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Neural Correlates of Object and Verbal Cognitive Style during Task Switching*

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The current study explored neural correlates of the relationship between cognitive style and task switching processes. A task switching paradigm including object and verbal tasks was employed and neural responses were collected using fMRI. Behavioral and neural switch costs were correlated with individuals' cognitive style preference scores. A total of thirty-five young adults participated in this study. Behavioral results showed that verbal preference scores were positively correlated with the switch cost in the object task. Neural responses in the object task showed a positive relationship between object style preference and the neural switch cost in the posterior cingulate cortex/precuneus and left intraparietal sulcus. In addition, an interaction between the object and verbal preferences was found in the angular gyrus during the object task. These results show how the individual differences in cognitive style preference during task switching could be linked to individual variations in neural responses. These findings suggest that cognitive style preference may be related to cognitive control through attentional resource allocation, and selection, and the processing of target- and distractor-relevant information during task switching.

Keywords: task switching, fMRI, cognitive style, switch cost

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Cognitive style is defined as an individual's attitude, preference, or habitual strategy in information processing (Messick, 1976), which is closely associated with a wide range of cognitive processes from perception to metacognition (Kozhevnikov, 2007). Many studies have reported neural correlates of the relationship between individuals' preferences for a particular cognitive style and their performance in various modality-specific cognitive tasks (Buzzell, Roberts, Baldwin, & McDonald, 2013; Cui, Jeter, Yang, Montague, & Eagleman, 2007; Hilbert et al., 2015; Kraemer, Hamilton, Messing, DeSantis, & Thompson-Schill, 2014; Kraemer, Rosenberg, & Thompson-Schill, 2009; Motes, Malach, & Kozhevnikov, 2008). In these studies, various types of questionnaires were administrated to measure individual's cognitive style, such as Awareness for Spatial Orientation (Buzzell et al., 2013), visualization questions (Cui et al., 2007), Verbalizer-Visualizer Questionnaire (Kraemer et al., 2009), Object-Spatial Imagery Questionnaire (Motes et al., 2008).

Meanwhile, Kozhevnikov et al. (2002; 2005) and Blazhenkova and Kozhevnikov (2009) proposed the

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Object-Spatial-Verbal model of cognitive style. According to this model (Blajenkova, Kozhevnikov, & Motes, 2006), a preference for the object style is represented by a preference for information with vivid and pictorial features, while a preference for the spatial style is described by a preference for information by location, spatial relationship, and movement. In addition, a preference for the verbal style is represented by a preference for verbal information.

Previous behavioral and neuroimaging studies have consistently confirmed that Object-Spatial-Verbal cognitive style can better explain individual differences in various types of modality-specific cognitive tasks recruiting visual, verbal, and/or spatial processing (Aggarwal & Woolley, 2013; Hilbert et al., 2015; Occelli, Lin, Lacey, & Sathian, 2014; Oh & Kim, 2016; Pitta-Pantazi, Sophocleous, & Christou, 2013; Shin & Kim, 2015). Interestingly, Shin and Kim (2015) investigated neural correlates of the relationship between individual's preference between Object-Spatial-Verbal cognitive style and cognitive control during a version of the Stroop task (Kim, Johnson, & Gold, 2014; Stroop, 1935). In their study using functional magnetic resonance imaging (fMRI), task-relevant regions related to neural conflict adaptation, including the left dorsolateral prefrontal cortex, left fusiform gyrus, and left precuneus, were strongly activated in accordance with an increase in cognitive style preference for the distracting feature. Based on these results, they suggested that the degree of cognitive control is influenced by the cognitive style preference through enhancing task-relevant processing.

Similarly, Oh and Kim (2016) investigated whether Object-Spatial-Verbal cognitive style was related to task-related processes using a task switching paradigm including object and verbal tasks. Their behavioral results showed that verbal style preference was negatively correlated with the reaction times (RTs) in the contrast between switch and non-switch trials (i.e., switch cost). However, no studies have examined neural evidence on the relationship between the Object-Spatial-Verbal cognitive style and switch cost.

