

Social Transmission of Human Termite Fishing Tool-Use Behaviors

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Background & Motivation

- **BACKGROUND:** Termite fishing is a tool-use behavior that a chimp uses as a form of food gathering
 - Requires the modification of an herb stem inserted into a termite mound to extract the termite within the mound (Sanz & Morgan 2011)
 - Chimpanzees often chew on the end of an herb stem to create a frayed end. The blunt end is inserted into the mound to create a probing hole, then the frayed end is inserted. The chimp will often use their hand to brush the termites off the stem and into their mouth for feeding (Sanz & Morgan 2009).
- Often there are ecological constraints and cultural variety amongst differing groups of chimpanzees (Pascal-Garrido et. al. 2021)
 - Chimps exploit resources nearby termite mounds to create their tools and rarely travel far away for resources
 - It can be hypothesized that there may be a similarity in how ancient hominins gathered raw materials to create stone tools (Pascal-Garrido et. al. 2021)
- **MOTIVATION:** We based our study off of a previously done study performed by Morgan et. al. (2015)
 - Focused on social transmission of hominin stone tool making
 - Morgan et. al. (2015) argues that the hominin stone tool making reliance formulated a strong selection for teaching with language as a form of social transmission, rather than imitation and emulation
 - Gestural and verbal teaching social transmission types were the most successful in creating stone tools
- Although Morgan et. al. (2015) focuses solely on human tool behaviors, we wanted to recreate the study with chimpanzee tool behaviors to see if there were any major differences in social transmission between our study and Morgan’s.
- We also wanted to address Tennie et. al. (2017)’s argument of latent solutions in humans

- A latent solution is that humans have the innate ability to create and use stone tools, like those in the Morgan et. al. (2015) study, because of the simplicity and requirement of low-fidelity social learning (Tennie et. al. 2017).
- Tennie argues that chimpanzee tool making and use is so simple that there is no need for any social transmission or communication for the task to be completed successfully.



Hypothesis & Objectives

- **HYPOTHESIS:** We hypothesize that termite fishing is simple enough to not require verbal communication but complex enough to require non-verbal teaching behavior.
- **NULL HYPOTHESIS:** Termite fishing is simple enough that it does not require any form of communication or teaching.
- **OBJECTIVES:** to determine the significance of chimpanzee tool-use in regards to hominin stone tool use
 - To determine the viability of termite fishing tools
 - To determine how much communication is required to transmit termite fishing tool use and behaviors

Research Methods

- **MATERIALS:** We created a simulated termite mound out of chicken wire and paper mache for this study. Horsetail reeds were used as the termite fishing wand with rainbow baking sprinkles as the “termites” for extraction.
- **EXPERIMENT STRUCTURE:** Social transmission chain split amongst 3 days of testing periods
 - Day 1: verbal teaching, day 2: imitation/observation, day 3: gestural teaching and reverse engineering
 - All teaching strategies were considered social transmission chains besides reverse engineering, which is not a teaching strategy, due to the lack of teaching.
 - A total of 5 participants were used for each transmission chain, all labeled as novice termite fishers. We had a total of 19 participants.
- This study was split into 3 phases for each participant; teaching phase, testing phase, mentoring phase.
- Participants received 5 minutes of teaching using their respective teaching strategy for the day
 - The first participant of the day was taught by an expert termite fisher (Heather Salmons)
 - Reverse engineering participants used this time to observe a completed and used tool, without a teacher present to instruct them
- Participants then received 10 minutes to create and use their tool, named the testing phase
- Participants then taught the next participant who arrived, known as the mentor phase
 - The last participant of the day did not participate in the mentor phase due to position in the chain
 - A mentor phase was not used for reverse engineering due to there not being any teaching conducted
- **DATA MANAGEMENT:** Participants were assessed on if they were able to successfully create their termite fishing tool, extracted a minimum of 5 “termites” from the simulated mound, time until successful extraction of the “termites”, and success in teaching the next participant in their mentor period
 - We took the time until successful extraction for each participant for each day and created a graph to visualize the results
 - Used to analyze if social transmission methods created a difference in successfullness of tool making and use in relation to the time it took to complete the task

Experiment Results

- **DAY 1 (VERBAL):** Incomplete social transmission chain
 - Only used 4 participants due to last participant not showing at their scheduled time
 - All used participants passed all 3 phases besides final participant, due to the inability to participate in mentor phase
- **DAY 2 (IMITATION):** Complete social transmission chain
 - All participants passed all 3 phases successfully
- **DAY 3 (GESTURAL):** Complete social transmission chain
 - All participants passed all 3 phases successfully
- **DAY 3 (REVERSE ENGINEERING):** One successful participant
 - All participants successfully extracted minimum of 5 termites, but only 1 successfully created their tool as well
 - Each unsuccessful participant used differing ways of extracting their termites; 1 used the reed as a straw, another licked the end to get the sprinkles to attach to the reed easier, another used the reed as a scoop, and another tore the end of their reed using their fingers to extract the termites
- **GRAPH:** The figure located to the right showcases the time until success in seconds during each of the social transmission conditions conducted on days 1 through 3
 - Using the Kruskal-Wallis Test, the significance level was 0.008, showcasing a significant difference for the results
 - Difference shows that results are likely not due to chance

