Response to Pepperberg; Herman and Uyeyama; and Shanker, Savage-Rumbaugh, and Taylor

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Whether the animals studied by Pepperberg, Herman, and Savage-Rumbaugh can learn prepositions remains an open and important question, though the dolphins' use of demonstratives and conjunctions suggests an impressive competence for at least some closed-class items. It is unlikely that human-like brain structure can explain the capacities of these animals. Their capacities may instead be built upon the cognitive mechanisms favored by social complexity.

In their thoughtful, stimulating commentaries, Pepperberg (1999), Herman and Uyeyama (1999), and Shanker, Savage-Rumbaugh, and Taylor (1999) have addressed a number of important issues. I will here focus on just three: closed-class items, the relations of brain structure and social complexity to linguistic capacity, and the importance of continued research on the linguistic capacities of nonhuman animals.

Closed-Class Items

I am pleased to hear that Pepperberg (1999) has proposed to teach Alex closed-class items, although I am disappointed that she has not yet done so. I disagree that Alex's success in learning *in* versus *on* (or *above* vs. *below*) would be trivial. Like Pepperberg, I strongly suspect that Alex possesses the necessary spatial concepts. The question is whether he can *map* those concepts onto lexical items and whether he can *use* those lexical items compositionally, in comprehension and production (to interpret a question like "What color hide in bowl?" or to respond to the question "Where yellow hide?" with "In bowl"). To date, Alex has succeeded in the mapping and compositional use of concepts related to object class, property, and number. It remains to be seen whether he can map and use the geometric and relational concepts relevant to prepositions.

Herman and Uyeyama (1999) present persuasive evidence that the dolphins have learned two closed-class items—the demonstrative (pronoun) *THAT* and the conjunction *AND*. I am especially impressed by their capacity to use demonstratives in the comprehension of relational commands (e.g., *THAT* *FETCH* *THAT*). The dolphins' mastery of *LEFT* and *RIGHT* is very striking, as these terms encode abstract, egocentric reference points. However, they are not closed-class items, but rather belong to the open-class set of nouns (at least in English).¹ Whether

the dolphins can learn prepositions remains an open question. I agree with Herman and Uyeyama that teaching *IN* versus *ON* would require the teaching of a new verb like *TAKE*; otherwise, as they point out, the verb *PUT* would become redundant, and we would have no way of telling whether the dolphins were interpreting the string compositionally.

Brains, Social Complexity, and Convergent Evolution

Herman and Uyeyama (1999) and Shanker et al. (1999) attribute the syntactic capacities of their subjects to human-like brains. To be sure, structural similarities do exist, but so do striking differences. Although it is true, as Herman and Uyeyama say, that dolphins and humans are both highly encephalized (i.e., the brains of both species are much heavier, relative to their body weight, than are the brains of other mammals), it is also true that humans are substantially *more* encephalized than dolphins (Marino, 1998). Moreover, cetacean brain *organization* differs markedly from primate brain organization, both in morphology and in cytoarchitecture (Glezer, Jacobs, & Morgane, 1988; Morgane & Jacobs, 1972). Chimpanzee brains are also less encephalized than those of humans. And, although the chimpanzee brain is more human-like in organization (for obvious reasons), the chimpanzee prefrontal cortex is substantially smaller in proportion to the rest of the cortex than is the human prefrontal cortex, which is anomalously large among primates (Deacon, 1997).² Any argument that attributes common linguistic competence to neuroanatomical similarity fares even less well when we consider the accomplishments of Alex, whose avian brain has an even more strikingly different organization.

Why, if their brains differ so much from the human brain, do these three species show competence in at least some of the core properties of human syntax? One possibility, which I explore in the General Discussion section of my paper, is that they emerge from similar ecological pressures operating to favor similar abilities—in other words, convergent cognitive evolution. This conver-

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gence may be driven in part by the demands of social complexity—including the need to keep track of individuals, their relationships, and their history of interactions (see, e.g., Barton & Dunbar, 1997; Humphrey, 1976). Both Pepperberg (1999) and Herman and Uye-yama (1999) appear to find this suggestion attractive. Pepperberg proposes that, because parrots live in complex social systems not unlike those of primates, their “cognitive abilities, whether or not syntactically expressed, should match those of nonhuman primates” (p. 17). Herman and Uye-yama, too, emphasize the social complexity of the dolphins, noting that the learning demands imposed by social complexity require “advanced cognitive skills” (p. 22). Whether social complexity really favors the cognitive substrates necessary for linguistic competence remains to be seen. To test this hypothesis, we would need data from a wide range of language-trained species that vary in their social complexity.

The Significance of This Research

Both Pepperberg (1999) and Shanker et al. (1999) are surprisingly pessimistic about the utility of further research on the syntactic abilities of their animals. Pepperberg’s stated goals are “to examine *cognitive* similarities and differences, and to determine what, if any, continua exist in cognitive and information processing abilities across and between species.” Syntactic capacities, in her view, are “too fraught with alternative interpretations” (p. 17). Shanker et al. voice confidence that Kanzi and Panbanisha will show competence with morphosyntax (e.g., understanding that the closed-class marker *-s* signals the plural). Yet they appear to shy away from further exploration of these capacities, because positive results cannot “lay to rest the discontinuity thesis” (p. 24). However carefully the research is done, there will no doubt be many who remain unpersuaded and rush to offer (sometimes byzantine) alternative explanations. But a lack of data will do nothing to change this situation.

I encourage Pepperberg (1999) and Shanker et al. (1999) to take the position advocated by Herman and Uye-yama (1999), who state that “the animal language work can help us to identify with more surety those processes in humans that may derive from general cognitive structures rather than from language-specific structures” (p. 22). By con-

ducting crucial experiments informed by prior research on human language acquisition, we can learn more about the extent to which language is built upon other cognitive capacities and about the power of natural selection to produce similar capacities in differently organized brains.

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NOTES

1. Because they can precede nouns, *left* and *right* might at first appear to be adjectives. However, this fact alone does not qualify a word as an adjective. Many nouns can precede other nouns in a modifying relationship (e.g., *maternity dress*). And *left* and *right* do not behave like adjectives in any other way. Although one can say both *his skillful sewing* and *his left hand*, only *skillful* can be turned into a noun or an adverb: Compare *the skillfulness of his sewing* and *he sews skillfully with the lefiness of his hand* and *he sews leftily*. (I thank Larry Trask for this observation and for these examples.)

2. Deacon (1997) has argued that the emergence of language depended crucially on the expansion of the prefrontal cortex. Studying the linguistic capacities of animals whose prefrontal cortexes are either much smaller or absent should help to illuminate the role of this structure in human language.