Thus, the aim of the current study is to explore neural correlates of the relationship between cognitive style preference and cognitive control in task switching processes using fMRI. To assess this relationship, the current study administrated the Object-Spatial-Verbal cognitive style model (Blazhenkova & Kozhevnikov, 2009) and a task switching paradigm including object and verbal tasks used in the previous study (Oh & Kim, 2016). The neural and behavioral switch costs were used to determine the relationship between cognitive style preference and cognitive control processing. If the cognitive style preference is related to cognitive control during task switching, a significant correlation is predicted between the neural responses in task-relevant regions and the cognitive style preference in relation to the current task set.

METHOD

Participants

Thirty-five right-handed young adults participated in this study for monetary compensation. Three subjects showing low accuracy (under 70%) were excluded from the analysis. Thus, data from thirty-two subjects were used in analysis (female, n = 15; male, n=17; mean age = 23.63, SD = 1.72). All participants were native Korean speakers and had normal or corrected-to-normal vision without color blindness. All participants had no history of neurological disease or mental disorders. All participants provided written informed consent forms, which were approved by the Brain Science Research Center at the Korea Advanced Institute for Science and Technology (KAIST) in Daejeon, South Korea.

Materials and procedure

The task programming, stimulus presentation, and recording of participants' behavioral responses were carried out using E-Prime 2.0. A switching paradigm that included an object task and a verbal task was used to assess the relationship between cognitive style and cognitive flexibility (Oh & Kim, 2016). The task stimuli consisted of a word and either a square or circle, which were presented simultaneously (see Figure 1). A Korean

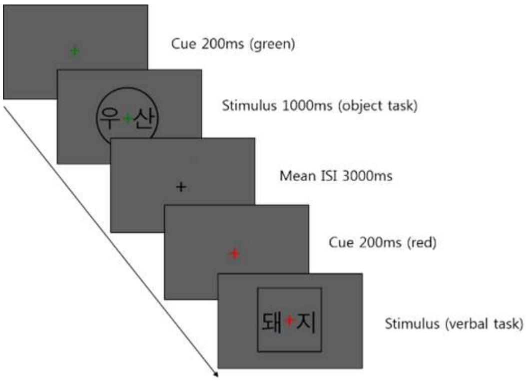

Figure 1. Task stimuli and task procedure. In this example, the first trial is the object task, which is indicated by the green cue. The second trial is the verbal task, which is indicated by the red cue. This example illustrates the verbal switch trial, in which participants switch from the object task to the verbal task. The first word, pronounced “Wu-san,” means “Umbrella.” The second word, pronounced “Dwae-ji,” indicates “Pig.”

word surrounded by a square or a circle was presented at the center of screen on a dark gray background. A black cross was presented as a fixation point at the center of screen during the ISI (inter-stimulus interval) after the response.

In the object task, participants had to indicate whether the object was a square or a circle, while ignoring the word. Before the task stimulus was presented, a green cross (‘+’) was presented as a fixation point at the center of the screen. The green cross was shown to inform participants that the trial that followed would be the object task. In the verbal task, participants had to indicate whether the semantic category of the presented word was living or non-living, while ignoring the object. Before the task stimulus was presented, a red fixation point was presented to indicate that the trial that followed would be the verbal task.

The trial was divided into four conditions by switching and task type: object switch (Object-Sw), object non-switch (Object-Ns), verbal switch (Verbal-Sw), and verbal non-switch (Verbal-Ns). In the switch trials (i.e., Object-Sw and Verbal-Sw), the task type differed between the current trial and the previous trial. Conversely, in the non-switch trials, the previous task type was maintained during the current trial. For example, in the Object-Sw trial, the subject performed the object task following the verbal task. In the Object-Ns trial, the subject performed the object task following the object task. In this way, two behavioral switch costs were calculated according to the task type (object switch cost = Object-Sw - Object-Ns; verbal switch cost = Verbal-Sw - Verbal-Ns).

