Human-like Theory of Mind in Mammals

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Abstract

Theory of mind is the ability to understand the mental state of an individual including one's self (Baron-Cohen et al., 1985). For adult humans, having a theory of mind is paramount, with it, we are able to communicate and establish a relationship with one another. The significance of the theory of mind has maximized yearly studies to gain a better perspective on the scientific cause of the theory of mind. In this paper, I will use these studies on humans and non-humans (infants, chimpanzees, dogs, and dolphins) and compare and contrast the human-like theory of mind in these mammals. Finally, I would like to solidify the theory of non-humans (particularly mammals) of having the theory of mind, and their ability to recognize social gestures humans give. By acknowledging the social capacity of non-humans, I aim to gain awareness of non-humans, which humans have disrupted or misused in the past.

Keywords: Theory of mind, non-humans, mammals, social cognitive behaviours, social capacity, mind-reading

Introduction

Are non-humans, able to have the same social capacity as humans? Humans tend to neglect these possibilities of non-humans being able to do something intelligent as humans because they are "non-humans". Social capacity is a crucial competence in the life of a mammal, helping it survive and reproduce in the context of other animals whose beliefs and intentions are important to predict and take into account. Unlike other competencies, social capacity is crucial for animals to survive in the wilderness impacting their relationship with humans as well. For this reason, the theory of mind, a critical component of social capacity, is an excellent test of whether non-human animals have similar social competencies to humans.

Theory of mind is the cognitive ability of the mind to read, have a belief (Rackoczy, 2012), problem-solving (Permack & Woodruff, 1978), perspective-taking (Behav, 2011), and recognize social cues (Tschudin et al.,2001). Hence, it is reasonable to use the theory of mind to identify the social capacity in non-human animals. This issue is not only interesting from a scientific perspective, but knowing whether non-human animals have a theory of mind (and therefore a human-like social capacity) also has ethical implications. Knowing an animal is capable of inferring the beliefs and goals of others may cause us to treat them more humanely.

Theory of mind is prominent especially for humans to communicate and understand each other. Although there is more research in need, it is presumed that non-humans, especially mammals, have a theory of mind due to their close primitive relationship with humans. With mammals and humans having a close relationship, I will look into how human's social capacity implements mammals' social capacity; thus, showing the theory of mind.

The social capacity in non-humans is usually conducted through the observation of their physical behaviors and motions. The non-human species I narrowed down to are chimpanzees, dogs, and dolphins. I focused on species with close interactions with humans to test the influence humans have on them and their adaptability to human lifestyles. This research will focus on: 1. Problem-solving performance by Chimpanzees (Permack & Woodruff, 1978), 2. Perspective-taking tasks on Dogs (Behav, 2011), and finally 3. Social cue recognition in dolphins (Tschudin et al., 2001).

1. Social Capacity in Humans

Human-like theory of mind consists of a series of different social cognition which humans use to develop a connection with one another. Communication is one of the examples. Communication is necessary to share thoughts, in which humans often use language and movements to convey

their feelings. Like none the others, humans are the only species that can precisely use words (speaking, writing, reading, and listening) to express thoughts and empathize with people. Despite our intuitive communication methods, we are unattainable and understand each other perfectly. Thoughts are not always expressible through words, which brings complications to contemplating thoughts; however, humans instinctively express them through behaviors and movements. These traces of behaviors do not contain thoughts but convey them. (Sperber, 1999)

Humans are also gifted with their adaptiveness. While non-humans have limits to their adaptability, humans evolved to cope with many different environments and circumstances. For this reason, humans have a higher chance of survival than non-humans and were able to develop our society today. Their adaptiveness was taken from their ability to problem-solve. Through experiences humans have gained over time, humans developed a perception to utilize their experience for a bigger cause. As we gain knowledge, it arousal many other cognitive abilities, such as logical thinking, memorizing, and processing/analyzing information. With problem-solving, we continue to develop our society into a place that humans can easily adapt to.

2. Social Capacity in Chimpanzees

Based on human genetics and evolution, it can be said that chimpanzees are the closest non-human species to humans. With similar genetics and 98% identical DNA, humans and chimpanzees both belong to the great ape group. Out of most non-humans, chimpanzees have a cognitive ability to complete complex tasks and a social capacity to understand behaviors. Moreover, infants show similarities with chimpanzees from their similar developmental stages, maternal care, and nurturing. (Tarjei et al., 2005). Investigating the studies of chimpanzees and the theory of mind can help us embark on new perspectives for the non-human theory of mind.

