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REVIEW

GEOFFREY D. HALL and SANDRA R. WAXMAN (eds). *Weaving a lexicon.*
  Cambridge, MA: MIT Press, 2004/ Pp. 672. ISBN 026208323X.

OVERVIEW

Research on word learning is vital and consequential. Acquiring a large,
accessible vocabulary is key to complete fluency in a language and to later
literacy. The drive to learn words is hard to extinguish even in challenging
circumstances (Goldin-Meadow & Mylander, 1984). For these reasons,
Weaving a Lexicon, an ambitious review of recent experimental research on
infants' and children's word knowledge, is a welcome contribution. It is also
timely because researchers have in recent years converged on a 'tool kit' for
assessing infants' inferences, and the time is ripe for the field to examine
these methods and their implications for theoretical models of early lexical
development.

Editors Geoffrey Hall and Sandra Waxman are former collaborators,
and each contributes a chapter (11 and 10 respectively). They and other
contributors are jointly responsible for much of the most influential
research on early word learning. As such, the volume is a fair summary of
the state of the field and the most visible research of the last decade.

The volume includes nineteen substantive chapters and a brief intro-
duction. It is divided into two sections, one on infants' identification and
inferences about words and another on preschoolers' later acquisition of
lexical knowledge. There is no further organization, so the volume would
require scaffolding for use as an undergraduate text. However, for that
purpose there are suitable chapters by Akhtar (ch. 15), Bloom (ch. 7),
Gelman (ch. 14), Gentner & Namy (ch. 17), Imai & Haryu (ch. 13) and
Markman & Jaswal (ch. 12). Graduate language seminars could utilize
contributions by Fisher, Church & Chambers (ch. 1), Hohenstein, Naigles
& Eisenberg (ch. 18), Landau (ch. 4), Snedeker & Gleitman (ch. 9), Werker
& Fennell (ch. 3) and Woodward (ch. 5). Seminars on thought and language
could utilize the chapters by Gelman, by Gentner & Namy and by Landau.
Phonology courses could use Werker & Fennell's and Echols & Marti's
(ch. 2) contributions.

Almost all chapters describe the authors' research programs, as is typical of
edited psychology volumes. Bloom breaks this mold with a more broadly in-
formative critique of assumptions about children's word-learning acumen;
this should be required reading for child language researchers. Other

chapters summarize research from top laboratories, mostly in the United States. The research is clever. The chapters are informative and engaging, not to mention uniformly well-written: a few, such as Bloom's chapter, Gelman's account of children's acquisition of generics and Waxman's review of infants' attention to words, are exceptionally good reading.

The chapters represent the main theoretical assumptions and approaches of the field of child language. Unfortunately prevailing theory is vague, outmoded and diffuse. The chapters thus show the need for clever methods to be grounded in rigorous, viable theory. To be sure, many chapters articulate seemingly sensible theoretical claims. However, such claims are often too vague. For example, many contributors agree that children's word learning requires some interaction of word-learning constraints and other cognitive, perceptual and social factors – and perhaps even input patterns! This is a promising start, but not really satisfactory theorizing. Nevertheless the volume, by bringing together much of the best research, gives us a fair sketch not only of progress made, but also (by omission) of progress that is needed.

COVERAGE AND CONTENT

The coverage is compatible with an introductory linguistics text: topics include phonetics/phonology, syntax, semantics and pragmatics. Chapters by Echols & Marti, Fisher *et al.* and Werker & Fennell consider how infants come to discriminate words, identify particular words, and process phonetic information in word forms. Many chapters consider how children infer meanings: Hall & Lavin (ch. 11) and Imai & Haryu consider how form-class and other information lead children to different ontological meanings, while Saylor, Baldwin & Sabbagh (ch. 16) consider children's synthesis of linguistic and paralinguistic cues to induce object versus part meanings. Hohenstein *et al.*'s and Lidz, Gleitman & Gleitman's (ch. 19) contributions examine syntactic factors in word learning. Akhtar and Woodward's chapters focus on children's use of pragmatic context to infer meanings. Thus, the volume nicely covers a general linguistics framework.

