

Introduction

The picture-word interference (PWI) paradigm has been widely used to inform theories on lexical selection and, in particular, the issue of whether lexical selection is a competitive process. The evidence obtained thus far with various experimental conditions is mixed and, furthermore, discrepant results have been found across laboratories even when the same experimental conditions were applied.

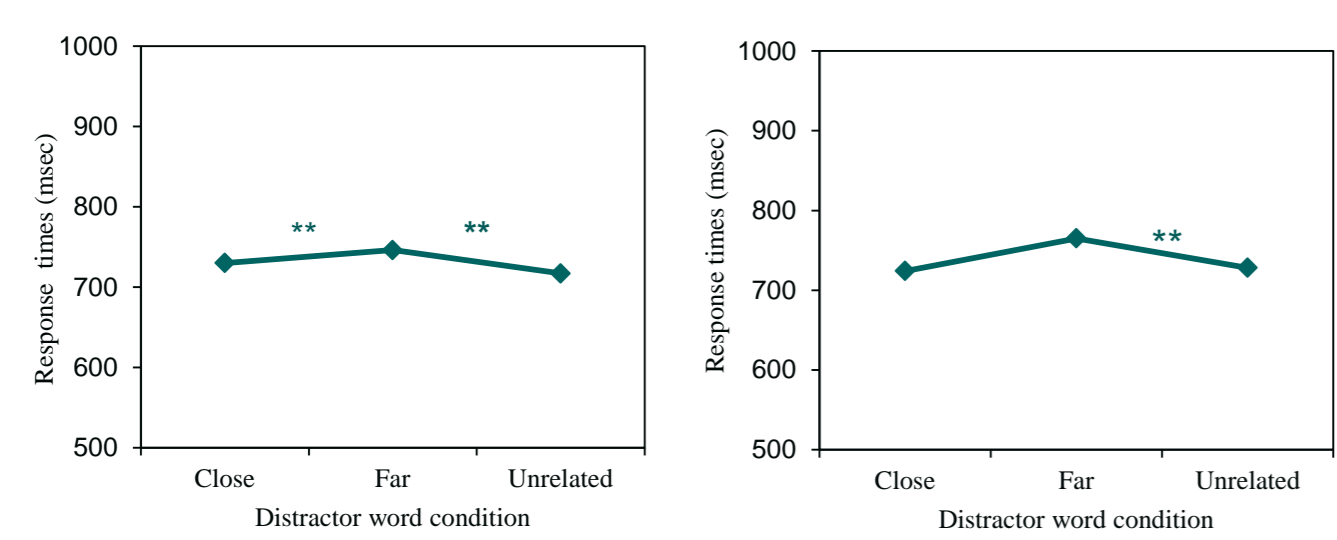
Using the PWI paradigm in a picture naming task with distractor words that were either semantically close, semantically far, or unrelated to the target word, Mahon et al. (2007) observed faster naming responses with semantically close in comparison with semantically far distractors. Decreasing the semantic distance between distractor and target words thus produced a *facilitation* effect on target naming (see Figure 1). In a pilot experiment using the same paradigm and conditions, we failed to replicate this facilitation effect (see also Lee & de Zubicaray, 2010; Vigliocco et al., 2004) and, in fact, we found a significant *interference* effect, namely, slower naming responses with semantically close compared to semantically far distractor words (see Figure 1). Looking at individual data, we noted that, although most participants showed the interference profile, 31% of them showed the reverse profile (i.e., facilitation).

Here we envisage the possibility that these discrepant results are due to participant sampling bias. In particular, we put forward the hypothesis that the effect of decreased semantic distance between distractor and target words is modulated by the individual's inhibitory capacity. We tested this hypothesis by presenting to the same participants a PWI naming task and two non-verbal tasks aimed at measuring their inhibition capacity. We predicted that participants with higher inhibition capacities should show less interference effect (or even a facilitation effect) than individuals with poorer inhibition capacities when naming target pictures with semantically close compared to semantically far word distractors.

