$) than on congruent trials (Non-Switch: $M = 4.80\%$, $SD = 4.41\%$; Switch: $M = 5.97\%$, $SD = 4.93\%$; $F(1, 66) = 111.55$, $p < .001$, $\eta^2_p = .63$), and there was no interaction between Congruency and Block Type ($F(1, 66) < 1$, $p > .33$, $\eta^2_p = .02$). The lack of interaction suggests that the flanker-interference congruency effect was not different between block types and thus independent of S-R reversal conflict.

Gratton effects. For RT, the ANOVA revealed significant main effects for Previous-Trial Congruency ($F(1,66) = 10.36$, $p < .01$, $\eta^2_p = .14$), Current-Trial Congruency ($F(1,66) = 543.60$, $p < .001$, $\eta^2_p = .89$), and Block Type ($F(1,66) = 27.03$, $p < .001$, $\eta^2_p = .25$). The interaction between Previous-Trial Congruency and Current-Trial Congruency was significant ($F(1,66) = 12.61$, $p = .001$, $\eta^2_p = .16$). However, none of the interactions involving Block Type was significant ($Fs < 2.39$, $ps > .12$, $\eta^2_{ps} < .07$).
For error rate, main effects emerged for Previous-Trial Congruency ($F(1,66) = 5.19$, $p < .05$, $\eta^2_p = .07$), Current-Trial Congruency ($F(1,66) = 105.11$, $p < .001$ $\eta^2_p = .61$), and Block Type ($F(1,66) = 4.41$, $p < .05$, $\eta^2_p = .06$). The interaction between Previous and Current Congruency was significant ($F(1, 66) = 5.84$, $p < .05$, $\eta^2_p = .08$). However, as in the RT data, no interactions involving Block Type were significant ($Fs < 1$, $ps > .42$, $\eta^2_p < .02$). These results suggest that Gratton effects were similar in both Non-Switch and Switch blocks and thus independent of S-R reversal conflict.

N2 Difference Wave. As noted in the main text, there were no interactions involving Block Type and Congruency for the N2. Follow-up *t*-tests showed that the N2 difference wave in Non-Switch blocks ($M = -.73$, $SD = 1.51$) was not different in Switch blocks ($M = -.80$, $SD = 1.48$, $t < 1$, $p = .76$).

In sum, flanker interference was not different between block types. This indicates that response-switching conflict was independent of flanker-induced congruency conflict. These results also suggest that the S-R reversal manipulation did not simply introduce ambiguity between S-R

mappings during Switch blocks. Rather, participants were aware of the S-R mappings throughout the Switch blocks, but had to compensate for the interference introduced by the rule reversal, resulting in switch costs.

Table S1 - Full output for Site X Congruency / Accuracy X Block Type ANOVA for N2, ERN, and Pe.

N2				
Effect	*F*	*df*	*p*	η^2_p
Site	100.95	4,264	<.0001	.61
Block	29.48	1,66	<.0001	.31
Congruency	24.09	1,66	<.0001	.27
Site X Block	29.16	4,264	<.0001	.31
Site X Congruency	3.00	4,264	<.05	.06
Block X Congruency	<1	1,66	.97	<.001
Site X Block X Congruency	1.24	4,264	.29	.02
ERN				
Effect	*F*	*df*	*p*	η^2_p
Site	101.94	4,264	<.0001	.61
Block	11.91	1,66	.001	.15
Accuracy	36.69	1,66	<.0001	.36
Site X Block	9.67	4,264	<.0001	.13
Site X Accuracy	67.88	4,264	<.0001	.51
Block X Accuracy	6.80	1,66	<.05	.09
Site X Block X Accuracy	1.69	4,264	.19	.03
Pe				
Effect	*F*	*df*	*p*	η^2_p
Site	5.56	4,264	.01	.08
Block	9.25	1,66	<.01	.12
Accuracy	271.23	1,66	<.0001	.80
Site X Block	22.18	4,264	<.0001	.25
Site X Accuracy	149.95	4,264	<.0001	.69
Block X Accuracy	27.04	1,66	<.0001	.29
Site X Block X Accuracy	10.83	4,264	<.0001	.14