Even at over 670 pages, however, the volume does not cover the range of major word learning research or theoretical approaches. *Weaving* is weighted towards contributors whose work derives from Chomskian or neonativist traditions, and is light on alternative perspectives (lexicalist, cognitive linguistics, dynamic systems, social constructivist). More striking, modern interdisciplinary frameworks are nearly absent: the nineteen chapters do not touch on modern neuroscience; only Werker & Fennell describe any neuropsychological data. No chapter tests or evaluates hypotheses using formalizations or simulations of learning models: Gentner & Namy alone refer to a 1980s-style discrete symbol-passing model. Because neuroscience

and computational modeling have had ample success in recent decades, it is hard to understand this self-imposed disciplinary isolationism. Of course no volume can cover everything and *Weaving* covers more than some, but a broader range of approaches could easily have been covered in nineteen chapters.

Another issue of breadth is that the chapters mostly focus on typically developing English-speaking infants and children. Only Goldin-Meadow (ch. 8) focuses on a special population (deaf children of hearing parents), and no chapter addresses adolescent or adult language learners. This reflects how the field has become partitioned, and that partitioning implies unexploited opportunities for more integrative science.

The chapters in *Weaving* barely address how input or experience affects children's lexical knowledge. Gelman alone uses a quasi-naturalistic study of parental labeling during book reading to understand the development of generic constructions. This omission is startling in light of innumerable calls, from many fronts, to richly document patterns of input that influence human knowledge. The influence of social context is broadly addressed by Goldin-Meadow, who analyzes a deaf child's naturalistic and uninstructed use of gestural symbols in ways that imply emergent form classes. However, beyond these chapters and Akhtar's review, *Weaving* does not cover socio-cultural approaches or ethnographic data. Only Gelman and Hohenstein *et al.* utilize evidence from the CHILDES database (MacWhinney, 2000). Only five chapters (Akhtar; Gelman; Hohenstein *et al.*; Imai & Haryu; Werker & Fennell) consider cross-linguistic or cross-cultural evidence to inform theoretical claims, though it is well known that child language research is historically Anglocentric.

The volume indicates that contemporary word-learning research focuses on children's isolated inferences, not, curiously, learning. Lidz *et al.* tellingly explain a child's interpretation of a novel verb in these terms: 'The LAD then makes the following deduction ....' (p. 629). Although the underlying presumption that learning is subordinate to innate structure might not be endorsed by all contributors, it is striking how little any of the contributors address learning. For example, the many learning phenomena and factors exactingly documented by psychologists from the 1940s through the 1970s are barely mentioned. Input frequency and schedule, practice, reinforcement and feedback are raised in only two chapters (Goldin-Meadow; Snedeker & Gleitman). Other learning dynamics like reminding, savings in relearning, forgetting curves, cognitive load, and interference are never mentioned, though demonstrably important in word learning (e.g. Childers & Tomasello, 2002; Deák, 2000b). Werker & Fennell do discuss specific cognitive processes in a readable overview of infants' processing of phonological information in recognized words; however, in this regard the chapter is an exception.

In sum, the volume should excite current and future word-learning researchers: it shows that the field is wide open for advanced theories that make use of a more informed interdisciplinary perspective. For example, what are the brain dynamics that occur when infants hear words? What are the resulting perceptual-motor encodings and neural traces? How is learning and memory for words specialized, if at all? This volume's many clever experiments could be adapted to study LEARNING, and hopefully they will be in future work.

TESTING CHILDREN'S WORD KNOWLEDGE: ARE CURRENT METHODS ENOUGH?

Weaving describes many creative experiments on infants' and children's inferences about words by Akhtar, Fisher *et al.*, Imai & Haryu, Snedeker & Gleitman, Waxman, Woodward and others. The volume also reveals areas for growth in the field's methods.