Effect of semantic distance: Previous results

Experiment 5 (Mahon et al., 2007)
 20 participants
 20 pictures – 80 stimuli
 Semantic similarity:
 Close = 5.3 Far = 3.9
 Unrelated = 1.3
 Full within-item design

Experiment 7 (SOA 0 msec)
 16 participants
 36 pictures - 144 stimuli
 Semantic similarity:
 Close = 5.3 Far = 3.3
 Unrelated = 1.3
 Full within-item design

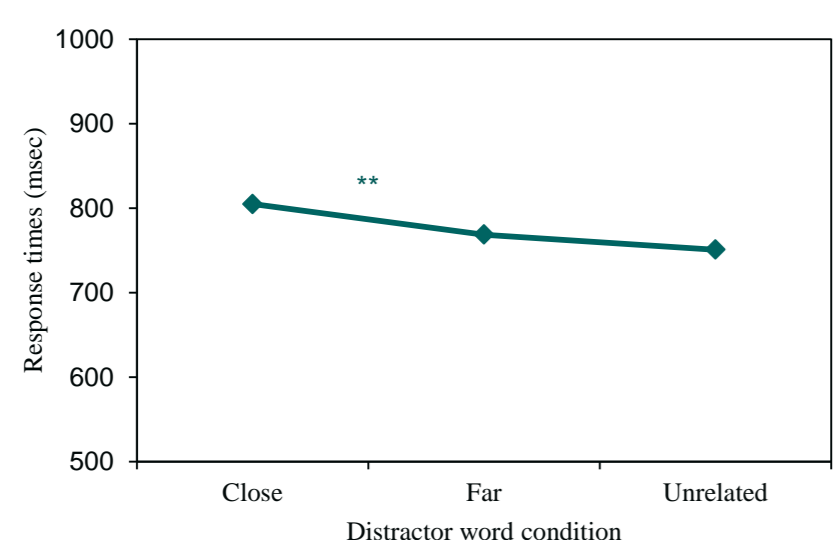


$F_1(2, 38) = 17.7, p < .001, \eta^2 = .48$
 $F_2(2, 38) = 13.2, p < .001, \eta^2 = .41$

$F_1(2, 90) = 20.2, p < .001, \eta^2 = .31$
 $F_2(2, 210) = 10.3, p < .001, \eta^2 = .09$
 (results for different SOA)

Pilot experiment

39 participants
 42 pictures – 126 stimuli
 Semantic similarity:
 Close = 5.8 Far = 3.6 Unrelated = 1.3
 Counterbalanced, within-item design



$F_1(1.71, 65.03) = 15.49, p < .001, \eta^2 = .29$
 $F_2(2, 82) = 6.22, p < .01, \eta^2 = .13$

Figure 1. Discrepant effects of semantic distance in two Mahon et al.'s (2007) experiments and our pilot experiment. ** $p < .01$

Method

36 participants (27 females; mean age=21.9, SD=1.9)