2.1 The Problem-solving Performance of Chimpanzees

A study conducted by Permack and Woodruff in 1978 took place to test the chimpanzee's ability to problem solve, following instructions by matching the problem with the solution. The target species, chimpanzees, were shown multiple different videos of a human actor trying to reach for a banana (figure 1). Each video consisted of different problems of locating the bananas such as trying to reach for a banana on the ceiling, reaching for the banana from inside the cage, or reaching for a banana from inside the cage but being disrupted by a foreign object.

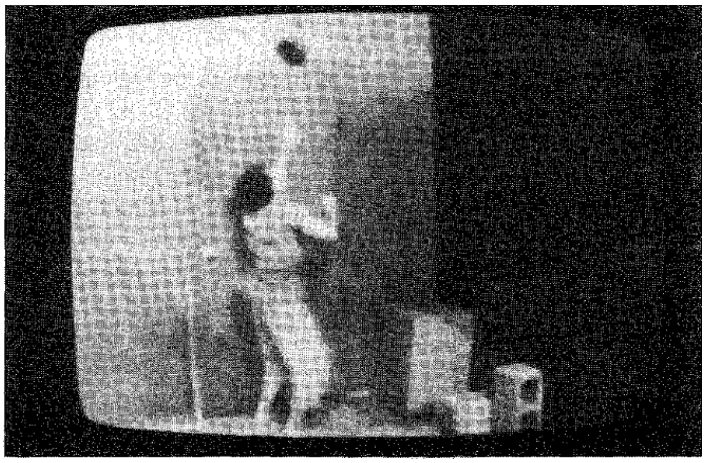

Figure 1. A video of the problem: a human is unable to reach the banana located on the ceiling (Permack & Woodruff, 1978)

Complementing these videos, the target species were also shown photos of solutions to the different situations that were shown in the video previously (figure 2). The photo consisted of the following: a photo of a human actor climbing onto a stepping box to reach for the banana on the ceiling, or a photo of the human actor using a stick to locate the banana that was placed outside of the cage. The task of the target species was to match the problems from the video to the correct solution from the photos.

Figure 2. A photo of the solution: a human using the box to reach the banana located on the ceiling (Permack & Woodruff, 1978)

A 14-year-old female chimpanzee, Sarah, experienced the testing from a young age, was qualified for this problem-solving research. The same process as explained above took place: Sarah was shown the video and she was required to match it with a solution shown in the photos. With Sarah's ability to process simplified visual language, the trainer instructed her to match the photos with the solutions to the given problem and ring a bell once

completed. The results showed that Sarah got a high score of 21 correct out of 24 trials.

The purpose of the test was to identify the non-humans' intelligence to understand the representation of the actions whereas Sarah was able to understand the purpose of the human's actions in the problem video and the purpose of the objects used for the solution photos. Not only did she understand the purpose of the objects, but she was also able to obtain the correct solution to the problem. Sarah empathized with how the human actor was struggling for the banana and managed to view the problem from her perspective to find the eligible solution she would take in the same situation. This action shows Sarah's ability to feel empathy toward humans, which implicates the characteristics of the theory of mind, understanding others. As a result, the problem-solving research shows chimpanzees are able to empathize with human feelings to function in their problem-solving skills. (Permack & Woodruff, 1978)

3. Social Capacity in Dogs

Dogs are part of the Canidae group and they are the descendants of wolves foxes, and coyotes... Over time humans have selectively created a genetic mutation that expanded the species into many breeds in different forms. Dogs are usually taken care of by humans as pets and they are known to be "emotional support" of humans (Menache, 1998). As pets, dogs are easy to care for due to their intelligence to learn tricks, and recognize tones and gestures; moreover, they are able to communicate with humans through tail motions, vocalization, postures, and such. Even without verbal communication, humans and dogs are still able to maintain relationships through their cognitive ability to understand and communicate.

3.1 Perspective-taking Performance of Dogs

A test conducted by Behav in 2011 consisted of testing Canidae groups (pet dogs, hand-raised wolves, and shelter dogs) on their perspective tasks using attentive (seer) and inattentive (blind) experimenters. Before the testing, the Canidae group went under a "pre-training" process, where they were allowed to approach the experimenters with treats. (figure 3) The main purpose of this process was for the dogs to be able to adapt to the testing environment to score true to their abilities. During this process, both experimenters (seer and blind) were visibly available and they were required to provide the Canidae group with treats once approached.

