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REVIEW ARTICLE
Representation and Processing Really Are Stuck with Each Other

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INPUT AND EVIDENCE: THE RAW MATERIAL OF SECOND LANGUAGE ACQUISITION. *Susanne E. Carroll*. Amsterdam: Benjamins, 2001. Pp. xviii + 462. $114.00 cloth.

The ambitious goal of this book is the exposition of "a truly explanatory theory of SLA" (back cover). Such a theory is bound to be multifaceted and complex, and indeed, Carroll draws from a variety of theoretical frameworks in exploring the relationship between input—or more precisely, the nature of the mechanisms brought to bear in processing language stimuli—and the nature of the language knowledge that (adult) second language (L2) learners ultimately acquire. In other words, a theory of acquisition must be integrated with a theory of speech processing to explain how language stimuli are transformed into abstract mental representations; this book represents Carroll's attempt to construct just such a model.

For her theoretical foundation, Carroll adapts Jackendoff's (1987) Representational Modularity, in addition to selectively using pertinent aspects of other models—for example, Sperber and Wilson's (1986) Relevance Theory; Holland, Holyoak, Nisbett, and Thagard's (1986) Induction Theory (minus its locus solely within the conceptual system); Johnson-Laird's (1983) Mental Models (minus schemas); Chomskyan (1981) Universal Grammar (minus parameters); and Bates and MacWhinney's (1987) Competition Model (minus the model's connectionist underpinnings positing a direct, unmediated link between stimuli and grammar). The book is dense as a result, because Carroll takes the reader through the core tenets of these and other theories with their attendant technical machinery, in the meantime sideswiping, if not broadsiding, most other approaches to SLA. However, each piece of her model is moti-

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vated and carefully argued for, and if the end result is rather complicated, well, that is the nature of the beast.

The first two chapters do an excellent job of sorting methodically through the requirements of a complete theory of SLA. Chapter 1 outlines the research objectives, focusing in particular on the need to define and differentiate the specific kinds of input required at each level of information processing. Stimuli available to the perceptual systems must first be converted into usable mental representations (such as CV syllables) that in turn serve as input to speech parsers, which are "tuned to the frequency of particular structures in the language the learner hears" (p. 10). Input to parsers is distinguished from input to learning mechanisms in that new learning occurs precisely when parsing fails. Input to learning mechanisms can thus come from incompletely parsed stimuli but can also be derived via inferencing—for example, from feedback and correction. One nice insight here is Carroll's reminder that input should not be viewed as something "out there" in the environment but rather as a product of language processing—a mental representation of selected properties of the stimuli on which the human mind or brain has imposed structure of a particular sort.

Chapter 2 argues that an explanatory theory of SLA must consist of at least four subparts: (a) a property theory of mental grammar representations that inform the parsers, (b) a transition theory of how mental grammars change over time, (c) a performance theory linking changing language knowledge states to the input, and (d) a learning theory that explains how grammatical restructuring takes place—that is, what happens when parsing fails.

Considerable space in chapters 2, 3, and 6 is devoted to a critique of generative SLA research, and indeed, Carroll notes in prefatory remarks that the book itself grew out of "increasing dissatisfaction" with generative work in SLA in the 1980s. She acknowledges that "an adequate theory of SLA must be grounded in a property theory of language adopting structural constructs provided by Universal Grammar (UG), and including the basic notion of autonomous levels of representation" (p. 67); such constructs include, for example, notions of structure dependence and c-command, and the observation that language is apparently encoded in the "right" representational systems in the L2 as in the L1 (p. 107). For SLA, in other words, UG (although not Principles and Parameters [P&P] theory) can constitute at least part of the right property theory in SLA.

As part of a transition theory for SLA, however, Carroll argues that UG fails, particularly regarding parameter theory. Carroll denies the reality of parameters as a biological construct, perhaps even in L1 acquisition (where she argues we should probably instead speak of canalization) and certainly in terms of conceptualizing SLA as involving the resetting of parameters. She observes that, if parameters correspond to actual neurological structures involved in selective learning, then the same parameter cannot be reset in L2 acquisition because the L1 setting obviously remains intact in the L1. This argument rests on her claim that there is no compelling evidence to suggest that the L2 is

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supported by distinct neurological structures from those of the L1 (p. 95), although this has indeed been suggested for some kinds of grammatical processing for later L2 acquirers by, for example, Kim, Relkin, Lee, and Hirsch (1997); Neville, Mills, and Lawson (1992); and Weber-Fox and Neville (1996), none of which are cited. In fact, more compelling arguments against viewing parameters as actual entities can be found in Fanselow (1993) and especially Haider (1993), also not cited.

