

Thinking about the out-of-sight: Referential use of video in chimpanzees

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Introduction

The ability to transfer meaning from displaced reference to real-life experience is not only a prevalent phenomenon in humans but also has long been considered as one of the defining features of human language. It enormously extends the range of information we can engage with, from things that are within our current perception to those that are displaced in space and time. However, the extent to which rudimentary forms of this ability are shared with nonhuman animals remains largely unclear.

Methods

In this study, I used video as a study tool and examined the cognitive underpinnings for displaced video reference using videos embedded with spatiotemporally distant problem-solving tasks. To explore possible primate precursors of displaced reference in human language and cognition, I studied chimpanzees (*Pan troglodytes*), the primate species that has previously exhibited behaviors presumed to involve the ability to extract information from video, but has not yet been explicitly examined on their ability to utilize video as displaced reference. I tested chimpanzees in the following two sets of experiments.

In Chapter 2 of the first set of experiment, I explored whether chimpanzees are capable of utilizing video as displaced reference in a spatiotemporally distant search for hidden food. I used video to inform chimpanzees about an otherwise unobservable food-hiding. I examined the extent to which chimpanzees would make use of video as a source of information to guide their retrieval of hidden food from a target container.

In Chapter 3 of the second set of experiment, I explored chimpanzees' ability to utilize displaced video reference in solving a prospective tool procurement task. It is well known that chimpanzees not only use objects as tools for extracting encased food items, but they also prospectively procure tools. When suitable tools are not immediately accessible at the tool use site, chimpanzees select tools in advance and transport them from other sites. However, what cues chimpanzees would use when prospecting for future tool-use situations during tool procurement is still largely unclear, impeding our understanding of the cognitive mechanisms involved in tool procurement and their role in the evolution of prospective ability. To address this question, I presented live videos about available type of food prior to chimpanzees' tool selection. I examined whether chimpanzees can use the video as a cue for prospective tool procurement (experiment 1) and whether the chimpanzees who acquired the ability to solve the tool procurement task with familiar tools, would generalize the ability to novel tool situations (experiment 2). The tool procurement task was conducted across two separated sites. First, chimpanzees could

select a tool at the tool procurement site, then transport it to the tool use site and use it to extract food.

Results

In Chapter 2, I found that when the events of observing food-hiding and retrieving the hidden food were close in space and time within the same room, all chimpanzees solved the task. Some chimpanzees continued to solve the task even when the two events were distant and separated spatiotemporally, in which they had to move to the next room between the events. The findings suggest that chimpanzees can utilize video as a displaced reference to retrieve hidden food later, solving real-life problems.

In Chapter 3 I found that, through trial and errors with information presented on live video, chimpanzees learned to procure the tools most likely to be functional, according to what type of food was available at the tool use site. This suggests that chimpanzees' tool procurement can result from prospective evaluation of subsequent utility of specific tools before moving to the tool use site. Moreover, one chimpanzee immediately applied the tool procurement solution to novel tools, indicating that an inflexible, stimulus-dependent mechanism alone does not account for all tool procurement decisions.

Discussion

Taken together, through the two sets of experiments using videos embedded within spatiotemporally distant problem-solving tasks, this study provided empirical evidence suggesting that chimpanzees can utilize video in a rudimentary, non-linguistic form of displaced reference in human language. Specifically, chimpanzees solved the tasks based on not only concrete relations of objects (i.e. perceptual similarity of the food container, Chapter 2; functionality of the tool for food extraction, Chapter 3) but also on abstract relations (i.e. spatiotemporal contiguity between events, Chapter 2; and rapid generalizability to novel exemplars, Chapter 3). Also, the act of referring at the time of decision-making (select between the target and distractor) can occur in both a retrospective (Chapter 2) and prospective (Chapter 3) manner. For both two sets of experiments (Chapters 2 and 3), it is also noteworthy that although chimpanzees can learn to solve the tasks utilizing videos as displaced reference eventually, they are not necessarily good at it in the beginning, consistent with previous findings in human children showing the gradual emergence and development of displaced reference. These underlying cognitive processes that enable language to convey information about spatially and temporally displaced entities, therefore have emerged before language evolved. The current experimental paradigm, using videos embedded with spatiotemporally distant problem-solving tasks, can be a feasible approach for future research to further elucidate the underlying mechanisms and evolutionary origins of spatiotemporally displaced reference.