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Cognitive Development 21 (2006) 174–193
COGNITIVE DEVELOPMENT

The distributed learning effect for children's acquisition of an abstract syntactic construction

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Abstract

In many cognitive domains, learning is more effective when exemplars are distributed over a number of sessions than when they are all presented within one session. The present study investigated this *distributed learning effect* with respect to English-speaking children's acquisition of a complex grammatical construction. Forty-eight children aged 3;6–5;10 (Experiment 1) and 72 children aged 4;0–5;0 (Experiment 2) were given 10 exposures to the construction all in one session (massed), or on a schedule of two trials per day for 5 days (distributed-pairs), or one trial per day for 10 days (distributed). Children in both the distributed-pairs and distributed conditions learnt the construction better than children in the massed condition, as evidenced by productive use of this construction with a verb that had not been presented during training. Methodological and theoretical implications of this finding are discussed, with particular reference to single-process accounts of language acquisition.

Keywords: Syntax acquisition; Construction learning; Distributed learning; Spacing effect

Children's initial multiword utterances mostly derive from lexically specific schemas, such as *I want [X], I'm [X]ing it*, and so forth (Braine, 1976; Tomasello, 1992). They then generalize across these to form more abstract constructions,[1] such as *[SUBJECT] [VERB] [OBJECT]*. In usage-based accounts of language acquisition, children form these abstractions via processes

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[1] In this paper, the term *construction* is used in its most common sense of *verb argument structure construction*. We would argue, however, that the phenomena discussed here are equally applicable to other types of construction (e.g., morphological constructions, such as the past tense VERB+ed construction).

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doi:10.1016/j.cogdev.2005.09.003

of schematization and analogy (Tomasello, 2003). Importantly, schematization and analogy are *general* learning processes that have their conceptual origins in non-linguistic domains. Piaget (1952) discusses the development of generalized sensory-motor schemas for acting on objects in infancy, and Gentner and colleagues have investigated analogy formation in various domains of later conceptual development (e.g., Gentner, Loewenstein, & Thompson, 2003; Kotovsky & Gentner, 1996; Lowenstein & Gentner, 2001).

Under their *structure mapping* theory, Markman and Gentner (1993) argue that the basis of analogy is relational similarity: the existence of similar internal relations between elements of the two structures to be mapped (see also Goldstone, 1996; Holyoak & Koh, 1987; Holyoak & Thagard, 1989). Providing the two structures share this relational similarity, *object commonality* – similarity between a particular element of one structure and the corresponding element of the other structure – is not required for an analogy to be made. As an experimental demonstration, children might be shown two pictures: one of a truck towing a car and the other of an identical car towing a boat. When asked to indicate the item in the second picture that is the "best match" for the car in the first picture, children tend to choose not the car, but the boat. Children are able to align the *tow-er/tow-ee* structure of the two pictures, and form an analogy between the two *tow-ees*.

As an analogous linguistic example, consider the hypothetical utterances *I kiss Mummy* and *Daddy threw the ball*. Although the two utterances have no morphemes in common, they share relational similarity such that the agent–action relation between *I* and *kiss* parallels the relation between *Daddy* and *threw*, whilst the action–patient relation between *kiss* and *Mummy* parallels the relation between *throw* and *the ball*. Thus, this relational similarity allows the child to form an analogy between the two utterances and move towards a wholly abstract *SVO* construction schema.

Although the formation of abstract constructions (via schematization/analogy) is a crucial feature of any constructivist acquisition theory, very little experimental research has investigated the specific details of this process. Factors that have been hypothesized to influence this process include (1) the token frequency of the schema in the child's input (Cameron-Faulkner, Lieven, & Tomasello, 2003; Rowland & Pine, 2000; Theakston, Lieven, Pine, & Rowland, 2001, 2002); (2) the variability or type frequency of variable elements in the construction (e.g., of the VERB in the *I'm [VERB]ing it* construction; Bybee, 1995; Gomez, 2002; Onnis, Monaghan, Christiansen, & Chater, 2004); (3) the presence in the construction of invariant elements, such as pronouns and inflectional morphemes (Childers & Tomasello, 2001; Pine, Lieven, & Rowland, 1998); and (4) prior knowledge of related constructions (Abbot-Smith & Behrens, in press; Croft, 2001; Elman et al., 1996; Goldberg, 1995; Langacker, 1988, 1991, 2000; Ruhland, Wijnen, & van Geert, 1995).

One factor that has not been studied is the temporal distribution of exemplars of the construction in the input. There are three plausible hypotheses. First, based on previous learning research, we might hypothesize that construction learning will show the well-known *distributed learning* or *spacing* effect: given a certain number of exposures to a stimulus, or a certain amount of training, learning is always better when exposures or training trials are distributed over several sessions than when they are massed into one session. This finding is extremely robust in many domains of human cognition. For example, in a meta-analysis of 97 studies, Janiszewki, Noel, and Sawyer (2003) found a distributed learning effect for meaningful and meaningless stimuli (real words versus nonce), familiar and novel stimuli, isolated and embedded stimuli (single word alone versus target word in a sentence), verbal and pictorial stimuli, and for simple stimuli (single words), structurally complex stimuli (sentences) and semantically complex stimuli (homographs). The