Prior to starting the experiment, all subjects performed practice trials (41 trials including eight trials for each Object-Sw and Verbal-Sw and twelve trials for each Object-Ns and Verbal-Ns). The experimental task included three sessions of 81 trials, totaling 243 trials. The object and verbal tasks included 120 trials each. The object task and verbal task each included 48 switch trials and 72 non-switch trials. The first trial in each session was excluded from the analysis because it could not be classified as either the switch or non-switch condition. The trial types were administered in a pseudorandom order. The stimuli were presented for 1000 ms, and the cues were presented for 200 ms. The mean ISI was 3,000 ms (range: 1,500 ms - 4,500 ms). Participants responded by using a left or right button press. They were instructed to respond as quickly and accurately as possible.

After completing the experimental task, the participants were administered the Korean version of the Object-Spatial-Verbal cognitive style questionnaire (OSIVQ: Blazhenkova & Kozhevnikov, 2009; Shin & Kim, 2013). It was self-report questionnaire using the 5-point Likert scale to measure an individual preference for the object, spatial, or verbal cognitive style. The preference scores were calculated by averaging each score for the three cognitive styles.

Imaging acquisition

Imaging data were acquired using a 3-T Siemens Verio scanner located at the Brain Science Research Center (KAIST in Daejeon, South Korea). T2*-weighted gradient echo-planar images (EPI) were acquired for the functional image (33 interleaved slices; repetition time (TR) = 2000 ms, echo time (TE) = 28 ms, flip angle (FA) = 90°, matrix size = 64×64, in-plane resolution = 3.5 mm×3.5 mm, thickness = 3.5 mm). Functional scans were composed of three sessions (171 volumes per session). T1-weighted images were also acquired for all participants using a magnetization-prepared rapid gradient-echo (MPRAGE) sequence (TR = 1,800 ms, TE = 2.52 ms, TI = 1100 ms, FA = 9°, field of view (FOV) = 256×256 mm, resolution = 1 mm^3, sagittal partitions).

Image preprocessing and voxel-wise analysis

Imaging data were preprocessed and analyzed using the SPM8 software package (Statistical Parametric Mapping; www.fil.ion.ucl.ac.uk/spm). The first three volumes of each session were eliminated before preprocessing for the magnet's stable state. Temporal differences were adjusted using the slice-timing correction, and then the images were realigned to the first volume of the first session to correct for head motion. These realigned functional images were co-registered with the structural MR images (MP-RAGE) and were spatially normalized to the International Consortium for Brain Mapping (ICBM) 152 template using unified segmentation-based normalization with 12-parameter affine and nonlinear transformations (2-mm cubic voxels). These images were then spatially smoothed with an 8-mm full-width at half-maximum (FWHM) Gaussian kernel.

Statistical analysis at the first level was performed in the context of the general linear model (GLM) using a canonical hemodynamic response function (HRF) with temporal and dispersion derivatives. Four conditions were included in the GLM model: Object-Sw, Object-Ns, Verbal-Sw, and Verbal-Ns. The first trial of each session and the error trials were included in the model as regressors of non-interest. Six head-motion parameters were also included in the model as regressors of non-interest. Then, contrast regressors were created for each participant for each task in order to represent the object and verbal neural switch costs. Object-Sw was contrasted with object-Ns, and verbal-Sw was contrasted with verbal-Ns. The contrast regressors, which reflected the switch cost, were used in the group analysis.

To assess whether the neural switch cost was influenced by the object and verbal cognitive style preference and the behavioral switch cost, the group-level analysis was conducted separately for each neural switch cost. The spatial cognitive style was not included in the analysis because it was unrelated to the task. Thus, two multiple-regression models were analyzed for each neural switch cost. The object and verbal cognitive style score, behavioral switch cost, and interactions among these factors (object cognitive style score×verbal cognitive style score, object cognitive style score×behavioral switch cost, verbal cognitive style score×behavioral switch cost, and ternary interaction) were included in these multiple regression models. For example, the multiple regression model for the object neural switch cost included the object cognitive style score, the verbal cognitive style score, the behavioral switch cost (the object task), the interaction of the object cognitive style score and the verbal cognitive style score, the interaction of the object cognitive style score and the behavioral switch cost (the object task), the interaction of the verbal cognitive style score and the behavioral switch cost (the object task), and the ternary interaction. A statistical threshold of uncorrected $p < 0.001$ at the voxel level and false discovery rate (FDR) correction of $p < 0.05$ at the cluster level were applied to the whole-brain analysis.