Carroll notes that theoretical successors to P&P theory such as the Minimalist Program and Optimality Theory rely more on absolute universals than on parameters (p. 44). Given her observations regarding the direction taken by generative theory over the past decade, one might wish for greater engagement with at least the broadest outlines and implications of more recent theorizing rather than her vigorous and quite meticulous beating of a (nearly) dead horse.

Given that L1 transfer within P&P theory has often been viewed as involving learners' reliance on L1 parameter values in the L2, how does transfer operate in a parameterless model? Carroll suggests that what really transfers is the set of L1 parsing and production procedures—that is, for L2 speech processing the parsers are still attuned to L1-specific cues for category classification and filter out L2-specific ones.

As Carroll rightly observes, UG's grammatical periphery—what Carroll refers to as "the flotsam and jetsam of specific language systems" (p. 40)—is ill defined, yet of course is hardly trivial or marginal and must be learned. The mechanism that accomplishes this is induction, or *i-learning*. Chapters 4 and 5 elaborate Carroll's own model of SLA, the Autonomous Induction Theory (AIT). Under the AIT, following Jackendoff, the language faculty consists of highly structured, domain-specific levels of representation (e.g., for phonetics, phonology, and syntax) that mediate the mapping from environmental stimuli to meanings and that interact with each other via correspondence rules that translate information from one representational format to another. For example, not everything representable in the conceptual system gets encoded at the levels of morphological or phonological form, which for the AIT has important implications for constraining the role of feedback and correction in grammatical restructuring.

Induction within the AIT is autonomous because it occurs within several domains, subject to "the operations and primitives of specific representational formats" of each domain (p. 120). The conceptual domain is hypothesized to be a convergence point for several information paths or "chains"—for example, for speech perception and comprehension, the representational chain might consist of low-level auditory analysis, acoustic-phonetic analysis, phonological analysis, lexical activation, lexical selection and integration, morphosyntactic analysis, semantic analysis or pragmatic inferencing, and integration (p. 121). Crucially, information can flow either bottom-up (from acoustic information "up the chain" to conceptual structure) or top-down (from conceptual structure "down the chain" to phonology), which explains how incom-

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pletely parsed utterances can nonetheless be interpreted. Carroll notes that if "the parser cannot compute a parse of the stimulus, the meaning derived must be derived via inferencing. The information stored in the conceptual system must then be able to influence the parsers" (p. 290). Top-down processing also allows a limited effect for correction on restructuring the grammar (which, according to Carroll, depends on pragmatic inferencing).

As mentioned previously, learning occurs when parsing fails. The i-learning mechanism consists of a set of procedures, or functions, that are triggered when parsing cannot analyze current input with available parsing procedures. These functions can recategorize elements and construct or activate new representations, associations, or analogies. These alternative representations and the cues that trigger them (e.g., phonological, conceptual, or distributional) then compete as the "solution" in analyzing a novel form (p. 136). Furthermore, the errors that trigger i-learning must be detectable errors whose representation is inconsistent with the learner's existing representations.

The detectability requirement explains why L2 learners can fail to attain a nativelike endstate—the parser fails to detect errors or mismatches between the input and the learner's existing representations but may still be able to assign an interpretation based on pragmatic inferencing. In such cases, Carroll argues, "feedback and correction will be the mechanism which will make it clear to the learner that his parsing strategies are wrong and that ignored stimuli provide critical cues to the proper analysis of the sentence" (p. 305). The question as to why the parser's failure to detect mismatches apparently persists to a far greater extent in adult L2 acquisition than in L1 acquisition is not addressed.

The last three chapters of the book more closely examine the role of different kinds of feedback and correction in SLA. Carroll reviews several empirical studies of the effectiveness of providing indirect negative evidence, metalinguistic instruction, and explicit feedback and correction. First, she argues that it has not been shown that indirect forms of feedback, which manipulate learner output, lead to grammatical restructuring. Assuming representational modularity, Carroll interprets the claim of the Interaction Hypothesis to mean that "the learner is able to construct a representation *at the relevant level of analysis* [italics added] and compare her output—*at the right level* [italics added]—to that" (p. 292), an ability that strikes her as "highly implausible" (p. 293). Although negotiation of meaning fails, in her view, to affect grammatical restructuring, it can enhance the identification and recall of lexical items. Interactionists will be irritated here with Carroll's failure to include in this section more recent work that might address some of her criticisms, including Long's more updated (1996) version of the Interaction Hypothesis.

