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Teaching Imitation to Children with Autism Using Most-to-Least Prompt Fading in Front of a Mirror

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Abstract

Children diagnosed with autism spectrum disorder have difficulty acquiring imitative skills, which may serve as an important factor in developing social skills and language (Miller et al., 2015; Ledford & Wolery, 2010; Young et al., 1994). Research has shown that most-to-least prompting is most effective for children who do not learn quickly (Libby et al., 2008). The goal of this study was to discover whether the presence of a mirror affected the rate of acquisition of imitative behaviors compared to a no-mirror condition, using most-to-least within-session prompt fading. This study used a multiple baseline design across sets of behaviors. Sets of behaviors were chosen for each condition that shared similar topographies, response effort, and automatic sensory consequences. A most-to-least within-session prompt fading procedure was used for both conditions. Past studies have observed the effects of a mirror on the acquisition of imitative targets, but this is the first study to use a most-to-least within-session prompt fading procedure with a mirror (Miller et al., 2015; Du & Greer, 2014). The results of this study show how a mirror affects the rate of acquisition of imitation when using most-to-least within-session prompt fading.

Introduction

Imitation is important for the acquisition of new behaviors, and also may serve as an important factor in developing social skills and language (Miller et al., 2015; Ledford & Wolery, 2010; Young et al., 1994). If a child can imitate a peer or adult, that child has the opportunity to acquire a wide range of behaviors the peer or adult may be engaging in. Unfortunately, children diagnosed with autism often have difficulty acquiring this skill (Miller et al., 2015; Ledford & Wolery, 2010).

A study by Miller, Rodriguez, and Rourke (2015) aimed to determine whether the use of a mirror facilitated the acquisition of imitative behaviors in children with autism. In this study, the experimenters taught a two-year-old boy imitation in conditions with and without a mirror. The researchers hypothesized that the use of the mirror would allow additional feedback to the student, and found that it led to a faster acquisition of the imitative behaviors compared to the mirror-absent condition (Miller et. al, 2015). The researchers used "progressive prompt-delay," using full and partial physical prompts and providing those prompts immediately or after a previously specified delay depending on the phase (Miller et. al, 2015). The definition of how the researchers implemented partial physical prompts was not provided in the article.

Prior to Miller, Rodriguez, and Rourke's study, there had only been one other study which experimented with this use of the mirror (Miller et al., 2015; Du & Greer, 2014). In the study by Du and Greer (2014), the participants were six preschool-age children, three of which were exposed to the mirror condition and three of which were exposed to a mirror-absent condition. The researchers did not provide prompts prior to the opportunity for responding. In both studies, participants acquired the imitative responses more quickly with

the mirror condition compared with the mirror-absent condition (Miller et. al, 2015; Du & Greer, 2014).

In Ledford and Wolery's (2010) review of the literature on generalized imitation, the researchers reviewed 15 articles that were chosen based on specific inclusion criteria. These criteria included that the articles: were published in peer-reviewed journals, included at least one child younger than 7 years and 11 months with a disability, included at least one independent variable as the "systematic manipulation of one or more instructional components" with the intended purpose of increasing imitation in participants, had at least one dependent variable as a quantitative measure of imitation responses, used a research design that included a baseline condition, and had a primary focus of using imitation to acquire new behaviors, rather than teaching imitation (Ledford & Wolery, 2010). After reviewing all of the articles, the researchers concluded that improvements need to be made in order to determine which instructional method is most effective. However, they did include suggestions for further research to improve upon, which included having specific prompting strategies, embedding instruction across activities and contexts, and teaching imitation with multiple models, including both peers and adults (Ledford & Wolery, 2010).

Libby, Weiss, Bancroft, and Ahearn (2008) conducted a study to compare the effectiveness of least-to-most (LTM) prompting and most-to-least (MTL) prompting. For LTM prompting, the child is given a brief opportunity to respond independently, and if they do not, the least intrusive prompt is given, followed by more intrusive prompts if necessary. For MTL prompting, the child is given the most intrusive prompt when first learning a skill, and the intrusiveness of the prompt is decreased over time when the child demonstrates success at the current prompt level (Libby et al., 2008). The researchers concluded that

MTL prompting leads to less errors, but in some cases, it may slow down the learning process for the child if they are ready to move on to less intrusive prompts more quickly (Libby et al., 2008). The LTM prompting procedure was more effective for the participants who were learning quickly, but slowed down the learning process for the participants who were having difficulty with the program. Libby et al. (2008) also compared the effectiveness of LTM prompting, MTL prompting, and a MTL prompting with a time delay procedure. The researchers concluded MTL prompting with a time delay was the best option of the three if the child's learning history was unknown.