Picture-Word Interference (PWI) task

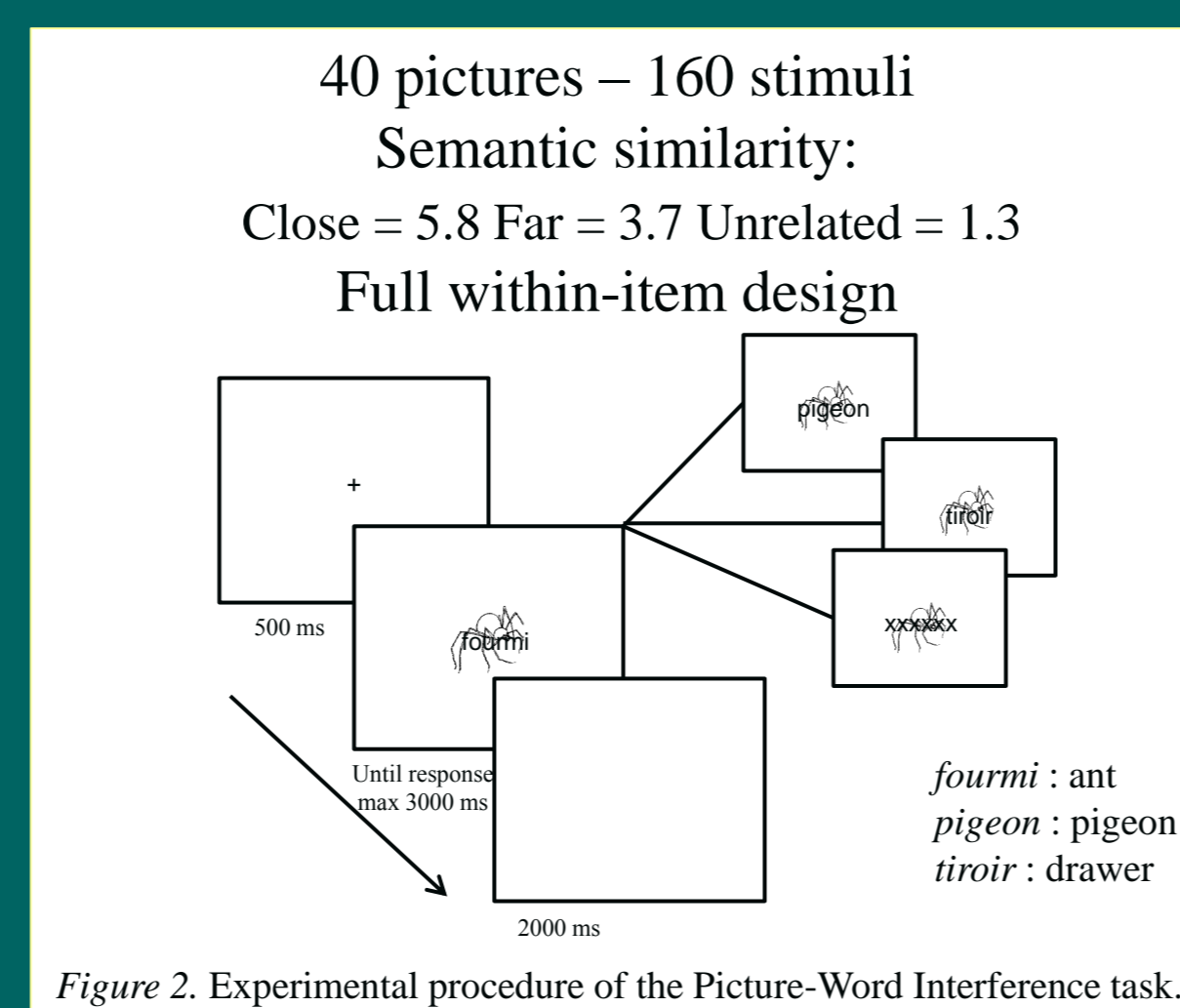


Figure 2. Experimental procedure of the Picture-Word Interference task.

