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Acquiring the Mental Lexicon Through Sensorimotor Category Learning

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To *categorize* is to do the right thing with the right *kind* of thing (Harnad 2005). We report the electrophysiological correlates of learning a new category through either direct sensorimotor experience (*E*) or verbal definition (*V*).

A word's meaning, as expressed by its definition, provides a *rule for picking out its referent*. Our experimental subjects (Ss) learned a new visual texture category: a dichotomy consisting of two kinds of texture -- called, arbitrarily, "Ks" and "Ls" -- which were 40x30 matrices made up of four micro-elements ($\cup \cap \subset \supset$) distributed randomly. The rule "defining" the category was that the Ks had more \cup elements, the Ls had more \cap elements. (The other two elements were irrelevant.)

This rule can be learned in two different ways: either (*E*), from direct trial and error experience, learning to categorize and name a training sample of Ks and Ls, guided by corrective feedback after each error, or (*V*), by *telling* the Ss the rule in advance, in words, defining the category, and then training them, with feedback, on the same sample. Visual event-related potentials (ERPs) were recorded during the training.

Our findings were that (1) Ss who successfully learned to categorize and name via *E* all showed an increasing late positivity in their ERPs; Ss who failed to learn did not. (2) All successful *E* learners could also state the rule verbally; nonlearners could not. (3) The increasing late positivity began to appear and increase only beginning with those trials in which the learners had discovered and could state the rule verbally. (4) When the nonlearners were *told* the rule verbally in a second phase of training (*V*),

thereby making them able to categorize and name, they too displayed the late ERP positivity. (5) The positivity was present once the rule was told to the Ss, even if the subsequent training was without feedback, whether their training trials were easy or difficult, and even when Ss failed to categorize correctly; surprisingly, the positivity was there even when categorization was *impossible* (i.e., the rule did not distinguish the textures). (6) Ss thought they were not doing too badly even in the impossible condition, and even when they were given feedback indicating they were performing at chance level (50%). (7) An early ERP negativity emerged in Ss who were given false positive feedback (80%) under the impossible condition.

We conclude that learners, whether they learned from experience or from a verbal definition, apply the rule mentally, and mental rule application is what the late ERP positivity reflects (even in the impossible condition, where the rule did not really serve to distinguish any categories). The meanings of words in the mental lexicon are grounded by the ability to pick out their referents. If we know how to pick out an “X” whenever we encounter it, “X” is then grounded and can be used to learn the meaning of Y” through verbal definition alone.

References

Harnad, S. (2005) To Cognize is to Categorize: Cognition is Categorization, in Lefebvre, C. and Cohen, H., Eds. *Handbook of Categorization*. Elsevier.