

Are U-Shaped Developmental Trajectories Illusory?

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Without criteria for what counts as a U/N-shaped developmental trajectory, it is not clear how many legitimate *Us* really exist. Many, if not all, *Us* may turn out to be illusions borne out of our sampling methods, task construal, and blurry lenses of description.

Rakison and Yermolayeva (this issue) consider whether knowledge is acquired with domain-general or domain-specific learning mechanisms and make a bold proposal: that U/N-shaped curves are products of domain-general learning. Specifically, they propose that these non-monotonic curves are generated by a combination of: 1) improvements in information-processing capacity yielding an initial rise in performance, 2) the structure of the accumulated information giving rise to constraints that restrict learning and create a performance dip, and 3) loosening constraints and improvements in information processing and executive function, yielding a subsequent rise in performance.

Whether or not one agrees with Rakison and Yermolayeva's (this issue) arguments about the nature of underlying learning mechanisms, we should all cheer their proposal for consensus on criteria for domain-general and domain-specific processes. We should also, however, have the same concerns about criteria for U/N-shaped developmental trajectories themselves. On closer inspection, without universal criteria for U/N-shaped curves, it's not clear how many legitimate *Us* really exist.

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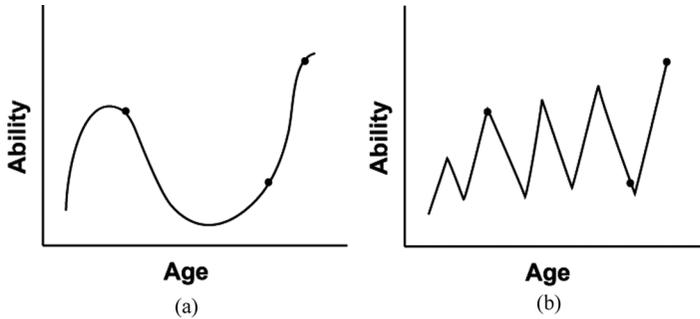


FIGURE 1 (a) An ostensive U/N-shaped trajectory, with dots representing three sampling points. (b) A locally variable trajectory (including the same three sampling points).

Ostensible *Us* may turn out to be more illusory than real for at least four reasons:

First, individual learning curves may look different whether infants are sampled monthly, daily, or hourly (Adolph, Robinson, Young, & Gill-Alvarez, 2008; Siegler, 2006). What may appear to be a stepwise dip or stepwise rise yielding a U-shaped function (Figure 1a) may, with denser sampling intervals, turn out to be locally variable (Figure 1b). Local variation could be influenced by performance factors (e.g., attention, fatigue, contextual priming) with the overall rise in performance underwritten by improvements in learning mechanisms of either a domain-specific or domain-general sort. Some *Us* reflect measurement artifacts from sparse sampling.

Second, *Us* may arise from the granularity of measurement and the experimenter's task construal (see Goldin-Meadow, 2004, for a related discussion on gestures). For example, the performance of infants in motor tasks (Adolph, 1997; discussed in Rakison and Yermolayeva, this issue) only looks like a *U* if the task is construed in general terms, such as infants' perception of the "environmental affordances of slopes, drops, gaps, etc." However, when the task is construed in terms of more specific variables such as "environmental affordances in posture *X*," performance does not dip, instead showing monotonically increasing improvement. Once infants learn to perceive affordances of obstacles in a given posture, they do not lose this ability (Figure 2). To the contrary, the same novice walker who waddles into a chasm can—in the same testing session—make appropriate judgments about the crawling affordances of that same chasmic gap. Some *Us* dissolve when infant abilities are construed at a finer level of description.

Third, changing task demands and the infants' construal of a task may permit an ability to be manifest or not. For example, does infants' ability

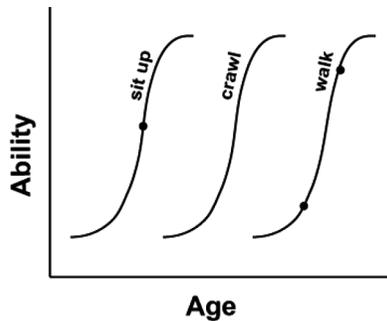


FIGURE 2 A series of finer-grained monotonically increasing trajectories.

to discriminate between native-language minimal pair phonemes (e.g., b/d, which differ in their place of articulation) truly change as they start to learn words? As a series of elegant studies has shown, the underlying discrimination ability persists, even as task demands determine whether infants can make this ability manifest or not (Fennell & Werker, 2003; Stager & Werker, 1997; Yoshida, Fennell, Swingley, & Werker, 2009). What was a simple discrimination task for an 8-month-old is construed as a word-learning task by a 14-month-old because the child's relation to the task has changed in a qualitative way; the older child's attention is now focused on creating new mappings. But that same 14-month-old's ability to discriminate native phonemes has not weakened when tested in a discrimination task. Because the underlying ability is maintained but differentially deployed, this should not be regarded as a true dip as predicted by U/N-shaped development. Dips in performance resulting from changing task demands are not true *Us*.

Fourth, performance may dip with no underlying change in competence, independently of task demands. Consider the classic example of U-shaped development: overregularization of the past-tense morpheme, in which children who correctly produced past tense forms like "went" suddenly produce incorrect forms like "goed." In one account, this performance dip is due to children learning that English past tense must be marked, using the regularities in the data to home in on the "-ed" morpheme, then overapplying this discovered rule (to produce "goed"; Marcus et al., 1992). Eventually, errors recede as the child's memory representations of irregular forms ("went") get strengthened through exposure. At a performance level, children suddenly produce wrong forms before producing correct forms again, yielding a dip in performance for these specific irregular forms. However, at a competence level, children become more and more syntactically competent by moving

from knowing specific lexical forms to discovering a principle of their language, which they apply to the correct parts of speech (verbs). The syntactic principle is gradually qualified by exceptions for irregulars. Thus, when competence is assessed, there is no regression, and there is no *U*.

Finally, one could argue against true *Us* on philosophical grounds. There is a sense in which a developing organism is never confronted with the same task twice because its mind and body are different every time it engages in a task. The continuity of maturation and learning processes in time mean that the organism at Time 2 cannot be the same as it was at Time 1. If (paraphrasing Heraclitus, Fragment 91) the same child can never step in the same river twice, then a true U/N-shaped curve becomes a logical impossibility. Whether one favors a view of development as a continuous process of “soft assembly” with monotonic improvements in a range of domain-general abilities determining the characteristics of the child as they navigate the world (Gershkoff-Stowe & Thelen, 2004; Thelen, 1992) or as an interplay of domain-specific and domain-general learning mechanisms yielding domain-specific and domain-general knowledge (Marcus, 2009), there is no doubt that past states contribute to future states and so true regression becomes impossible.

Us may give useful windows into performance factors, but there may be less than meets the eye. Many, if not all, *Us* may turn out to be illusions borne out of our sampling methods, testing tools, and blurry lenses of description. Until clear criteria for U/N-shaped trajectories are established, claiming them as evidence for domain-general learning seems premature.

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