In this study, the procedure used was a MTL within-session prompt fading procedure. We chose a MTL procedure instead of a MTL with time delay procedure because the participants had previously struggled with acquiring imitation, so a time delay might have impeded the participants' progress. The intrusiveness of prompts was decreased when the child repeatedly responded correctly with the current prompt, and increased when the child repeatedly responded incorrectly with the current prompt. We developed explicit instructions on how prompting should be implemented and clear criteria for fading the prompt intrusiveness. This procedure was performed in both mirror and mirror-absent conditions, and the rate of acquisition of the imitative behaviors in both conditions were compared. This study expanded upon the research by Miller et al. (2015) and Du & Greer (2014). However, this is the first study that combines the mirror procedures with MTL within-session prompt fading. The participants were two preschool-age students at West Campus who had been exposed to a LTM imitation procedure but still had not acquired imitative skills.

Method

Participants

In this study, there were two participants: Richie, a five-year-old male diagnosed with autism, and Charlie, a two-year-old male diagnosed with autism. Both participants were enrolled in West Campus's EIBI classrooms, and were chosen based on their performance on an initial generalization probe. In the generalization probe, if the child had received 25 percent of probed imitation trials correct, that child was excluded from the study. This criterion was set to determine whether the child had previously acquired imitative behaviors, and if the child would be a good candidate for intensive imitation training.

Design

The experiment began with a 25-response generalization probe of each participant's imitative responses. The participant was given three opportunities to respond for each target response, and the best score of the three trials was taken. The trial was marked correct if the child engaged in the correct response after the model was presented during any of the opportunities. The trial was considered an approximation if the child's topography was similar to that of the model, but not a close point-to-point match. The trial was incorrect if the child engaged in a different response than that of the model. Finally, if the child did not emit a response during any of the three trials, the target was marked as no response. Richie's first generalization probe was run prior to beginning the procedure. His second generalization probe was run after 10 blocks (one block equals 6-10 trials) of the mirror targets, seven of which were without a mirror for baseline, and five blocks of the no-mirror targets. Richie's final generalization probe was run at the end of the study, after Richie had completed 18 blocks of mirror target trials and 21 blocks of no-mirror target trials. Only

one generalization probe was run for Charlie, before beginning the procedure. Due to lack of time and the participant's lack of attending skills, no other generalization probes were run.

This study used a multiple baseline design across sets of behaviors. Sets of behaviors were matched in opposite conditions so that they had similar topographies, required similar response effort, and resulted in similar automatic sensory consequences. For example, a response of clapping hands would be paired with a two-hand pat on the table, but not touching nose. Each participant was going to be exposed to the mirror-present condition at a different time, however, Charlie was never exposed to the mirror condition due to lack of participant attending and the time constraint of the study. A MTL within-session prompt fading procedure was used during both conditions. Baseline data were obtained for the participants' rates of acquisition of the mirror targets without the use of the mirror prior to the mirror-present condition being introduced.

The independent variables were the mirror and mirror-absent conditions, while the dependent variable was the participants' rates of acquisition of imitative behaviors. The aim of the study was to compare the effects of using a MTL within-session prompt fading procedure, with and without a mirror, on the participants' rates of acquisition of imitative behaviors.

Procedure

This study was implemented over the course of 23 weeks. Each session lasted 30 minutes, with the exception of two sessions that were terminated early due to high levels of stereotypy and lack of attending. The prompts used were hand-over-hand full physical,

partial physical (PP) from the wrist, PP from the forearm, PP from the elbow, PP from the shoulder, and independent. These prompt levels were altered during the session according to the child's progress. When the child responded correctly for three consecutive trials of the same target, the prompt level was decreased in intrusiveness. For example, if the child responded correctly for three consecutive trials with a full physical prompt, the next trial of that response would be partially prompted at the wrist. When the child responded incorrectly for two consecutive trials of the same target, the prompt level was increased in intrusiveness. For example, if the child responded incorrectly for two consecutive trials at the partial physical prompt from the shoulder, the next trial of that response would be partially prompted from the elbow.

Correct trials were followed by immediate reinforcement, which included praise and preferred reinforcers, such as edibles and toys. We conducted frequent preference assessments to determine the most powerful reinforcer at that moment. Trials in which the child responded incorrectly were followed by an immediate five-second quiet hands, in which the prompter held the child's hands on the table or on the child's lap for five seconds. Trials in which the child did not respond were followed by LTM prompting beginning from the current prompt level until the child completed the response, and no reinforcement was provided. The child was considered to have mastered a target once they correctly responded independently for that target in 10 consecutive trials.