RESULTS

The mean accuracy and RTs are presented in Table 1, and the behavioral switch costs are presented in Table 2. The mean accuracy on the object task was significantly higher in the non-switch condition than in the switch condition [$t(31) = -3.649$, $p = 0.001$)], while the mean accuracy on the verbal task did not show a significant difference between the switch condition and the non-switch condition [$t(31) = -1.973$, $p = .058$]. RTs were significant faster in the non-switch condition than in the switch condition on both the object task [$t(31) = 9.842$, $p < 0.001$] and the verbal task [$t(31) = 7.205$, $p < 0.001$].

A correlation analysis was conducted among the scores for the three cognitive styles. There was a negative correlation between the verbal and spatial cognitive style

Table 1. Descriptive statistics on accuracy and reaction times

	Task Condition	Object task		Verbal task		Total	
		Mean	(SD)	Mean	(SD)	Mean	(SD)
Accuracy (%)	Switch	92.94	(7.27)	90.99	(6.38)	91.97	(6.85)
	Non-switch	96.41	(3.13)	92.59	(5.56)	94.50	(4.87)
Reaction times (ms)	Switch	861.35	(174.68)	911.34	(168.15)	886.35	(171.93)
	Non-switch	738.79	(165.67)	814.46	(123.05)	776.63	(149.70)

Table 2. Correlation coefficients between cognitive style and behavioral switch cost and descriptive statistics on behavioral switch costs

	1	2	3	4	5	Total Switch Cost
1. Object style	–					
2. Verbal style	−.154	–				
3. Spatial style	.054	−.469**	–			
4. Object switch cost	−.098	.395*	−.121			
5. Verbal switch cost	.083	−.031	.180			
Mean	3.30	3.12	3.10	122.56	96.88	109.72
(SD)	(0.58)	(0.69)	(0.90)	(70.44)	(76.07)	(73.86)

** $p < 0.01$, * $p < 0.05$

scores ($r = -0.469$, $p < 0.01$). In addition, a correlation analysis was conducted to assess the relationship between the behavioral switch costs and the cognitive style scores. A positive correlation was detected between the object switch cost and the verbal cognitive style score ($r = 0.395$, $p < 0.05$). No correlations were found among

Table 3. Stepwise regression analysis for the interaction between the object and verbal cognitive style scores, and the object and verbal behavioral switch costs

	Step	Variable	B	SE	B	R2	ΔR2
Object switch cost	1	Object	−11.983	22.126	−.098	.010	–
	2	Object	−4.699	21.008	−.039	.157	.148*
		Verbal	39.876	17.685	.389*		
	3	Object	−5.473	21.553	−.045	.159	.002
		Verbal	41.417	18.901	.404*		
		Object×Verbal	7.277	27.576	.049		
Verbal switch cost	1	Verbal	−3.453	20.203	−.031	.001	–
	2	Verbal	−2.081	20.729	−.019	.007	.006
		Object	10.595	24.623	.081		
	3	Verbal	7.230	21.438	.065	.073	.065
		Object	5.919	24.446	.045		
		Verbal×Object	43.972	31.277	.273		

*$p < 0.05$

other factors (ps > 0.05).

In order to find interactions between the object cognitive style scores and the verbal cognitive style scores, stepwise regression analyses were conducted on both behavioral switch costs in RTs. However, the results demonstrated no significant interactions with either behavioral switch cost (see Table 3).

