Supplementary Note

Expanded Discussion of Behavioral Results

Initial analyses of reaction time (RT) and errors confirmed the efficacy of the four control manipulations. Judgment Specificity reliably impacted RT, such that Feature judgments took longer than Relatedness judgments (Exp. 1: $F(1,21) = 70.6$, $p < .0001$; Exp. 2: $F(1,10) = 114.1$, $p < .0001$; Fig. 2A), indicating that RT slowed as putative selection demands increased. Though errors were slightly higher during Related (12% errors) than Feature judgments (10% errors) in Exp. 1 ($F(1,21) = 8.1$, $p < .01$), there was no such difference in Exp. 2 ($F(1,10) = 2.7$, $p = .13$).

Cue–target Associative Strength impacted both RT and errors. RT was longer (Exp. 1: $F(1,21) = 17.5$, $p < .0005$; Exp. 2: $F(1,10) = 171.4$, $p < .0001$) and errors were higher (Exp. 1: $F(1,21) = 7.5$, $p < .05$; Exp. 2: $F(1,10) = 60.9$, $p < .0001$) when one of the targets was a Weak associate of the cue than when one of the targets was a Strong associate (Fig. 2B). The crossing of Associative Strength with Judgment Specificity in Exp. 1 revealed a reliable interaction (RT: $F(1,21) = 11.4$, $p < .005$; errors: $F(1,21) = 5.4$, $p < .05$), with the effects of Associative Strength being reliable during Relatedness judgments (RT: $F(1,21) = 36.4$, $p < .0001$; errors: $F(1,21) = 12.1$, $p < .002$) but not during Feature judgments (RT: $F = 1.6$; Errors: $F < 1$). This pattern is consistent with Associative Strength impacting controlled retrieval demands during the Relatedness task, but not during the Feature task (which requires selection of specific stimulus features).

Number of Targets impacted performance, such that selecting from amongst Four targets in Exp. 2 slowed RT ($F(1,10) = 9.1$, $p < .05$) and increased errors ($F(1,10) = 4.7$, $p = .055$; Fig. 2B) relative to when there were Two targets. Number of Targets and

Associative Strength did not interact ($F < 1$). Importantly, central to a subsequent analysis conducted to rule out time-on-task accounts of the fMRI data, there was no behavioral difference between Weak–Two vs. Strong–Four trials (RT: $F < 1$; Errors: $F(1,10) = 1.6$, $p = .23$). Finally, the Congruency manipulation of selection demands affected both RT and errors, such that RT slowed (Exp. 1: $F(1,21) = 66.2$, $p < .0001$; Exp. 2: $F(1,10) = 142.9$, $p < .0001$) and Errors increased (Exp. 1: $F(1,21) = 21.1$, $p < .0005$; Exp. 2: $F(1,10) = 24.9$, $p < .0005$) on Incongruent than Congruent trials (Fig. 2C).

The Non-Selection Component

The Non-Selection Component did not account for variance in the Congruency manipulation, but loaded strongly on the effects of Associative Strength and Judgment Specificity (Fig. 3). A conjunction analysis (conjoint alpha = .0025) between the correlation of the Non-Selection Component and the Associative Strength and the Judgment Specificity neural effects revealed convergent activation in left fronto-polar cortex (FPC; -42 45 –3), well rostral to the anterior VLPFC region selectively sensitive to Associative Strength (Fig. 4D).

Though the present focus was on left VLPFC, it may be of some interest that this analysis implicated FPC, a region that was also shown to be sensitive to Judgment Specificity (Fig. 4D). One possible account for this pattern is that FPC mediates episodic retrieval of the instructed task goal, a demand that is greater during Feature trials because the semantic dimension changed with each Feature block. Hence, subjects had to remember which feature was relevant for the current block of Feature trials based on the most recently encountered instruction. Another possibility, supported by recent studies of FPC function (Bunge et al., 2005; Braver and Bongiolatti, 2002; Koechlin et al., 1999), is that FPC is engaged in an integration (and/or subgoaling) function whereby retrieved information about each cue-target pair is further processed with respect to maintained goal criteria. Such demands might be greater during Feature relative to Related trials, and also on Weak relative to Strong trials. Further research will be required to verify whether these or other conceptualizations of FPC function can account for why behavioral variance indexed by the Non-Selection meta-variable, on which both the Associative Strength and Judgment Specificity manipulations loaded heavily, was associated with functional variance in left FPC. Furthermore, such theories might also address how this FPC mechanism interacts with the controlled retrieval and selection mechanisms associated with VLPFC.