Both experimenters collected data independently—the one who modeled the behaviors and the one who prompted—using printed data sheets, writing utensils, and clipboards. The experimenters communicated vocally with each other when it was time to

change the level of the prompt to ensure the procedure was implemented properly. There were no disagreements between the experimenters regarding phase changes.

Setting/Materials

Initially for Richie, the study was implemented in a small booth, separated from other booths by wall dividers, in an EIBI classroom at West Campus. In this booth, there was a small table and three kid-size chairs. A long and narrow mirror was used for mirror sessions in this booth, attached to the wall with Velcro. The experiment was later moved to a new setting due to concerns with Richie pulling the mirror off the wall. The remainder of Richie's sessions and all of Charlie's sessions were run in this new setting. In this setting, there was a wide and taller mirror already secured to the wall, a small table, and three kid-sized chairs. Wall dividers were used to block the area into a booth. For no-mirror sessions, the dividers were also used to cover the mirror. Additional materials included data sheets, writing utensils, clipboards, and the children's preferred edibles and toys. Data sheets for the generalization probe and procedure can be found in Figures A and B of Appendix A.

Results

The goal of this study was to determine whether the presence of a mirror increased the participants' speed of acquisition of imitative behaviors while using a MTL within-session prompt fading procedure. The participants involved in the study had not yet acquired imitative skills, which are important to their development and learning of new behaviors. Richie reached independence for the mirror target of touch head and the no-mirror target of touch cheeks, but did not master either of these targets. He did not reach beyond forearm prompts for the mirror target of clap hands, and did not reach beyond

elbow prompts for the no-mirror target of pat table. These data can be seen in the cumulative record graphs in Appendix B.

Figure A in Appendix C shows the number of trials it took Richie to initially phase out of each prompt level for each of the targets. Richie reached independence with touch head and touch cheeks, but did not reach independence with pat table and clap hands. This may have been due to the repetitiveness of the targets of pat table and clap hands, which requires more response effort with less intrusive prompts. In order to eliminate the confounding factor of repetitive targets, we chose only single-response targets for Charlie: hands on side, hands on belly, hand on mouth, and hand on head. Unfortunately, we were unable to run the procedure with the mirror for Charlie, due to lack of prerequisite attending skills and the time constraint of the study.

When probed for generalization at the end of the study, Richie responded correctly for only one behavior, and either had no response or responded incorrectly for the twenty-four other behaviors. This shows that our study was not effective in the generalization of imitative skills. See Appendix D for graphs of all generalization probe data.

Discussion

Based on the results of this study, the hypothesis that the presence of a mirror aids in the acquisition of imitative targets compared to a no-mirror condition cannot be supported. Richie reached independence for the no-mirror target of touch cheeks quicker than the mirror target of touch head, and moved past the wrist prompts for the no-mirror target of pat table quicker than the mirror target of clap hands, as shown in Figure A of Appendix C. However, when comparing the two single response targets of touch head and touch cheeks, Richie moved through forearm, elbow, and shoulder prompt levels twice as

fast with the mirror condition than he did with the no-mirror condition, after phasing out of wrist prompts. Richie did not phase out of forearm for the mirror target of clap hands, and did not phase out of elbow for the no-mirror target of pat table.

It took longer to move past wrist prompts for both responses in the mirror condition, which may have been due to the competing contingencies involved with the mirror. Richie engaged in behaviors with the mirror that were incompatible with attending. These behaviors included putting his face very close to the mirror, putting his feet on the mirror, pulling on the mirror, making faces while watching himself in the mirror, and engaging in stereotypy. Another potential confounding factor is that there was a period of time in which the researchers ran mirror sessions only, and when Richie began no-mirror sessions again, he was attending much better and acquired the skills more quickly. Lastly, half way through the study, we had to change our experimental setting due concerns with Richie pulling the mirror, which may have affected our results.

Richie moved through prompt levels of the single responses of touch head and touch cheeks much more quickly than with the repetitive responses of pat table and clap hands, as shown in Figure A of Appendix C. A potential reason for these results is that repetitive targets require more independence for prompts past full physical, compared to single response targets. Another potential reason is that these targets required a higher response effort.

The results of this study show that MTL within-session prompt fading is highly effective in teaching single imitative responses. Richie was not able to acquire imitative skills using the previous LTM classroom procedure, but reached independence in 65 trials

for touch head and in 56 trials for touch cheeks with the MTL within-session prompt fading procedure.

If this study were to be replicated, researchers should use single response targets so that the repetitiveness of targets is not a confounding variable. The researchers should also alternate mirror and no-mirror sessions consistently and maintain the same experimental setting throughout all sessions. The mirror should be tightly secure to prevent pulling on it. We also highly suggest that researchers train appropriate attending behaviors prior to beginning the study. We defined attending as making eye contact with the experimenter, sitting, having hands on the table or on the child's lap, making no vocalizations for a duration of three seconds or more, and not engaging in stereotypical behaviors for a duration of three seconds or more. These criteria were difficult for the participants to attain without prior intensive training on attending skills.