The fMRI analyses were conducted to find regions associated with the two cognitive styles, the behavioral switch cost, and their interaction. The associated regions are presented Figure 2 and listed in Table 4. For the neural switch cost of the object task, a significant positive correlation with the object cognitive style score was detected in the right posterior cingulate cortex expanding into the adjacent precuneus (PCC/Precuneus) and in the left intraparietal sulcus (IPS). In addition, there was a significant negative correlation with the interaction of the object cognitive style score and the

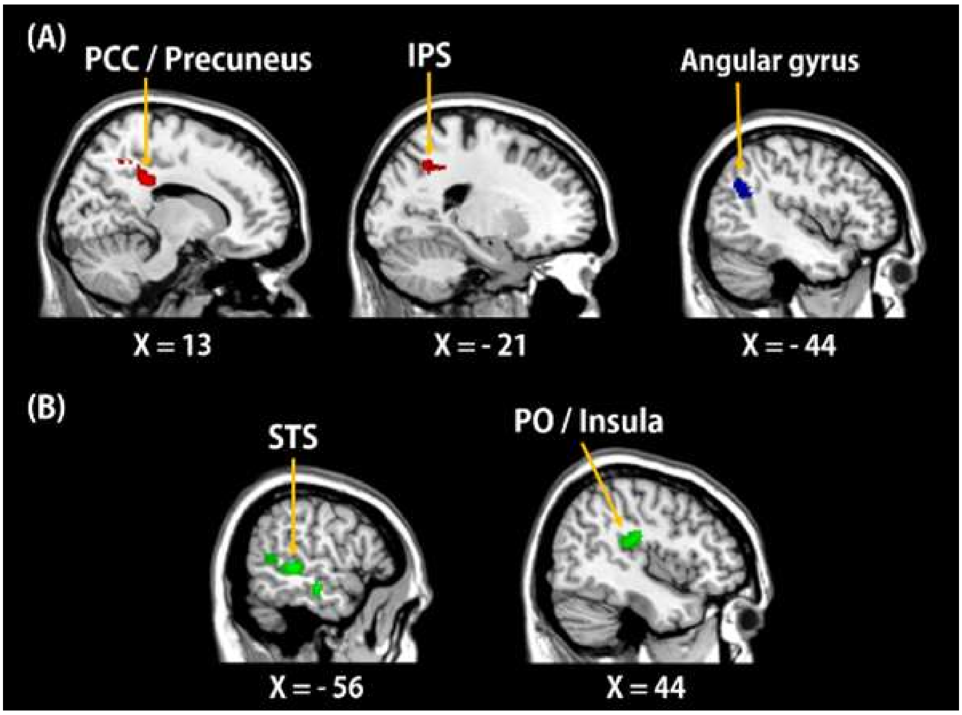

Figure 2. Regions associated with cognitive style preference or behavioral switch cost. (A) Regions associated with the object neural switch cost. The red clusters, the right PCC/Precuneus and left IPS, showed significant positive correlations with the object cognitive style score. The blue cluster, the left angular gyrus, had a significant negative correlation with the interaction of the object cognitive style and the verbal cognitive scores. (B) Regions associated with the verbal neural switch cost. The left STS and the right parietal operculum expanding into the insula, showed significant negative correlations between neural and behavioral switch costs in the verbal task.

Table 4. Clusters related to the neural switch cost

Task	Correlation	Region	L/R	BA	MNI coordinates			size	z-score
					X	Y	Z		
Object	Object style	PCC/Precuneus	R	31	14	−36	32	251	4.57
		IPS	L	7	−23	−56	44	232	3.97
	Object×Verbal style	Angular gyrus	L	39	−32	−52	28	533	5.01
Verbal	RT switch cost	STS	L	21	−56	−36	0	558	4.29
		PO/Insula	R	43	42	−26	22	293	4.26

Note. PCC, posterior cingulate cortex; IPS, intraparietal sulcus; STS, superior temporal sulcus; PO, parietal operculum.

verbal cognitive style score in the left angular gyrus. No other correlations were detected. For the neural switch cost of the verbal task, a significant negative correlation with the behavioral switch cost was found only in the left superior temporal sulcus (STS) and the right parietal operculum expanding into the insula (PO/Insula). There were no other correlations with the cognitive style in the verbal task.