Shape-Shape Interference (SSI) task

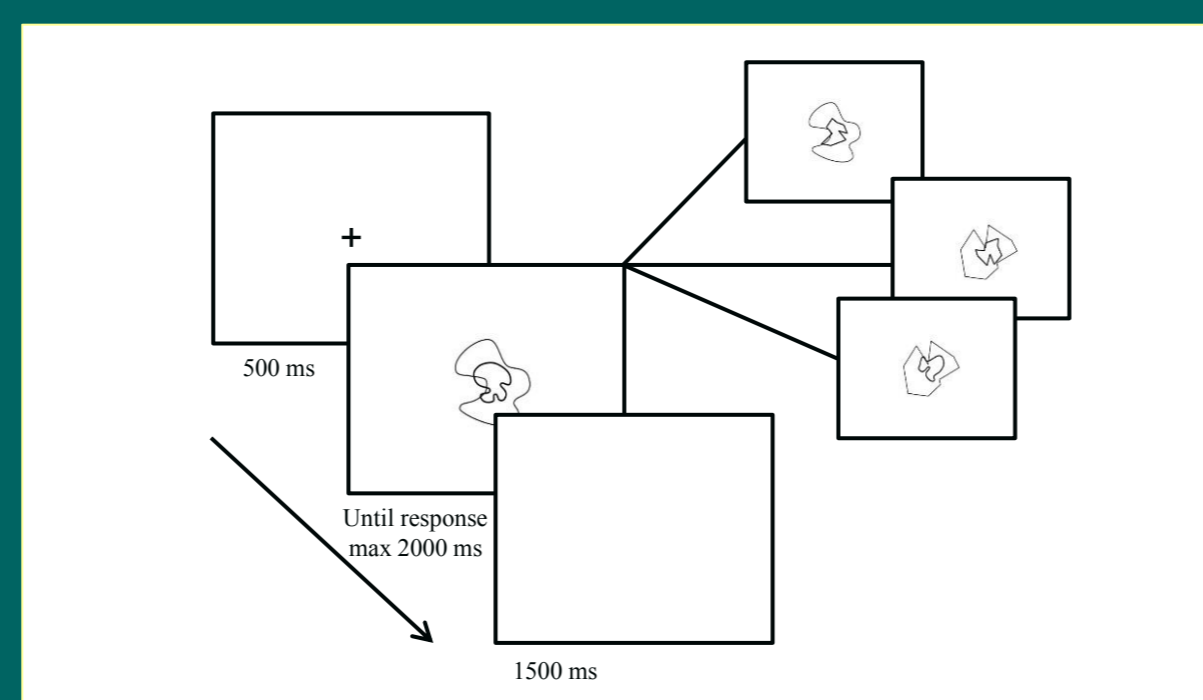


Figure 3. Experimental procedure of the Shape-Shape Interference task.

Incompatibility (I) task

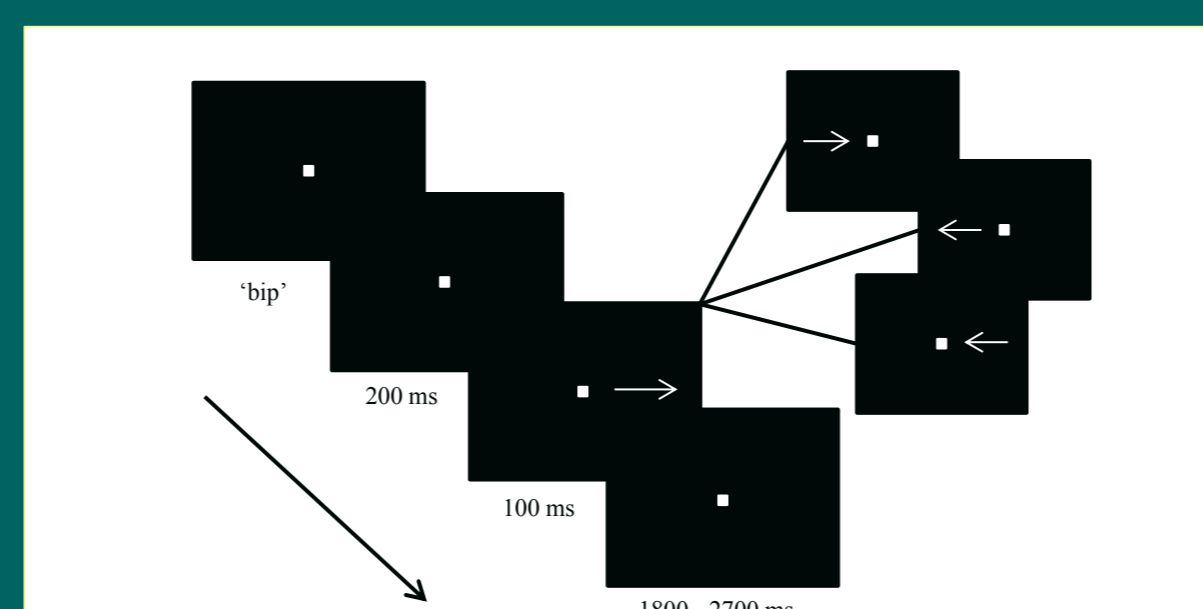


Figure 4. Experimental procedure of the Incompatibility task (Zimmerman & Fimm, 2009)