Figure 3. Pre-Training in progress (Behav, 2011).

The actual testing occurred in different forms within every trial, where the seer experimenter remained the same, and the blind experimenter had frequent condition changes such as back-turn condition, bucket condition, and camera condition (figure 4). All of these conditions required the blind experimenter to cover their face with the object they were provided. In every trial, the experimenter called the name of the Canidae and if they touched the experimenter or remained in the 1-meter radius for at least 3 seconds the results were recorded. If the Canidae group chose the seer experimenter, they were counted correctly and given a treat; however, if they chose the blind experimenter they received no treats and they were counted wrong.

Figure 4. The back-turn condition is in progress. The furthest person with the dog (seer), the person facing the back (blind) (Behav, 2011).

Pet dogs and wolves scored the highest with a median of 9 correct out of 10; next, the shelter dog performed a median of 7 correct out of 10 (figure 5). Some of the reasons for an incorrect result are confusion with the pretraining process, unfamiliarity with the objects used, and lack of begging tasks. Overall, pet dogs had a higher success rate compared to other Canidae groups in their closer relationship with humans. Compared to pet dogs; wolves and shelter dogs lack the life experience to acknowledge the normality of witnessing buckets, cameras, and books. Therefore, they lack in the begging task towards the blind

experimenter, causing them to score incorrectly more frequently than pet dogs.

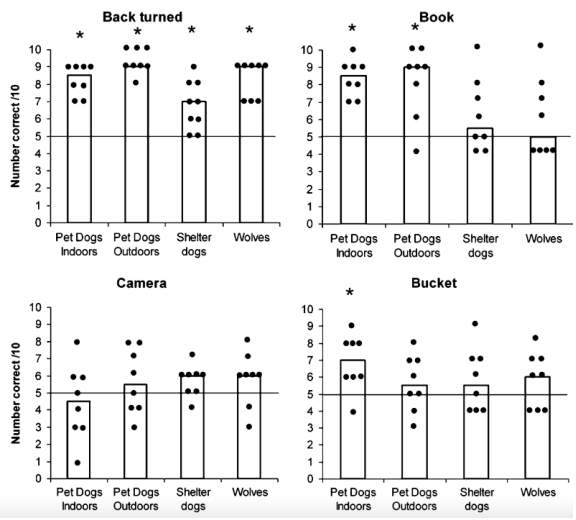

Figure 5. Results in a graph format (Behav, 2011).

In conclusion, Pet dogs are capable of perspective-taking. The social cognitive skill varies depending on their histories and experience with humans; since pet dogs are more familiar with the human lifestyle from a young developmental stage, they have larger social cognitive skills. Meanwhile, wolves and shelter dogs have an unknown history or experience with humans; therefore, they are unfamiliar with human actions and the objects used during the test. As Professor Behav once said, "If one has a theory of mind, then one should do some specified behavior". The Canidae group was able to show specified behavior by selecting the seeing experimenter over a non-seeing person. Pet dogs have a theory of mind from their adaptability and perspective taking human lifestyle and the trial.

4. Social Capacity in Dolphins

Dolphins are one of the most intelligent marine animals. There have been multiple studies and research on their social cognitive behaviors, and their extravagant communication skills. These studies have helped scientists to gain knowledge of other animals within the marine ecosystem. Not only do humans use them for extended research, but they have also taken use of their intelligence through therapy for people with mental or physical disorders, and tourism such as dolphin shows and dolphin watching (Servais, 1988). In comparison to other marine animals, dolphins have unique yet intuitive behaviors; they are able to imitate the behaviors of dolphins, seals, and humans, and with their mental capacity they are also able to sense the presence and absence of certain objects within their environment (Mercado et al., 1998). Dolphins have very proficient cognitive skills embedded, in which these aspects have been the reason humans and dolphins have a close relationship with one another.

4.1 Social Cue Recognition in Dolphins

A study conducted a test on dolphins to see their reaction after instructions through gestural signs to catch a particular object (Tschudin et al., 2001). The subject of this study was 6 dolphins (3 female, 3 male) born and trained at SeaWorld located in South Africa. There were two portions to this testing, one was Pretest, where dolphins were required to fetch an object– a ball or hoop– after being given a command sign. The second portion of this testing consisted of 12 trials with 3 different types of gestural signals: point, gaze, and replica; to retrieve an object either the basket or the lid (Table 1).