DISCUSSION

This study investigated neural contribution to the relationship between cognitive control and cognitive style preference using a task switching paradigm. The behavioral results demonstrated that individuals with higher preference for the distractor-relevant cognitive style showed higher switch cost in the object task, while no relationship between cognitive style preference and behavioral switch cost was found in the verbal task. This might be due to the fact that task requirements were different in the two tasks. For instance, the object task included only two stimuli and participants had to recognize them whreas the verbal task required participants to categorize various words into living or non-living ones, which might recruit additional processes. Similarly, imaging results showed that the neural switch cost in the object task had a relationship with cognitive style preference but not with the behavioral switch cost. In contrast, in the verbal task, the neural switch cost had a relationship not with cognitive style preference but with the behavioral switch cost. We presume that this might be caused by asymmetry in the task requirements.

The imaging results showed a positive correlation between the target-relevant cognitive style (i.e., object style) preference and the neural switch cost in the PCC/Precuneus and the left IPS in the object task. An interaction was also detected between the preference for the target-relevant cognitive style (i.e., object style) and the preference for the distractor-relevant cognitive style (i.e., verbal style) in the left angular gyrus. In contrast, there was no relationship between the neural switch cost and the preference for a particular cognitive style in the verbal task, yet a negative correlation between the neural and behavioral switch costs was observed in the left STS and the right PO/Insula. The following discussion focuses on the functions of the observed regions. The results in the object task are discussed first because the relationship between cognitive control and cognitive style preference was observed only in the object task.

First, a positive correlations between the preference for the object cognitive style and the neural switch cost in the object task was found in the PCC/Precuneus. Namely, the more a subject preferred the object cognitive style, the less deactivation occurred in the PCC/Precuneus during the trials switching from the verbal to the object task. The PCC/Precuneus is known to be a region in the default mode network (DMN), which is activated during the resting state but deactivated while performing an attention-demanding task (Fransson & Marrelec, 2008; Raichle et al., 2001; Song et al., 2009). In particular, this region is regarded as a crucial hub node in the DMN and could mediate intrinsic activity throughout the DMN (Fransson & Marrelec, 2008).

Previous studies have reported that individual differences including intelligence and verbal fluency are associated with the level of deactivation in the PCC/Precuneus (Cao et al., 2009; Lipp et al., 2012). For instance, Lipp et al. (2012) investigated the relationship between neural activations and visuo-spatial intelligence using a mental rotation task. They found that participants who had lower visuo-spatial intelligence scores showed stronger deactivation in the PCC/Precuneus compared to participants who had higher visuo-spatial scores. These studies suggest that individuals with a high task-relevant ability may show less deactivation in the PCC/Precueneus during an attention-demanding task than individuals with a lower task-relevant ability. Given that these studies reported a close association between cognitive style preference and the ability to perform the related tasks (Kozhevnikov, Blazhenkova, & Becker, 2010; Shin & Kim, 2013), the preference for modality-specific information might be related to the use of mental resources, similar to the task-relevant ability. Therefore, we speculate that the current results suggest that individuals who prefer the target-relevant cognitive style could require fewer attentional resources for task switching.

Second, the IPS is involved in the selection of target-relevant information and target-related control processes rather than the selection of the appropriate response and preparation processing (Brass & von Cramon, 2002, 2004). Considering that cognitive style is related with stimulus processing, the positive correlation between the neural switch cost and the preference for the target-relevant cognitive style in the IPS might be associated with a positive relationship between target-relevant cognitive style and target-relevant control processes in the object task. This is consistent with previous studies that reported positive relationships between modality-specific processing and the preference for the task-relevant cognitive style (Hilbert et al., 2015; Zarnhofer et al., 2013; Zarnhofer et al., 2012).

Third, an interaction between the target-relevant object cognitive style and the distractor-relevant verbal style was found in the neural switch cost in the left angular gyrus. This indicates that the effect of the preference for the distractor-relevant style diminished in parallel with the increase in preference for the target-relevant style. Considering that most of the studies reported that preference for either target-relevant (Hilbert et al., 2015; Kraemer et al., 2014; Kraemer et al., 2009; Motes et al., 2008; Zarnhofer et al., 2013; Zarnhofer et al., 2012) or distractor-relevant cognitive style (Buzzell et al., 2013; Shin & Kim, 2015) is related to cognitive processing, the current result is the first to show an interaction between the two cognitive styles that might be related to cognitive processing. For instance, the left angular gyrus is known to be involved in verbal semantic processing (Binder & Desai, 2011; Binder, Desai, Graves, & Conant, 2009; Seghier, 2013), as well as visual perception and visual mental imagery (Ganis, Thompson, & Kosslyn, 2004). This may support that the activity of the angular gyrus in relation to both target and distractor processing is influenced by the cognitive style preference.