Results

Picture-Word Interference task

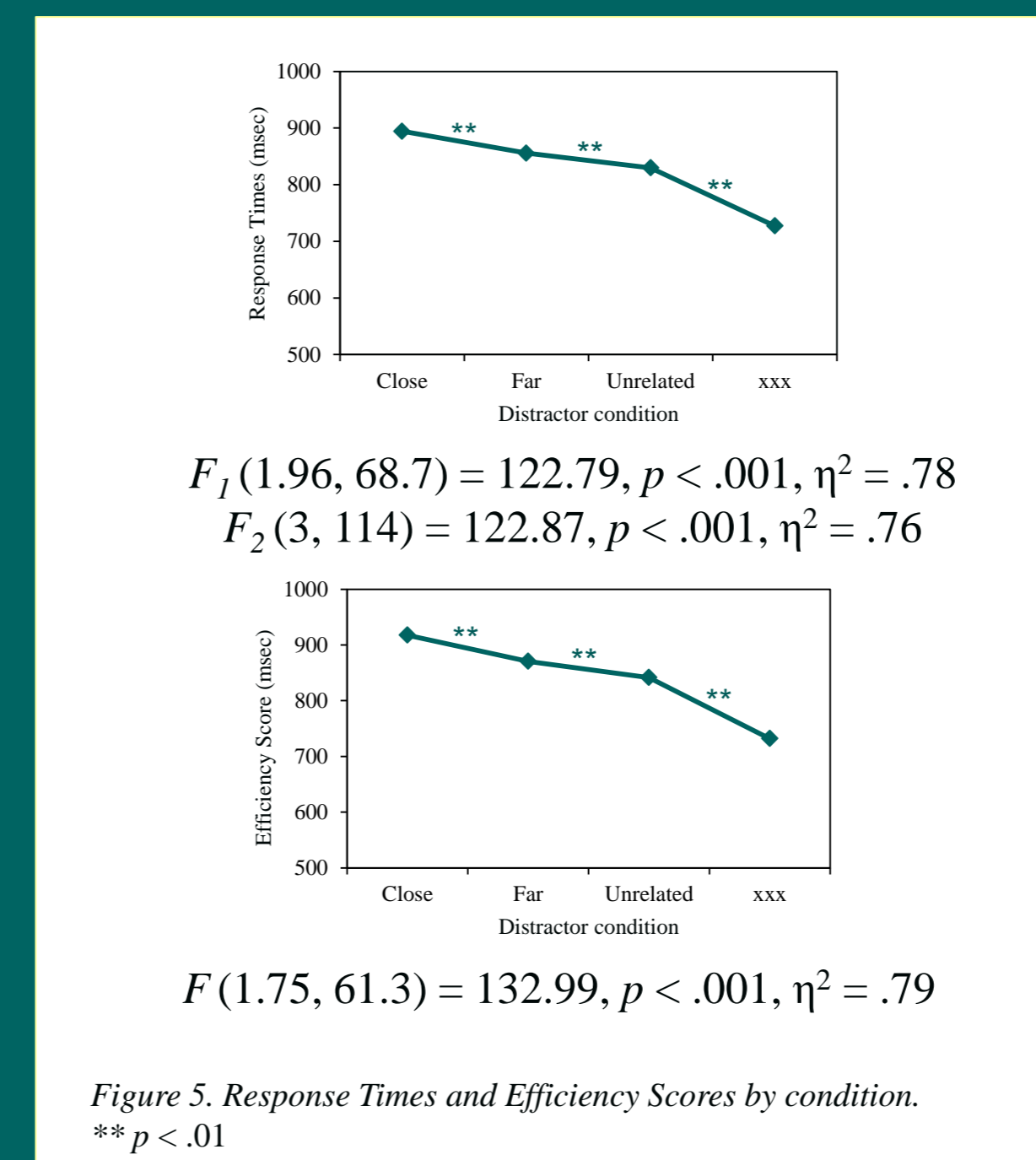


Figure 5. Response Times and Efficiency Scores by condition. ** $p < .01$