Table 1. Types of gestural signs used in the experiment (Tschudin et al., 2001)

Types of Gestural Signals	Explanation
point	Signaled to retrieve the object by hand gestures by pointing at the object with **the right hand.**
gaze	Signaled to retrieve the object by moving her head and eyes toward the direction of the object
replica	Signaled to retrieve the object by holding an identical replica of an object with **the left hand.** (the opposite hand they used for pointing signal)

Table 2. Tables of the results conducted (Tschudin et al., 2001)

Subject	Pretest	Gaze	Pointing	Replica	Total test trials
Kani	12/12	11/12*	11/12*	1/12	36
Kelpie	12/12	10/18 (10/12*)	11/12*	11/22 (11/12*)	52
Jula	12/12	10/12*	11/12*	9/18	42
Khanya	12/18 (12/12)	13/18 (7/9)	4/12	4/13	43
Tombi	12/12	11/17 (8/9*)	14/25 (7/9 in 18)	11/14* (9/10*)	56
Affrika	12/12	13/18 (11/12*)	14/18* (6/7)	12/25 (7/9 in 23)	61

Note. Numbers in parentheses represent best performance in consecutive trials.
* $p < .05$, binomial test.

During the pretest, all 6 dolphins were able to get a perfect score of 12/12 on their first attempt. On the other hand, the results for the signal testing varied between each individual. Affrika was able to receive a high score in all of the gestural signs, but Khanya wasn't able to get a high score on both the pointing and replica signs. There is no specific pattern seen in the graph, which signifies that each individual has different levels of intelligence and understandability. Overall, the replica gestural signs seem to have the lowest median score (challenging), and the gazing gestural signs are the highest (least challenging) (Table 2).

Most dolphins were able to increase the probability of getting the correct object as they gained the frequency of the trial; therefore, as they proceeded with the trial they were able to adapt to the signals the trainers gave. The reason why the replica signal was the most challenging attempt was because they lacked to allocate a difference between the two objects. However, the dolphins overcame these challenges by identifying which hand (left or right) held the object, instead of identifying the object alone. By recognizing the "ipsilateral hand", the dolphins were able to acknowledge the instructions the trainers gave. Based on their developments after the trials, it can be said that they are able to understand the communicative human signals. The experiment conducted by Tschudin significantly showed the dolphins' ability to understand the cues/gestures humans gave, fitting the criteria for having a theory of mind.

Conclusion

Studies related to the theory of mind have developed over time allowing us to gain a better understanding of the cognitive behaviors of not only humans but also non-humans. Throughout the paper, I aimed to focus on the human-like theory of mind in non-humans answering our question, do mammals have a human-like theory of mind? According to the research, it has evidently shown mammals have a theory of mind because of their close primitive to humans. Chimpanzees, the closest primitive species to humans, showed the ability to problem-solve and emphasize human feelings (Permack & Woodruff, 1978). Dogs, a species with the closest friendship with humans, showed the ability to take their experiences with humans to the test. (Behav, 2011) Dolphins, a species with similar personality traits to humans, showed the ability to clearly recognize human social cues. (Tschudin et al., 2001). In conclusion, all mammals researched throughout, have shown characteristics of a human-like theory of mind, in communication, adaptivity, problem-solving, and understanding social cues. Through noise, auditory, and movement, typically all animals are able to communicate within their species or their ecosystem, however, mammals did not only communicate with their own species but were able to communicate with humans. While humans are able to complete any complex tasks, chimpanzees have the ability to problem solve, dogs have the ability to perspective take, and dolphins have the ability to understand human social cues. The intuitive intelligence of the mammals not only defined their communication skills but also other unique cognitive features each species had. By recognizing non-humans' human-like theory of mind, how would humans start to view them differently? Humans and non-humans are unable to communicate directly and our indifferences have caused humans to not treat non-humans humanely. By sharing non-humans' humane cognitive attributes with the world, I hope for a better animal-friendly environment, where humans accept non-humans for their intelligence and their human-like theory of mind. Although I was able to acknowledge non-human's social capacity, more research needs to be conducted for us to get a full understatement if these non-humans are able to interpret human's daily actions instead of "experiments" where the non-humans are required to understand the given objective. Nonetheless, when the research candidates are enforced to take part in an experimental environment and required to complete specific tasks, they are unable to show their instinctive behaviors. For future reference, it is a necessity to observe non-human reactions to human daily actions outside of an experimental environment, to identify the mammal's instinctive behaviors.

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