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Be it numbers or words -- the structure of our language remains the same

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It is one of the wonders of language: We cannot possibly anticipate or memorize every potential word, phrase, or sentence. Yet we have no trouble constructing and understanding myriads of novel utterances every day. How do we do it? Linguists say we naturally and unconsciously employ abstract rules—syntax.

How abstract is language? What is the nature of these abstract representations? And do the same rules travel among realms of cognition? A new study exploring these questions—by psychologists Christoph Scheepers, Catherine J. Martin, Andriy Myachykov, Kay Teevan, and Izabela Viskupova of the University of Glasgow, and Patrick Sturt of the University of Edinburgh—makes what Scheepers calls "a striking new finding": The process of storing and reusing syntax "works across cognitive domains."

More specifically: "The structure of a math equation correctly solved is preserved in memory and determines the structuring of a subsequent sentence that a person has to complete." Neuroscientists have found evidence suggesting a link between math and language, "but this is the first time we've shown it in a behavioral setup."

The findings will be published in an upcoming issue of *Psychological Science,* a journal of the Association for Psychological Science.

The study made use of a cognitive process called structural priming. Simply put, if you use a certain kind of structure in one sentence, you're

likely to use it again in a subsequent sentence. To find out how abstract—and cognitively general—this process is, the experimenters gave native English-speaking students a pencil-and-paper test containing a series of math problems paired with incomplete sentences.

Each math problem was structured in one of three ways. With "high-attachment" syntax, the final operation of the problem applied to a large "chunk" of the earlier part. For instance: 80 – (5 + 15) / 5, where the final division (/ 5) applies to the previous addition term (5 + 15). With "low-attachment" syntax—say, 80 – 5 + 15 / 5—the final operation applied to a smaller previous chunk. A third category—"baseline" problems like 80 – 5 —implied neither high nor low attachment.

After each equation, the participant was given a sentence fragment that could be completed with either high or low attachment syntax. For instance – The tourist guide mentioned the bells of the church that … A high-attachment ending would refer to the entire phrase the bells of the church and might finish with "that chime hourly." Low attachment would link only the church to the completed final clause—say, "that stands on a hill."

The subjects were variously successful in solving the problems. Their choice of high or low attachment sentence completions also revealed complexities—some perhaps related to the preference in English for low-attachment syntax.

Still, in significant numbers, high-attachment math problems primed high-attachment sentence completions, and low-attachment problems made low-attachment completions likely.

What does all this mean? Our cognitive processes operate "at a very high level of abstraction," the authors write. And those abstractions may apply in similar fashion to all kinds of thinking—in numbers, words, or

perhaps even music.

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