24 SLA and Cognitive Science

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Little more than three decades of research since modern SLA emerged as a serious field of inquiry in the late 1960s have brought significant advances in our knowledge of the acquisition process and of typical patterns in final achievement. A neo-behaviorist conception of second language learning as the substitution of one set of language patterns and habits for another through such opaque processes as "overlearning" has been replaced by an awareness that, to the extent that habit formation plays a role at all, it is in the development of skill and fluency, not to be confused with the new underlying L2 knowledge system that makes "skill" and "fluency" possible – and knowledge is a matter of mind, not behavior. A discernible trend, therefore, especially in the 1980s and 1990s, has been for increasing numbers of researchers and theorists, rationalists all, to focus their attention on SLA as an internal, individual, in part innately specified, cognitive process – one that takes place in a social setting, to be sure, and can be influenced by variation in that setting and by other interlocutors, as demonstrated by several chapters in this volume, but a psycholinguistic process, nonetheless, which ultimately resides in the mind-brain, where also lie its secrets.

A discernible trend does not imply consensus or unanimity, however, and there remain identifiable groupings of scholars – socioculturalists, conversation analysts, and action theorists, for example – who persist in seeing external learner behavior, even group behavior, not mental states, as the proper domain of inquiry. More generally (and more vaguely) there are "critical theorists" and an often overlapping group of self-professed epistemological relativists, who express general angst with SLA's cognitive orientation and/or its growing accountability to one or more theories and to empirical findings while offering no alternative but the abyss.

In this light, it is not surprising that indications abound of increasing tensions and fragmentation within the field. More conferences are held which

offer platforms primarily or exclusively for papers with one or other theoretical allegiance, journals are born which attempt to do the same, research funding is sought from different government agencies and private foundations depending on the kind of work involved, philosophical assumptions range from rationalist to relativist, an array of qualitative and quantitative research methods is imported from the various disciplines in which SLA scholars were originally trained, and (healthily increasing numbers of) jobs for SLA specialists are offered in a variety of university departments, including linguistics, modern languages, psychology, English, and education. (To our knowledge, there are as yet no departments of first or second language acquisition.) Given such variability and growing diversification, it is becoming less and less clear whether "SLA" is viable as a discipline at all, or where its future lies if it has one. SLA has traditionally hovered on the borders between the humanities and social sciences, yet many scholars (including most authors in this volume) identify themselves increasingly as cognitive, not social, scientists.

Cognitive science is a field whose unifying focus is its principal object of inquiry: the mind. Cognitive scientists accept that study of cognitive phenomena involves use of the notions of representation and computation, and further that successful research will require interdisciplinary collaboration. Cognitive scientists conduct research on such matters as the evolution and nature of human intelligence; intelligence and reasoning in humans, other animals, and machines; novice and expert approaches to problem solving; individual and group (e.g., cultural) differences in cognition; the localization of mental functions in the brain; biological constraints on language development; the neural bases of perception, learning, and memory; the ways language is processed, acquired, stored, accessed, and used; and relationships between innate and learned knowledge. Applications include robotics, information processing, data retrieval, medical diagnoses and treatments, manufacturing, telecommunications, human–computer interaction, treatment of communication disorders, and the design of instruction.

While knowledge, intelligence, reasoning, consciousness, and thought processes in general have occupied philosophers from Aristotle and Plato to the present day, modern cognitive science is generally accepted as dating from three major developments in the late 1950s and early 1960s. The first of these, based on pioneering work by the British mathematician Alan Turing in the 1940s and 1950s, and the building of the first digital computers soon thereafter, was the initiation by Minsky, Newell, Simon, and others in the 1960s of research programs in artificial intelligence, producing such early successes as Newell, Simon, and Shaw's computer program, Logic Theorist. The second development was the dismantling of the behaviorist hegemony in psychology, begun by Miller's work on short-term memory and Chomsky's famous review of Skinner's *Verbal Behavior* in 1959, and its replacement by a pre-eminently cognitive, information-processing approach that holds sway to this day. The third, heralded by the publication of Chomsky's *Syntactic Structures* in 1957, was related work on language and language learnability by

Chomsky, Fodor, and others that replaced the patterns and habits of American structuralism with the rules and modules of the generative tradition, and had a lasting impact on linguistics and on research in first and second language acquisition.

