The Cognitive Sea Lion: Meaning and Memory in the Lab and in Nature
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The pinnipeds, or seals, sea lions, and walruses, are descendents of terrestrial carnivores. In contrast to their fully aquatic counterparts, the dolphins, they are shorter lived, have less complex social organization, and have only average-sized brains in proportion to the size of their bodies. Despite these facts, some pinnipeds species display obviously intelligent behavior, seen in the ease of their trainability in oceanaria settings and in their ability to trick unlucky fishermen from their catch. The quick wits and adaptability of one species in particular, the California sea lion, make it an ideal subject for our laboratory studies of problem solving and memory.

Sea Lion Language Learning

Historically, a "top-down" approach has been used to study cognition in a select group of mammals, including the great apes and bottlenosed dolphins. This approach emphasized the search for rudiments of language in nonhuman animals, and our own early work on sea lion cognition, namely teaching them to comprehend an artificial gestural sign language (Schusterman and Gisiner 1988, 1989, 1997; Schusterman and Krieger 1984, 1986) was inspired by the apparent success of similar research with bottlenosed dolphins (Herman et al. 1984). Throughout much of the 1980s, we focused our efforts on teaching three sea lions to relate particular gestural signals to objects (such as bats, balls, and rings), modifiers (large, small, black, and white), and actions (such as fetch, tail touch, and flipper-touch). These signals could be combined into over 7,000 different combinations, each instructing the animal to carry out a specific behavioral sequence. For example, in what was termed a ‘single object’ instruction, the presentation of four signs such as SMALL WHITE BALL FLIPPER-TOUCH would usually result in the sea lion touching the small white ball with its flipper, while ignoring the irrelevant objects in the pool (see Figure 1). More complicated instructional sequences required the sea lion to press one of two paddles to indicate whether an object was present or absent. The most complicated instructions required the sea lion to select one object in the tank and bring it to another. These ‘relational’ sequences could include up to seven signs; for example, the gestural sequence LARGE WHITE CONE, BLACK SMALL BALL FETCH instructed the sea lion to bring the black small ball to the large white cone. Our sea lions were eventually able to respond appropriately to familiar as well as novel combinations of signs with a great deal of accuracy, as shown in Figure 2 which describes the performance of our most experienced sea lion, Rocky.

Our results with the sea lions on the language-learning task gave us insight into several aspects of their cognitive abilities. Obtaining positive results with animals that were smaller brained, shorter lived, and less social than apes and dolphins led us to speculate that we were dealing with general learning processes rather than specialized cognitive abilities such as language. Instead of comprehending the instructional sequences within a linguistic framework, we believed that our sea lions, and perhaps other animals trained on similar tasks, were learning specific problem solving rules via associative mechanisms we will describe below.

The artificial language tasks also led us to make predictions about how sea lions represented and remembered critical information. For example, our sea lion Rocky exhibited a stereotyped search response following her observation of the gestural cue denoting an object. As soon as she was given the cue, Rocky would turn her head to the left and slowly scan the pool until she located the correct object, at which point she would return to station to wait for the action signal to be given (see Figure 1). Her purposeful search for the specified object suggested that she was coding the object signal prospectively; that is, she was translating the gestural cue into a representation, or search image, of the target object. This search image hypothesis is further supported by Rocky’s performance on trials based on the presence or