Non-verbal Inhibition tasks

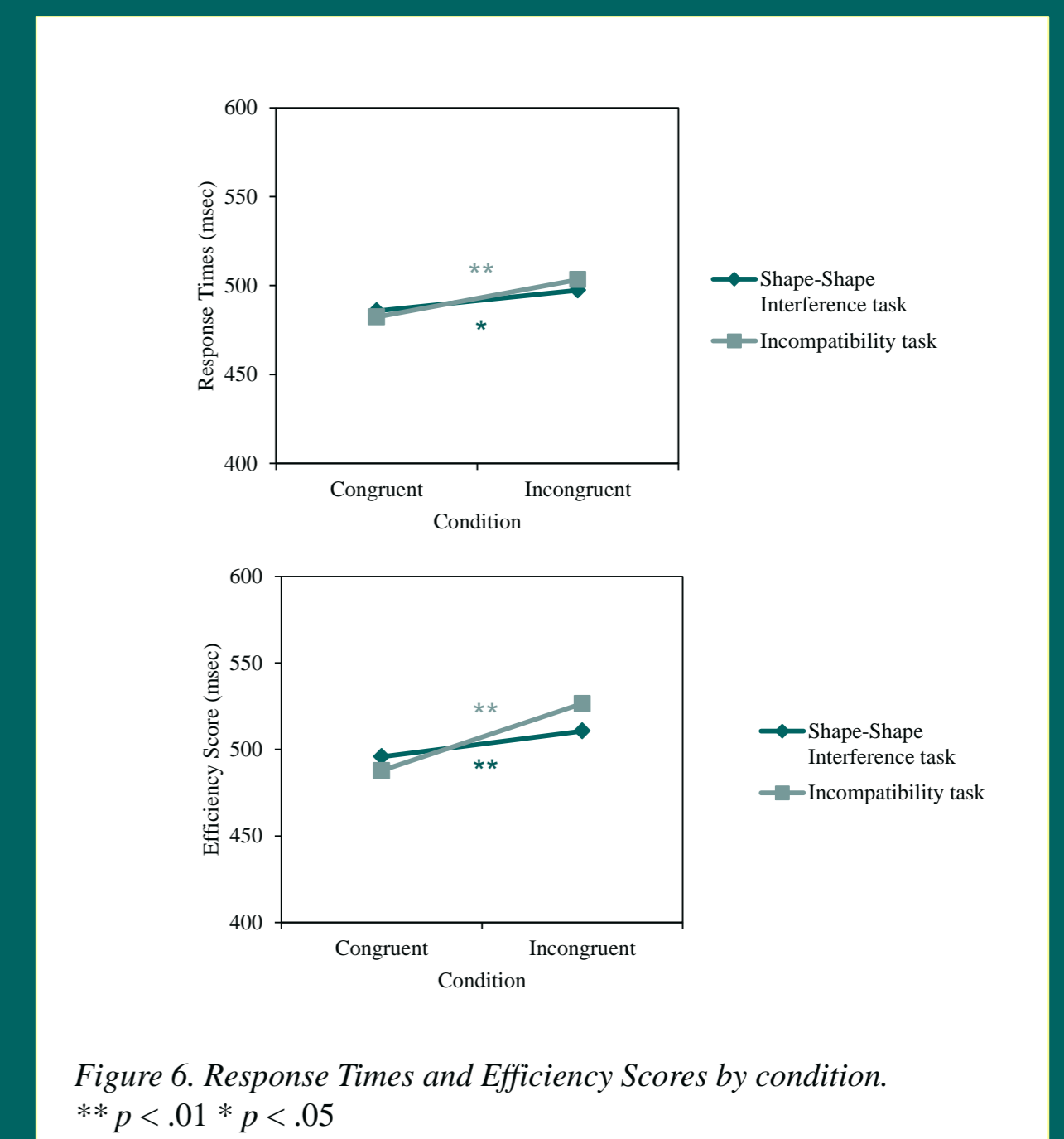


Figure 6. Response Times and Efficiency Scores by condition. ** $p < .01$ * $p < .05$