References

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Braver, T. S., & Bongiolatti, S. R. (2002). The role of frontopolar cortex in subgoal processing during working memory. Neuroimage 15, 523-536.

Koechlin, E., Basso, G., Pietrini, P., Panzer, S., & Grafman, J. (1999). The role of the anterior prefrontal cortex in human cognition. Nature 399, 148-151.

Supplementary Table 1. PFC foci from the principal control contrasts.

	Stereotaxic Coordinates			~Brodmann's	
Contrast	**X**	**Y**	**Z**	**Area**	**Peak Z**
Incongruent - Congruent (Exp. 1 & Exp 2 Conj.)					
Left Posterior VLPFC/Premotor	-39	3	27	6/44	2.3
Left Posterior VLPFC	-42	9	21	44/6	2.5
Left Post./Mid-VLPFC	-54	12	18	45/44	2.8
Left Premotor	-21	15	60	8/6	3.4
Left Mid-VLPFC	-48	18	18	45	2.8
Left Operculum	-30	27	-18	47	3.8
Left Mid-VLPFC	-54	30	12	45	2.4
Left PreSMA	-3	33	48	8	2.0
Left (Dorsal) Anterior VLPFC	-45	39	3	45	2.5
Right Operculum	30	24	-15	47	3.2
Weak - Strong (Exp. 2)					
Left Premotor	-45	9	51	6/8	4.5
Left Posterior VLPFC	-51	9	33	44/6	5.2
Left Premotor	-39	12	48	6/8	4.7
Left Post./Mid-VLPFC	-42	12	18	45/44	4.3
Left Mid-VLPFC	-48	15	24	45/44	4.4
Left Mid-VLPFC	-51	21	21	45	4.0
Left ACC	-9	21	42	24/32	5.0
Left Mid-VLPFC	-45	27	15	45	4.4
Left Anterior VLPFC	-51	27	-3	47	4.3
Left Operculum	-33	27	-6	47	4.8
Left Mid-VLPFC	-48	30	12	45	4.3
Left Anterior VLPFC	-48	30	-12	47	3.4
Left Operculum	-36	30	-3	47	4.7
Left Anterior VLPFC/FPC	-45	42	-9	47/10	3.6
Right Motor/Premotor	33	0	57	4/6	3.5
Right Post./Mid-VLPFC	42	12	27	45/44	3.3
Right PreSMA	6	21	51	8	4.5
Right ACC	9	30	12	24/32	3.3
Right Operculum	36	30	-9	47	4.4
Feature - Related (Exp. 1 & Exp 2 Conj.)					
Left Posterior VLPFC	-45	6	15	44/6	3.2
Left Premotor	-48	9	45	6/8	2.4
Left Posterior VLPFC	-48	9	18	44/6	3.2
Left Post./Mid-VLPFC	-51	12	27	45/44	3.3
Left Premotor	-27	18	57	6/8	3.2
Left PreSMA	-6	21	51	8	2.6
Left Mid-VLPFC	-45	27	15	45	3.5
Left PreSMA	-6	30	42	8	2.3
Left Mid-VLPFC	-42	33	9	45	3.8
Left Orbital Frontal	-36	42	-15	11/47	2.5
Left FPC	-45	45	-3	10/46	2.9
Right Premotor	30	15	45	6/8	2.3
Right Premotor	33	18	57	6/8	3.0
Right Premotor	39	21	51	6/8	2.5
Right Mid-VLPFC	54	21	27	45	3.5
Right Mid-VLPFC/DLPFC	54	36	21	45/46	2.8
Right FPC	48	42	6	10/46	3.3

Note: Ventrolateral Prefrontal Cortex (VLPFC); Dorsolateral Prefrontal Cortex (DLPFC); Pre-Supplementary Motor Area (PreSMA); Anterior Cingulate Cortex (ACC); Fronto-Polar Cortex (FPC)