Meanwhile, a negative correlation between the behavioral and neural switch costs was found in the left STS and the right PO/Insula when the task was switched from the object task to the verbal task. The left STS is known to be play an important role in the semantic processing of visual words (Binder et al., 2009), which includes conceptual and perceptual processing (Fodor, 1983). The right PO/Insula is known to be selectively activated when top-down and bottom-up attentional control signals are directed to the same stimulus (Corradi-Dell'Acqua, Fink, & Weidner, 2015). Therefore, the negative correlation between the behavioral and neural switch costs in the left STS and the right PO/Insula may be associated with stimulus processing and the congruence of top-down and bottom-up control signals during task switching. This is consistent with previous studies, which reported that the activity of the task-related region is associated with task performance (Perfetti et al., 2011; Ress, Backus, & Heeger, 2000; Stern, Wager, Egner, Hirsch, & Mangels, 2007) and that bottom-up and top-down signals affect task performance simultaneously (Kiss, Grubert, Petersen, & Eimer, 2012).

Although the current study provides evidence of the relationship between cognitive style preference and task switching, it is important to note that several issues still remain. First, the relationship between cognitive style preference and switch cost was not detected in the verbal task. This relationship might be detected in an automatic reading. The behavioral switch cost in the verbal task was relatively lower and its standard deviation relatively greater than that in the object task. Therefore, cognitive style might have an influence on task switching processing when there is some level of switch cost. Second, behavioral results were incongruent with the neural results in the object task. It is likely that individuals with high preference for the verbal style have weaker cognitive control during the object task. Consequently, the neural results suggest that control processing might be absent.

Third, although the current study focused on individual differences in neural responses, the number of participants was relatively small. This may be a caveat that generalize the current findings to the population. In detail, while a total of 83 participants' data were included in the previous behavioral study, the current study had a relatively small sample (N=32). This could have yielded in differences in the behavioral data between the two studies. Namely, the previous study showed a significant relation between verbal preference and the switch cost in the verbal task, but the current study showed a significant relation between verbal preference and the object switch cost. Thus, future studies should consider aforementioned limitations.

In conclusion, the current study found that the cognitive style preference is related to neural activations associated with cognitive control during task switching. These findings provide evidence that cognitive style preference may be related to attentional allocation, selection, and the processing of target- and distractor-relevant information during task switching.

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과제전환 동안의 대상 및 언어 인지양식의 신경상관

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본 연구는 과제전환 동안에 관여하는 인지양식의 개인차를 신경 상관을 통해 확인하고자 하였다. 기능적 자기공명영상을 이용하여 대상 및 언어과제로 구성된 과제전환 패러다임을 수행하는 동안 개인의 신경반응을 수집하였고, 이후 개인의 인지양식 선호점수와 전환비용 간 상관분석을 분석하였다. 총 35명의 젊은 성인이 본 연구에 참여하였다. 행동결과에서 언어선호 점수는 언어과제에서 대상과제로 전환할 때의 전환비용과 정적 상관을 보였다. 대상과제를 수행하는 동안의 신경반응에서는 대상양식에 대한 선호와 신경 전환비용 간에 정적 상관이 후측 대상피질 및 쐐기앞소엽, 좌반구 두정내구에서 관찰되었다. 또한 각회에서는 언어 및 대상 인지양식 선호 간 상호작용에 대한 뇌활동이 관찰되었다. 이러한 결과는 과제전환에서 인지양식 선호가 어떻게 신경반응에서의 차이와 관련되는지를 보여준다. 본 연구 결과를 바탕으로, 과제전환 시 인지양식에 대한 선호가 주의자원 할당과 선택, 그리고 목표자극 및 방해자극 처리와 관련될 수 있음을 논의하였다.

주제어: 과제전환, 기능적 자기공명영상, 인지양식, 전환비용