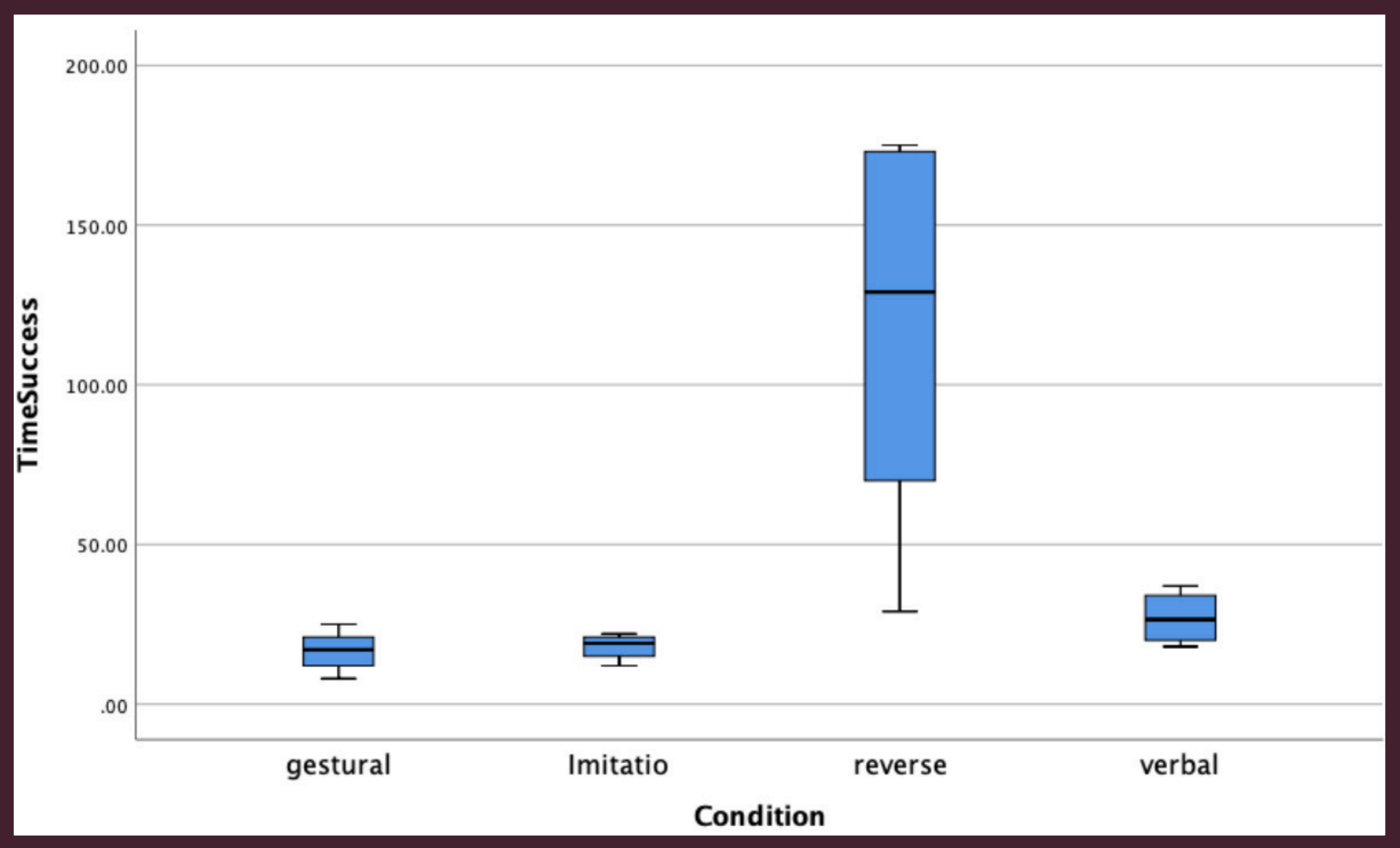
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Discussion

- Termite fishing tool behaviors do require some form of social transmission or communication
 - Days 1, 2, and 3 (gestural) were or almost were completely successful in a full social transmission chain, but day 3 (reverse engineering) only had 1 successful participant.
- With reverse engineering being the only chain with 1 person to successfully create and use their tool, this shows that some form of communication or social transmission is needed to pass down termite fishing tool use and behaviors.
 - This disproves our null hypothesis to an extent, with the singular participant having a success, which could prove the null hypothesis
 - We believe there may have been some outside elements that attributed to this participant’s success, which may have affected their participation results
 - Outside elements include previous participants waiting in the halls, talking about their experience
- Each participant in the verbal, gestural, and imitation groups all successfully made, used, and extracted their minimum of termites in about 30 seconds or less.
 - If we were to conduct this experiment again, we would try to make the task slightly more difficult, like raising the minimum number of termites to be extracted, to see if these times would change.
 - Shows that task was simple for humans that they don’t need verbal teaching, but complex enough to need some interaction with a teaching element
 - Could disprove Tennie’s latent solutions hypothesis with further research
 - Also shows how termite fishing is not an extremely simple task that humans can learn quickly with no interactions; need some form of communication of social transmission to successfully make and use tool correctly

Time Until Success (in seconds) For Different Social Transmission Conditions



References

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