A survey of publications in the journal *Cognitive Science* and presentations at the annual meeting of the Cognitive Science Society from 1977 to 1995 (Schunn, Crowley, and Okada, 1998) found that two disciplines, cognitive psychology and computer science, had dominated both journal and conference during that period, between them accounting for over half the articles and papers. This dominance may soon change, however. The dramatic increase in the accessibility and use of computers in numerous areas of public and private life has given further impetus to the field, simultaneously providing both seemingly endless new applications and the technological means to achieve them. Not unrelated, in neurophysiology, new brain scanning and imaging techniques, notably computer-assisted tomography, positron emission topography, and magnetic resonance imaging, have led to greater understanding of the functions of different cerebral areas, for example, the location of various linguistic abilities and memory, and relationships between cognitive impairments and anatomical damage in different locations, and have made cognitive neuroscience an increasingly central and successful research area.

While the new science is still young, indications of its institutional recognition have grown rapidly over the past 25 years. The journal *Cognitive Science* was founded in 1977, and the Cognitive Science Society in 1979. Cognitive science programs at the undergraduate and graduate levels are offered by over 60 universities in North America, Europe, and Australasia, with new ones announced every year. Conferences devoted to the whole field or to domains within it are ever more numerous.

As is inevitable in the emergence of any new discipline, the first generations of cognitive scientists hail from diverse academic backgrounds and training programs: artificial intelligence, linguistics, anthropology, biology, neuroscience, philosophy, physiology, mathematics, education, speech and hearing, library information science, computer science, electrical engineering, and more. Most hold formal academic qualifications in those fields, not in cognitive science per se, and collectively they employ a large variety of research methods in their work. The formal academic training now available in the new discipline tends to consist not of a lengthy series of courses in "cognitive science" per se, either, but of one or two introductory survey courses, followed by extensive work in one or more of the feeder disciplines, such as psychology or computer science, emphasizing domains inside them that speak to the broader issues and applications of interest outside, in cognitive science.

The huge diversity of the new discipline means that the work of some practitioners is unintelligible or of only marginal interest to others, and that some research which appears in cognitive science books and journals could just as easily appear in publications within the source discipline, and vice versa. It is not surprising, therefore, that questions have been asked both within the field

and by outsiders as to whether a discipline of cognitive science distinct from the disciplines on which it draws really exists, or whether "cognitive science" is just an umbrella term for (sometimes very) loosely related work in each of them. Moreover, is it the case that to qualify as cognitive science, particular research programs should be multidisciplinary (this is sometimes referred to as the *localist* conception of multidisciplinarity; Schunn et al., 1998), or, more inclusively, is it enough that multiple disciplines contribute to the field's overall research program (the so-called *holist* conception; Von Eckardt, 2001)?

To the extent that *Cognitive Science* and the Cognitive Science Society reflect tendencies in the field as a whole both inside and outside the USA (and they may not), the evidence suggests that cognitive science is more than just the sum of its parts, that it increasingly has an identity of its own, independent of, albeit closely related to, its source disciplines. Thus, as indicated by departmental affiliations of first authors, collaboration make-up of authors, research methodology used (computer simulation and/or empirical study, or neither), and disciplinary sources of previous theories and results cited, Schunn et al. (1998) noted that despite the steady dominance of psychology and computer science overall (linguistics and philosophy being very minor players thus far), multidisciplinary studies were on the increase, accounting for 30–50 percent of work in the journal in recent years. The same was true of "cognitive science" departments or institutes as authors' primary work affiliation, recently amounting to nearly 20 percent of the papers.

Cognitive science and SLA, it transpires, exhibit many of the same characteristics: youth, interdisciplinarity, theoretical and methodological diversity, and lack of a single clear institutional home. Cognitive science has the immense advantage, however, of the substantive coherence accruing from its common focus of inquiry, the mind and cognition. As reflected in the chapters in this volume, many SLA scholars share that focus: grammatical nativists, general nativists, connectionists, processing researchers, those studying individual differences in such attributes as age, aptitude, intelligence, memory, or cognitive style, and those investigating such processes as implicit, explicit, incidental and intentional learning, and automatization, among others. Underlying all their work is a shared conception of SLA as a cognitive process involving representations and computations on those representations. There is a big difference between that conception and the view prevalent among some applied linguists that would equate "SLA" with almost any research having to do with non-natives when they *use* a second language. Much of the work that would be included under the broader definition is rigorous and valuable, but little of it has anything to do with how people *learn* a second language – or, at least, a connection has yet to be demonstrated.

But a common focus is not enough. For SLA to achieve the stability, stimulation, and research funding to survive as a viable field of inquiry, it needs an intellectual and institutional home that is to some degree autonomous and separate from the disciplines and departments that currently offer shelter. Cognitive science is the logical choice.

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