First, the field has converged on a narrow range of measures. This is partly because methods have matured, but also because researchers want easy-to-use procedures. Infant looking-time methods are widely used (chapters by Echols & Marti, Fisher *et al.*, and Hirsh-Pasek, Golinkoff, Hennon & Maguire [ch. 6]), and some authors have nicely refined these processes (Hirsh-Pasek *et al.*). Yet such measures only show infants' discrimination, not comprehension, so they support quite limited theoretical claims.

Second, because methods like preferential looking are indirect, there is greater need for converging evidence. Also, because so many 'incidental' factors can influence infants' looking patterns (e.g. Smith & Gasser, 2005), converging measures are especially important. Yet few chapters (Gentner & Namy; Hohenstein *et al.*; Werker & Fennell) rely on converging evidence.

An expanded methodological toolbox is also needed in studies of preschoolers. Although children as young as two or three years readily demonstrate their lexical knowledge through comprehension, production or generalization methods, most studies rely on single measures in highly simplified, artificial tasks. These practices greatly limit the inferences we can draw about children's knowledge. The answer is not to sacrifice experimental control but to use methods that simulate more naturalistic learning processes, even if this requires more complex and challenging procedures and designs. For example, many studies in this volume and elsewhere have preschoolers choose between two stimuli based on a direct prompt (e.g. 'Find the [X]' after hearing a word two to three times). This method is simple but it lacks sensitivity (i.e. 50% random correct responses) and it is subject to perseverative errors across trials. Also, it is impossible to interpret errors if there is only one alternative to a 'correct' choice.

Moreover, it is unnatural: children seldom get to choose between two clear, balanced interpretations of a word. More powerful or exacting methods could be used, as exemplified by Akhtar and Imai & Haryu. The former has toddlers make inferences in more conversational contexts. The latter simply give preschoolers more than two choices to assess their use of syntactic information to infer novel word meanings.

Third, although many experiments in this volume are carefully controlled, there is still room for improved experimental designs. Some studies do not control learning-relevant factors like timing, prosody or stimulus properties. For example, Waxman describes intriguing and ambitious studies (Booth & Waxman, forthcoming) in which a noun-input group aged 1;2 hear 'These are blickets. This one is a blicket and this one is a blicket.' By comparison, a control group hears 'Look at these. Look at this one and look at this one.' The noun group generalized to a mean of 65% same category objects (e.g. another mammal) compared to 52–55% in the control group. From this Waxman concludes that infants at 1;2 expect nouns to refer to abstract object categories. Yet the control input is not matched for complexity (e.g. entropy), presence of a novel lexeme or verb phrase structure. One or more of these might have contributed to the modest between-group difference.

The point is not to single out one study. Imperfect experimental control is not uncommon. However, the field's tolerance of imprecise methods that are also over-simplistic, narrow in scope and indirect does us no service. Certainly specialized procedures are needed to test infants and young children, and *Weaving* nicely describes the common ones. This field now should be challenged to improve our methods. It is possible that improved methods, that yield more nuanced results, will allow us to test more precise and powerful theories. This possibility raises another limitation shown by *Weaving*: the absence of good theories of emerging lexical knowledge.

UNDERSTANDING CHILDREN'S WORD LEARNING: IN SEARCH OF THEORY

Though the volume reflects the lack of competing rigorous theories, many chapters share a common assumption: young children have some specialized biases or constraints that guide word learning, in coordination with other knowledge of the physical, social and linguistic world. Many chapters center on this coordination, on the emergence of constraints and on how children resolve conflicts between competing interpretations. For example, Hall & Lavin and Saylor *et al.* argue that children's object-kind bias is so strong that children need specific syntactic or social marking to override it and learn words for ontological kinds like individuals or substances.