Correlation analyses

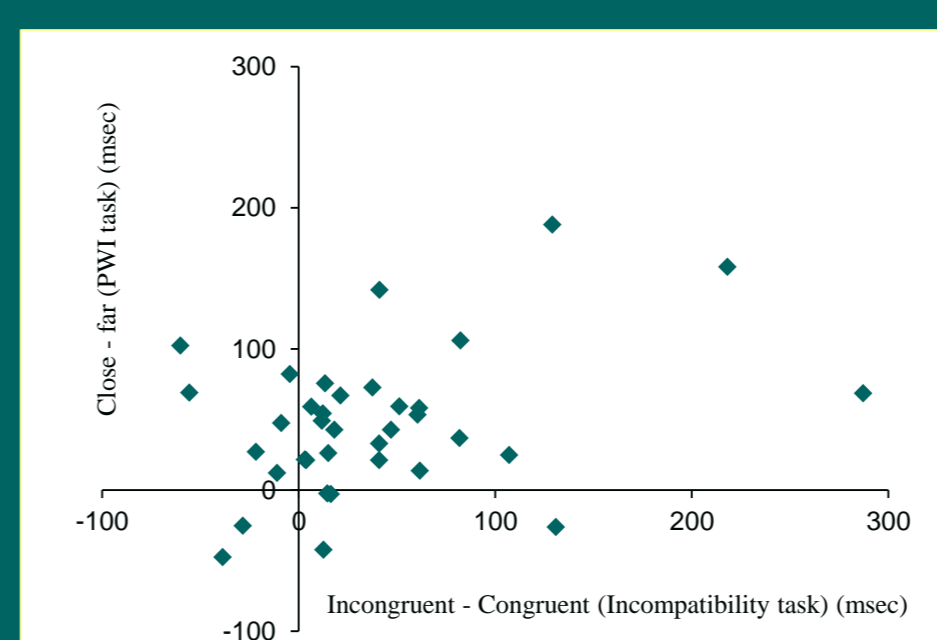


Figure 7. Relation between the distance effect in the PWI task and the Incongruity effect in the I task.

Table 1
 Correlations between the participants' performance (RT and ES) in the Shape-Shape interference task and the Incompatibility task for the Congruent/Incongruent conditions and the Incongruity effect.

	Response Times	Efficiency Score
Congruent	$r = .56, p < .01$	$r = .50, p < .01$
Incongruent	$r = .50, p < .01$	$r = .46, p < .01$
Incongruity effect (Incongruent - Congruent)	$r = .02, p = .89$	$r = .17, p = .30$
Relative incongruity effect (Incongruent-Congruent/Incongruent+Congruent)	$r = .02, p = .92$	$r = .17, p = .32$

Table 2
 Correlations between the semantic distance effect in the PWI task (Close-Far condition) and the Incongruity (Incongruent-Congruent) effect in the Shape-Shape Interference and Incompatibility tasks.

		Difference between close and far conditions in the PWIT
Response Times	Incongruity effect in the SSI task	$r = -.04, p = .81$
	Incongruity effect in the I task	$r = .39, p < .05$
Efficiency Score	Incongruity effect in the SSI task	$r = .08, p = .64$
	Incongruity effect in the I task	$r = .35, p < .05$

Discussion

These preliminary results indicate that the extra processing cost caused by decreasing the semantic distance between the distractor word and the target word in the PWI paradigm is partly explained by *non-verbal* inhibition capacities.

Non-verbal inhibition mechanisms can modulate word production in the PWI paradigm either at a pre-lexical processing level (e.g., suppressing the processing of the distractor word) or at a post-lexical level (e.g., suppressing the erroneously selected distractor word as response) or both. Alternatively, lexical selection processes may involve inhibition mechanisms that are shared between verbal and non-verbal domains.

This study underscores the need for investigating in future studies how and when domain-general cognitive processes contribute to the efficiency of word production.

Multiple regressions and ANOVAs by group (higher vs. lower inhibition capacity)

- The semantic distance effect is significantly predicted by the incongruity effect in the Incompatibility task (see Table 3).

- The differences between the close, far, unrelated conditions and the xxx condition are also all significantly predicted by the Incongruity effect in the Incompatibility task (beta = .36 to .48, all $p < .05$).

- When the group of participants is splitted into 2 groups (higher/poorer inhibition capacity), there is a significant effect of distractor type ($F(1.85, 65.9) = 143.93, p < .001, \eta^2 = .81$) and a significant interaction ($F(1.85, 65.9) = 3.88, p = .029, \eta^2 = .10$).

Table 3
 Regression characteristics and results.

Regression type	Stepwise
Predictors entered in the analysis	- Age - Performance (ES) in the xxx Condition PWI task - Incongruent-Congruent (ES) SSI task - Incongruent-Congruent (ES) I task
Results	$F(1, 35) = 4.69, p = .037, \beta = .348, r^2 = .09$