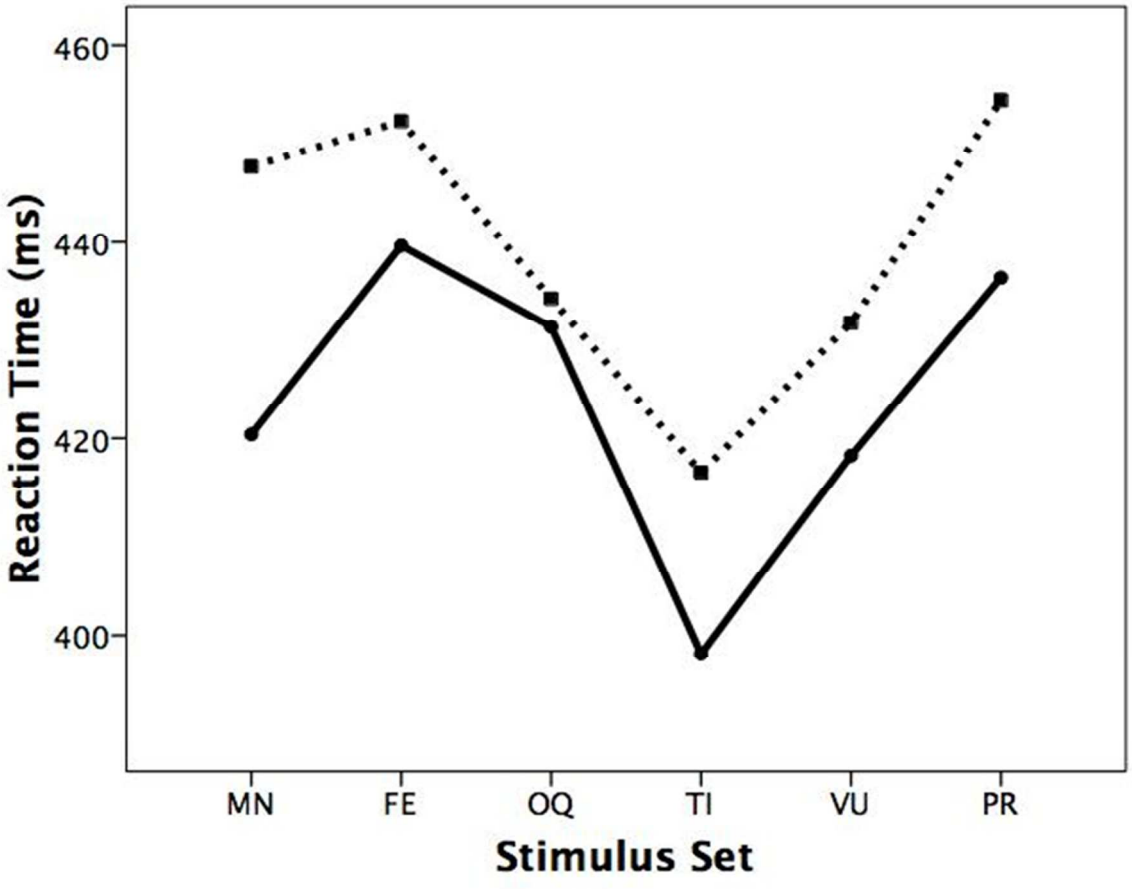

Figure S1 - Across task analysis. Non-Switch blocks are depicted in solid lines, Switch blocks are depicted in dashed lines. Note that the S-R reversal effect lasted throughout the entire task, regardless of stimulus set.