These are interesting research questions, but the underlying assumption deserves analysis. All proposed formulations of 'constraints' just label or re-describe some behavioral tendency, typically with an added assumption that the tendency is specialized for words, and possibly innate. Yet recent studies suggest proposed word-learning constraints are not domain-specific (e.g. Childers & Tomasello, 2002; Markson & Bloom, 1997). The problem of separating general and specific factors is recognized by several contributors (Hall & Lavin; Hirsh-Pasek *et al.*; Markman & Jaswal), but what is still missing is a satisfactory formulation or replacement of the construct 'word learning constraint' (Deák, 2000b).

The need for a better construct becomes evident as one reads chapters of *Weaving* by some influential researchers who contrast lexical constraints with social inference (Hirsh-Pasek *et al.*) or general perceptual and cognitive mechanisms (Hirsh-Pasek *et al.*:179; Snedeker & Gleitman). These distinctions sometimes misrepresent scholars who argue for epigenetic accounts (Smith, 1999). More damaging, the distinctions are neither empirically or deductively valid (Deák, 2000b). The central problem is that all learning is constrained by the structure of an organism's learning and action systems, including perceptual surfaces, motor systems and neural dynamics. All these details constrain learning. And, because the brain's structure is itself an emergent product of complex interactions of an organism's genetic and experiential history one cannot call some phenotypes especially constrained, without compelling evidence of specialized differentiation in emergence and in function. For example, spike-timing dependencies in some cortical neurons (Dan & Poo, 2004) constrain how input events alter the neurons' firing thresholds and experience-dependent firing synchronies. These sensory experiences include, for example, hearing novel words. But there is no evidence that timing dependencies of auditory cortical cells evolved to be more responsive, from the earliest stages of development and independent of experience, to lexically relevant sound distinctions in human speech. To the contrary, specialization of mammalian auditory cortical response properties is plastic and input-dependent (e.g. Kilgard, Pandya *et al.*, 2001). Thus, no proposed word-learning trait has been shown to originate as a canalized specialization for processing lexical information.

When the volume tackles specializations of word learning the results are anticlimactic. Hirsh-Pasek and colleagues attempt a multifactorial account of the transition from early to later word learning. Multifactorial accounts are necessary (Bates & Goodman, 1999; Bloom, 2000; Deák, 2000a) as other contributors acknowledge (Akhtar; Hohenstein *et al.*; Snedeker & Gleitman). However, Hirsh-Pasek *et al.*'s more specific claim (p. 182) is that as infants get older they use social and linguistic cues more, and use attention cues (e.g. perceptual salience) less. This is difficult to dispute: any abstract learning system with limited encoding capacity and more

potentially-informative input than can be encoded in each time-step will learn over time (by almost any learning process) that some cues are more informative (i.e. will reduce uncertainty) than others. If the system can also control what it encodes (e.g. selective attention), the influence of less-informative cues will gradually decline. Infants fit the description of such a system. Thus, the claim is reasonable but does not constitute a novel theoretical claim. One might instead take a set of almost indisputable DESCRIPTIVE assumptions like these as a starting point for a falsifiable model of word learning, which then must be fleshed out to explain learning of a wide range of specific words (*hi, doggy, daddy, go*), lexical kinds AND regularities in their use and interpretation.

SUMMARY

Hall & Waxman have solicited nineteen individually solid chapters that accurately survey the mainstream word-learning field of the last fifteen years. The chapters are informative and engaging. Yet as a whole there is more to be desired. Areas of omission (e.g. special populations; learning processes; descriptions of input patterns) are not justified by a well-specified organizational scheme. Also, the volume underscores endemic problems in the field: isolation from other cognitive sciences, a need for methodological diversification and improvement, and an absence of good, competing theories. One of *Weaving*'s contributions is therefore the spotlight it throws on the need for word-learning research to learn from other domains, including cognitive ethnography, modern linguistics, experimental and theoretical neuroscience, machine learning and 'good old-fashioned' cognitive and experimental psychology.

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