Turning to the effects of metalinguistic instruction on acquiring specific properties of the grammar, Carroll notes that results are mixed, with several experimental studies showing positive effects of instruction on various performance measures. Has actual grammar restructuring occurred, however? Carroll's view is that the "most parsimonious" position is to "simply assume that

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all results which indicate that learning occurred are also support for the claim that grammatical restructuring occurred" (p. 299). She is well aware, however, that in at least one study reviewed that included a long-term posttest (White 1991), "the effects of instruction clearly did not last" (p. 298), casting some doubt on whether learners who in the short term showed positive learning effects had, in fact, restructured their L2 grammar.

Of particular interest to Carroll are input processing studies that, rather than manipulating learner output, focus instead on structuring the input—that is, drawing learners' attention to particular forms in the environment that might otherwise be filtered out as noise (say, due to reliance on L1 parsing strategies). Such studies in her view clearly show that SLA "takes place on the basis of the parsing of stimuli, lest anyone have any doubts on this score" (p. 308).

Regarding the role of explicit negative feedback and correction, Carroll concludes that it can lead to learning information associated with individual lexical items as well as more abstract generalizations that could be applied to novel items (p. 321). On the basis of the studies reviewed in chapter 8, however, including some apparently unexpected and "difficult to interpret" (p. 337) findings from one of her own studies introduced there, the results again appear mixed. Carroll's strength in this latter part of the book lies in theoretically motivating just what sorts of information could in principle be learned on the basis of corrective feedback, given the assumptions of representational modularity.

Just as environmental stimuli do not intrinsically instantiate grammatical structure, so too for corrective feedback. Carroll writes that "no utterance is intrinsically corrective in nature" (p. 348) and argues that an utterance counts as corrective only if the learner is able and willing to metalinguistically construe that utterance as expressing corrective intent. Because repetitions and other types of indirect feedback do not require the learner to attribute corrective intent to an interlocutor, they require more pragmatic inferencing and the learner is less likely to interpret them correctly. Thus Carroll argues that "contrary to common assertions in the interaction literature, the 'best' feedback and correction is probably the most explicit—which is the least likely to occur" (p. 390).

Moreover, assuming representational modularity, the necessary involvement of metalinguistic conceptual representations in interpreting feedback and correction means that only some areas of the grammar will be susceptible to restructuring via correction. These include information in lexical entries and aspects of linear order. On the other hand, Carroll argues, this leaves "huge areas of grammatical competence potentially impervious" to correction, such as aspects of meaning, morphosyntactic features, sublexical word structure, subsegmental aspects of phonology, and all of phonetics (p. 394).

Finally, for feedback and correction to be effective, the timing must be right. If it is too early in development, Carroll observes, the corrective utterance may be unparsable. If it is too late, and the learner has already learned the

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information despite being unable to control it well in spontaneous production, the learner may dismiss it as redundant and thus irrelevant (technically Irrelevant, in Sperber & Wilson's [1986] sense).

In considering virtually the entire range of the language faculty from phonetics to pragmatics, as well as the role of language processing in the construction of mental representations within these domains, while still maintaining an appreciation for their internal complexity, Carroll manages to integrate several heretofore disparate research areas into a coherent model of SLA. The book itself is imperfect—much is outdated and it is difficult to keep track of all the theoretical constructs associated with all the different theories under discussion, only certain subsets of which are likely to be familiar to any one reader. (On the other hand, one cannot help but be impressed by the extraordinary breadth of Carroll's research for this book.) Given the model's complexity, there is little explicit guidance on what sort of specific testable predictions can be developed from it. Stylistically, the tone is cranky and polemical (e.g., sentences beginning with "No one in SLA has bothered to . . ." appear twice on the same page). Occasional typos may cause some minor confusion (e.g., the examples on p. 309 from Izumi & Lakshmanan's [1998] study both illustrate the "direct" passive rather than contrasting direct and indirect passives in Japanese; "Speaker A" on p. 355 should read "Speaker B").

In overall substance, however, for those of us interested in the relationship between linguistic theory and second language acquisition, Carroll's insightful book has landed in the field at an opportune time, countering what Jackendoff (1997, p. 15) has dubbed the "syntactocentrism" of Chomskyan generative theorizing. Within the Minimalist Program, many of the interesting questions for language acquisition study have been pushed aside or, more precisely, into the theoretical black hole of the interfaces of the articulatory-perceptual and conceptual-intentional systems and the lexicon. Carroll's emphasis (following Jackendoff) on the nature of language representations at these interfaces and her explicit model of how such representations get constructed in SLA and can or cannot be modified by corrective feedback represent a truly important and valuable contribution to the field.

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