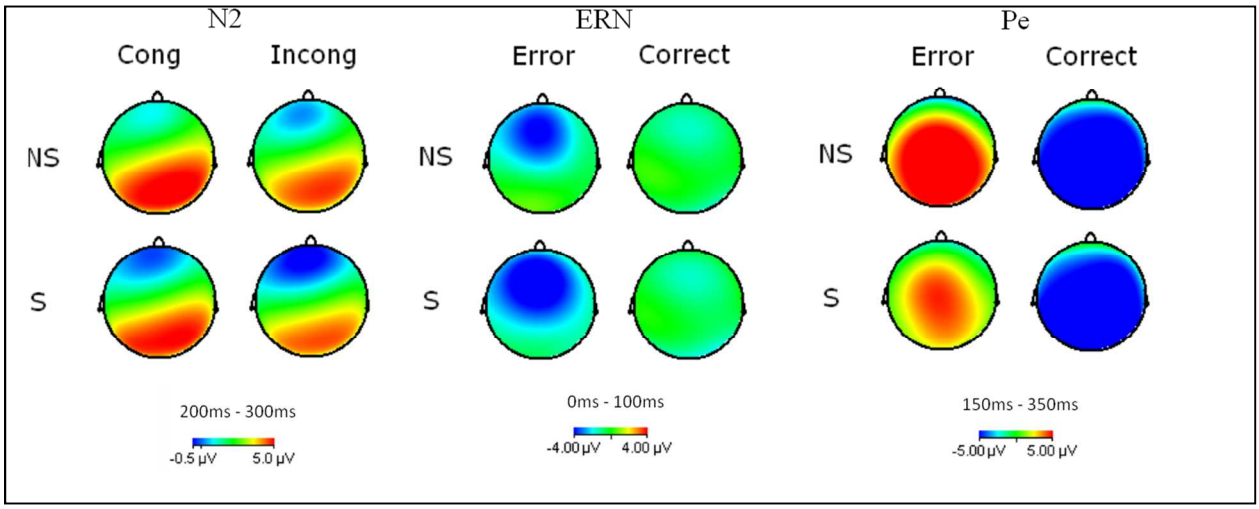

Figure S2 – Topographic Maps of S-R Reversal Effect. Topographic maps depicting the effects of the S-R mapping reversals for the N2 (left), ERN (center), and Pe (right). NS: Non-Switch; S: Switch; Cong: Congruent; Incong: Incongruent; ERN: Error-related negativity; Pe: error positivity.

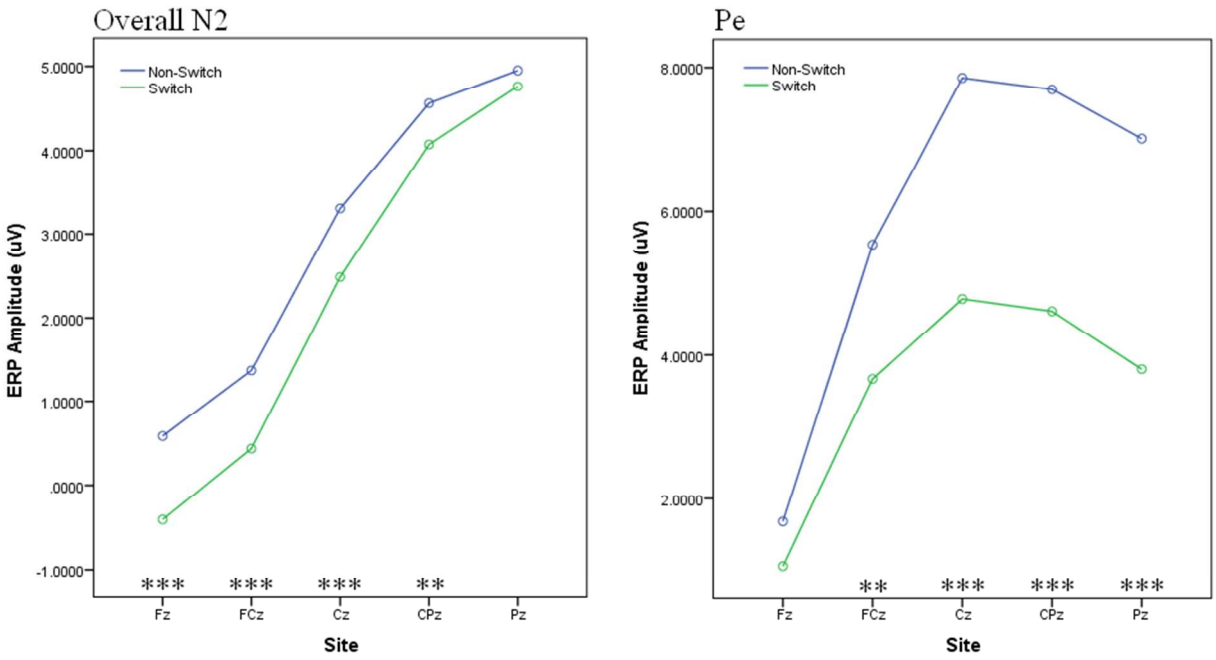

Figure S3 – Localization of the S-R Reversal Effect. Output from the Site X Block Type X Congruency/Accuracy ANOVA. Overall N2 was averaged across congruency. Pe: error positivity on error trials. ** p <.01, ***p <.001

References

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