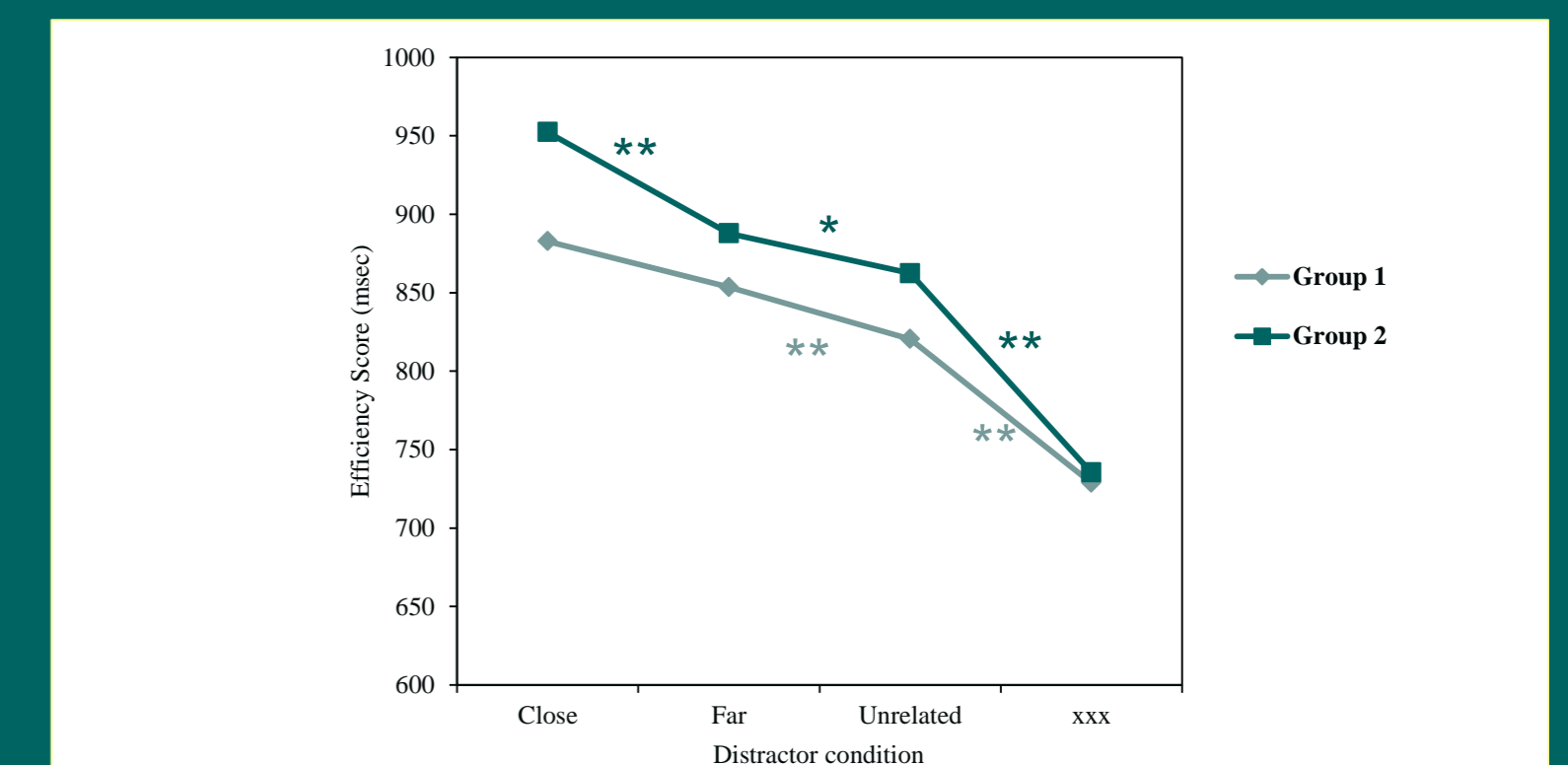


Figure 8. Participants' Response Times and Efficiency Scores in the 4 conditions of the PWI task, according to their having higher (Group 1) vs. poorer (Group 2) inhibition capacity (cut-off= median Incongruity Effect in the Incompatibility task) ** $p < .01$ * $p < .05$

References

Lee, M. M., & de Zubicaray, G. (2010). *Lexical selection is by competition: A failure to replicate Mahon et al.'s (2007) Experiment 7*. Poster presented to the 6th International Workshop on Language Production, Edinburgh, Scotland.

Mahon, B. Z., Costa, A., Peterson, R., Vargas, K. A., & Caramazza, A. (2007). Lexical selection is not by competition: A reinterpretation of semantic interference and facilitation effects in the picture-word interference paradigm. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 33, 503-535.

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