Socially-Directed Behavior in Bonobos Facing Danger

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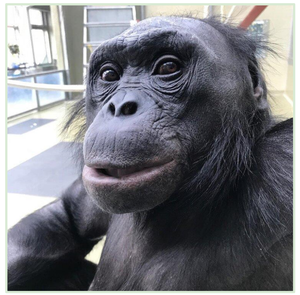
Introduction

Theory of mind (TOM) refers to the ability to assign mental states to another individual; it's a cognitive skill that allows one to predict future behaviors others. Chimpanzees have shown TOM behavior in previous studies (1, 2). Crockford et. al hypothesized that TOM behavior in chimpanzees occurs more when a group member is unaware of a threat. The study used vocalization of alarm calls and "marking" behavior to test their hypothesis.

Our study modifies Crockford et. al's procedure to test TOM behavior for bonobos by using animated videos with an avatar bonobo and a snake. **We hypothesize bonobos show greater TOM behavior and will communicate with a group member unaware of danger and demonstrate their awareness of a threat. Our hypothesis predicts that subjects will exhibit more alarm calls, scratching, and vigilant behaviors in the ignorant video than in the knowledgeable video.**

Subjects



Kanzi

Teco

Nyota

Clara

Maisha

Mali

Elikya

N = 7 bonobos (*Pan paniscus*), 3 males, 4 females (range 13 - 43 years old, mean age: about 23 years old) from the Ape Initiative Center, Des Moines, IA. All procedures were in accordance with the ASAB/ABS Guidelines for the Use of Animals in Research. The research was approved by the Institutional Animal Care and Use Committee of the Ape Cognition and Conservation Initiative (IACUC # 180711-01).

Ethogram

Behavior	Description
Alarm Call	Vocalizing a shrill, high-pitched call indicative of danger or emergencies.
Scratching	Rubbing any area of the body using an object or self; one scratch is counted as one direct contact to body with self.
Looking Behind/Over Shoulder	Head movement and redirection of gaze toward behind the subject.

Procedure

The seven bonobos were each subject to two test videos. We ran one trial of both videos for every subject. We record subjects' reactions by setting up two cameras from close up and afar, and starting videos once subjects focus on the screen. For both videos, a visual cue then prompts the subject to look toward the direction where the snake will appear.

Fig 1. The bonobo avatar first appears on the video facing forward. No audio plays and the danger is not present.

Fig 2. The bonobo avatar then turns around, facing backward away from the site of the danger.

The ignorant video represents a case when a bonobo's group member is unaware of a threat. We simulate this situation by facing the bonobo avatar backward and playing audio of a bonobo's "resting call," or a call a bonobo emits when it is content and not in danger. Therefore, the bonobo avatar is ignorant to the threat because it is emitting a resting call and turned away from the snake animation. The snake approaches the unaware bonobo on a loop for three minutes, with thirty seconds per loop.

Fig 3. A flash appears in the animation to alert subjects of the appearance of the animated snake.

Fig 4. The snake approaches the avatar on a loop for three minutes, with thirty seconds per loop.

The knowledgeable video follows the same procedure but has the bonobo in the video emitting an "alarm call," or a high-pitched sound it makes when danger is present. Even though the bonobo is still facing backwards, the audio of the alarm call to simulate the avatar bonobo vocalizing the call allows subjects to perceive the avatar as aware of the snake. To analyze whether subjects displayed theory-of-mind behavior, we coded for alarm calls, scratching, and vigilance, such as looking behind. The frequency of these coded behaviors were the dependent measures we tested to prove our hypothesis.

Results

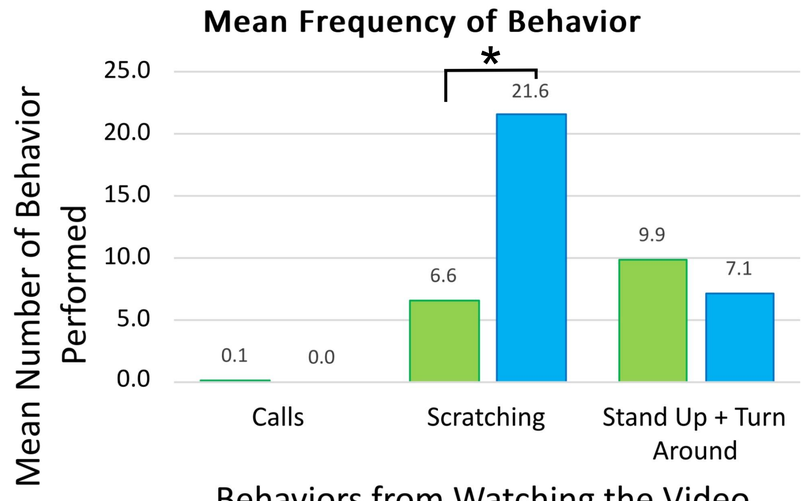


Fig 1. This graph compares the mean frequency of alarm calls, scratching, and vigilance in the seven bonobos. Blue bars represent the ignorant video while green bars represent the knowledgeable video. We ran a one-tailed T-test on each behavior to determine whether results are statistically significant. The * equals statistical significance.

The mean of scratching behavior in the ignorant video (IS) was higher than in the knowledgeable video (KS) and statistically significant. The mean of vigilant behavior in the ignorant video (IV) was lower than in the knowledgeable video (KV); results were not statistically significant. As there were no alarm calls, there was no need to run a statistical significance test on the values.

Conclusion

Our hypothesis stated that bonobos exhibit more TOM behavior to communicate with a group member unaware of danger. We predicted that subjects would exhibit more alarm calls, scratching, and vigilance in the ignorant than the knowledgeable video. Despite the difference in scratching behavior proving our hypothesis, the subjects failed to produce any significant number of alarm calls and vigilance. Takemoto et al. (4) concluded that while multiple *Pan* populations evolved north of the Congo River, bonobos solely evolved south of the Congo River suggesting no need to evolve threat communication. Therefore, the lack of evolutionary competition may explain why scratching only produced a statistically significant result. Like chimpanzees, bonobos still may have the implicit TOM behavior of understanding and becoming anxious when other individuals are be in a threatening situation.

1. Crockford, Catherine, et al. "Vocalizing in Chimpanzees Is Influenced by Social-cognitive Processes." *Science Advances*, vol. 3, no. 11, Nov. 2017, https://doi.org/10.1126/sciadv.1701742.
2. Krupenye, Christopher, et al. "Great Apes Anticipate That Other Individuals Will Act According to False Beliefs." *Science*, vol. 354, no. 6308, Oct. 2016, pp. 110–14. https://doi.org/10.1126/science.aaf8110.
3. Takemoto, Hiroyuki, et al. "The Formation of Congo River and the Origin of Bonobos: A New Hypothesis." *Oxford University Press eBooks*, 2017, pp. 235–48. https://doi.org/10.1093/oso/9780198728511.003.0016.