

SHARED BASIS FOR LANGUAGE AND MATHEMATICS REVEALED BY CROSS-DOMAIN SYNTACTIC PRIMING

TOMOYA NAKAI^{1,2}, KAZUO OKANOYA^{1,3,4}

1 Graduate School of Arts and Sciences, The University of Tokyo, Tokyo, Japan, 2 Japan Society for the Promotion of Science, Research Fellow, 3 Center for Evolutionary Cognitive Science, The University of Tokyo 4 Riken Brain Science Institute
cokanoya@mail.ecc.u-tokyo.ac.jp (K.O.)

It has been proposed that the capacity of recursive computation plays a central role in language evolution, and that such capacity provides a basis not only for syntax in language, but also for mathematics (Hauser et al., 2002). It is possible that an evolutionarily older linguistic function is “recycled” in novel cultural inventions such as mathematics (Dehaene & Cohen, 2007). Recently, Scheepers et al. (2011) found that the syntactic structures of prime mathematical expressions affected the processing of following target linguistic stimuli. In their subsequent study, Scheepers and Sturt (2014) revealed that such cross-domain syntactic priming effect was bidirectional.

Although these priming studies had a critical importance, their questionnaire-based experimental settings had limitations in evaluating on-line syntactic processing. In the present study, we created a new task that focused on the on-line syntactic priming between language and mathematics. We recruited 34 college students

(all native Japanese speakers, aged 18–26). Participants were asked to perform a calculation task and a semantic decision task for consecutively presented mathematical expressions and sentences (in Japanese), respectively. For both domains, we created stimuli with left-branching (“ $4*3+8$ ” and “*kuroi neko-ga hashiru*” [*a black cat runs*]) and right-branching structures (“ $8+3*4$ ” and “*neko-ga hayaku hashiru*” [*a cat runs fast*]). Linguistic stimuli were created by inserting either an adjective or adverb into the phrase composed of a NP and an intransitive verb. This experimental setting allowed us to examine the implicit structural priming effect between two domains. To consider the influence of participants’ sensitivity to structural information in mathematics, we recruited students in both scientific and non-scientific departments.

By using two-way repeated measures analysis of variance (ANOVA), we found a significant main effect of congruency (structural priming effect) only for students in scientific departments ($P < 0.05$). We found no significant main effect of modality (language to math/math to language) or interactions. Structurally congruent stimuli induced lower error rates compared to incongruent stimuli, both from language to mathematics, and from mathematics to language. Our results support the idea that language and mathematics have a shared basis in their syntactic structure, with individual variability related to the environment. We also suggest a putative application of current task settings in neuroimaging experiments.

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