Sensitivity to Stroop interference facilitates anticipation-driven comprehension

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The presence of the Stroop effect has often been known as an indicator of automatic semantic access (Raz et al., 2002). However, the sensitivity to Stroop interference failed to predict the goodness of semantic integration ability during sentence comprehension, where syntactic and semantic interferences were manipulated in the processing of English relative clauses (Tan et al., 2017). We attempt to show that those more vulnerable to Stoop (in other words, more automatic to semantic access) show less difficulty in the processing of upcoming information.

It is well known that readers' active use of given lexical/structural information and event knowledge are highly likely to elicit anticipatory processing of yet-to-be-encountered information. We speculate that the anticipation-driven processing represents the automatic process of sentence comprehension and that the goodness for anticipation-driven comprehension might differ as a function of readers' sensitivity to semantic access rather than a function of readers' WM storage capacity. By conducting two studies (picture description and self-paced moving window reading comprehension) and two cognitive tasks (Stroop and Reading span tasks), we demonstrated that the differences of readers' sensitivity to Stroop led to significant prediction on crucial variations on the predicative use of lexical and structural information during sentence comprehension.

For our aim, we used Korean recipient/source constructions, as indicated in sentences (1-4), which contain three thematic roles (agent, recipient or source, and theme). Note that a recipient/source argument can syntactically precede or follow a patient argument, as in sentences (1 vs. 2) and (3 vs. 4), and that the postposition, *-eykey*, is semantically ambiguous, marking either a recipient or a source argument. First, in order to detect the likelihood distribution of possible choices at upcoming positions, we conducted a picture description study in which participants were required to describe an event drawn in a who-did-what-to-whom picture. Second, a self-paced moving window reading comprehension was conducted to measure the difficulty of sentence comprehension. Finally, participants' cognitive capacities were measured in two cognitive tasks (Stroop and Reading Span)

Our results are as follows: First, the results of the picture description task revealed that 1) the order of recipients/sources followed by themes (95%) was predominant in comparison to the order of patients followed by recipients/sources (5%) and 2) the sense for *-eykey* was predominantly biased toward recipients (52%) rather than sources (25%). The outcomes strongly suggested that readers highly expect to encounter themes at R4 after reading recipients or sources at R3 and to encounter *give*-type verbs rather than *receive*-type verbs at R5. Second, we used role-order type and Stroop score as fixed factors to test RTs obtained from R3, R4, and R5 while subjects and items were submitted as random variables. The results from linear mixed-effect regressions (Table 2) yielded that 1) the effect of Stroop score on RTs appeared at R3, meaning that those with higher Stroop scores read faster nouns at R3. 2) Also, the significant interaction between Stroop scores and role types occurred at R4, indicating that themes following recipients were read faster than recipients and sources following themes only for those with higher Stroop scores. 3) The effect of Stroop score remained at R5 in the same way that we observed at R3; the higher Stroop score leads to faster RTs of verbs in which the ambiguity of roles associated with *-eykey* was resolved. Those with high Stroop scores felt easier to integrate verbs into sentences, in other words, to resolve the ambiguity of role integration. Models using Reading-span scores showed no significant results at any regions.

In sum, our results suggest that automatic semantic access, indicated by Stroop performance, could help readers to maximally utilize available information in the processing of upcoming information even prior to encountering it.

Table 1. A set of example stimuli

	Condition	R1	R2	**R3**	**R4**	**R5**	R6
(1)	Recipient>Patient Giving verb	Cengweni-ka Cengweni-NOM	Pokyengi-eykey Pokyengi-DAT	swuhak-ul Math-ACC	yelsimhi hard	kaluchi-nun teach	cwungita be -ing
(2)	Patient>Recipient Giving verb		swuhak-ul Math-ACC	Pokyengi-eykey Pokyengi-DAT			
(3)	Source>Patient Receiving verb		Pokyengi-eykey Pokyengi-DAT	swuhak-ul Math-ACC		paywu-nun learn	
(4)	Patient>Source Receiving verb		swuhak-ul Math-ACC	Pokyengi-eykey Pokyengi-DAT			

Table 2. Results from linear mixed-effect regressions on RTs at R3, R4, and R5

		Estimate	S.E.	t-value
R3	Intercept	540.68	41.61	12.99*
	(1)-(2)	14.00	42.37	.33
	(1)-(3)	-15.76	42.17	-.37
	(1)-(4)	13.76	42.38	.33
	Stroop score	-105.44	42.49	-2.48*
	(2)*Stroop Score	55.92	48.91	1.14
	(3)*Stroop Score	28.92	48.08	.60
	(4)*Stroop Score	46.14	48.89	.94
R4	Intercept	469.02	32.85	14.28*
	(1)-(2)	60.19	34.44	1.74
	(1)-(3)	6.96	34.93	.20
	(1)-(4)	95.18	35.46	2.68*
	Stroop Score	-38.11	34.01	-1.12
	(2)*Stroop score	-87.37	39.69	-2.20*
	(3)*Stroop Score	-24.15	39.59	-.61
	(4)*Stroop Score	-100.46	40.21	-2.50*
R5	Intercept	474.65	36.72	12.93*
	(1)-(2)	8.83	33.72	.26
	(1)-(3)	24.79	33.82	.73
	(1)-(4)	61.58	34.18	1.80
	Stroop Score	-92.29	35.63	-2.59*
	(2)*Stroop score	1.39	39.02	.04
	(3)*Stroop Score	53.85	38.45	1.4
	(4)*Stroop Score	17.15	38.67	.44

* If the absolute *t*-value of a fixed factor was over 2, the effect of the factor was considered to be significant at $\alpha < .05$, marked with * (Gelman & Hill, 2007).

References:

Gelman, A., & Hill, J. (2007). *Data analysis using regression and multilevel hierarchical models*. New York: Cambridge University Press.

Tan, Y., Martin, R., & Van Dyke, J. (2017). Semantic and Syntactic Interference in Sentence Comprehension: A Comparison of Working Memory Models. *Frontier in Psychology*, 8:198. doi: 10.3389/fpsyg.2017.00198.