Researchers should also consider full-physically prompting the first few trials of a session when the participant has had a long period of time between sessions. This will help eliminate the confounding effects of the break, and will decrease the likelihood of regressing quickly in prompt levels. Lastly, in future research, researchers should recruit a higher number of participants so that more data can be obtained and compared.

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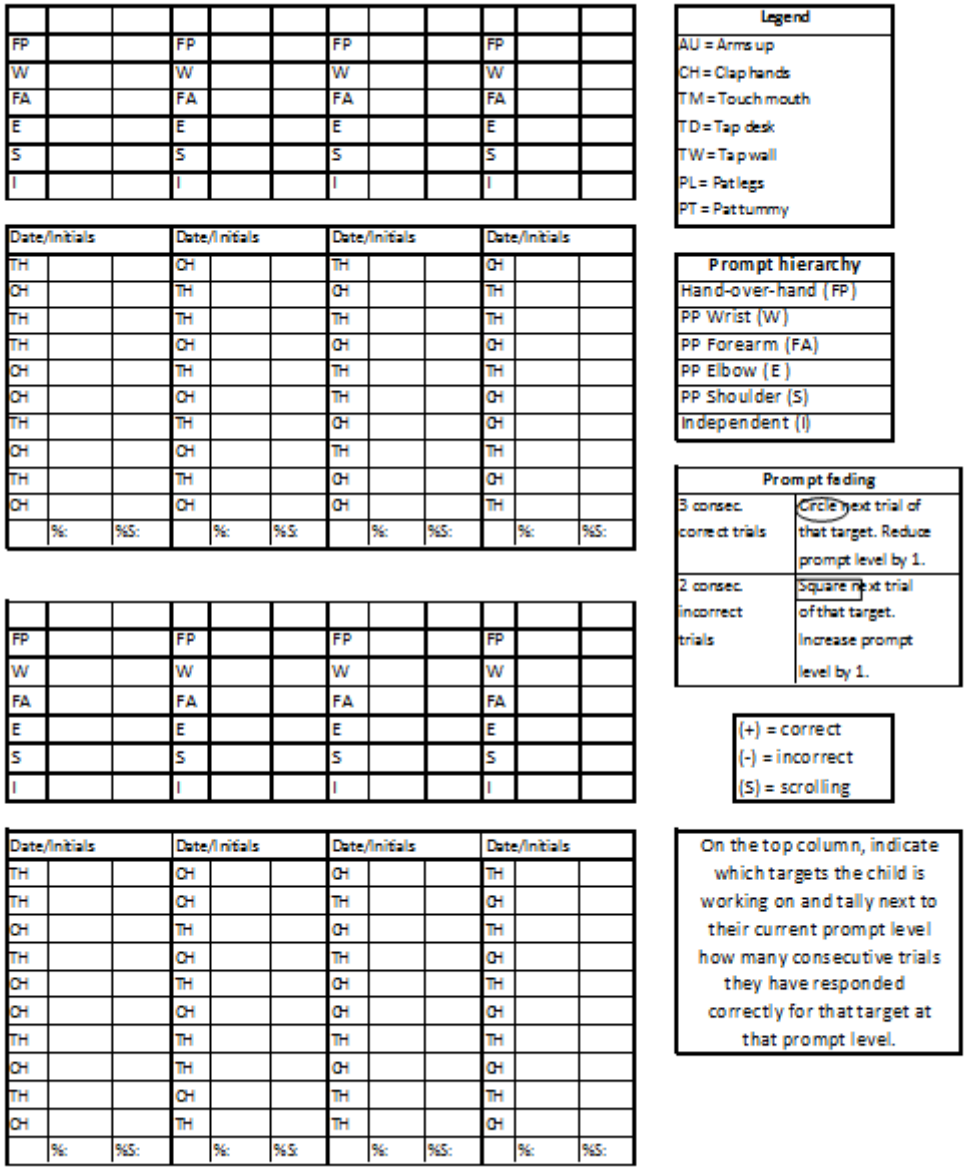
Appendices

Appendix A

Physical Imitation Generalization Test

+ = correct, independent response - = incorrect (other response)			**A** = approximation to the response **NR** = no response		
Targets: Date: Initials:	Test #1	Test #2	Test #3	Test #4	Test #5
1. Clap Hands					
2. Tap Table					
3. Stomp Feet					
4. Arms Up					
5. Pat Stomach					
6. Touch Feet					
7. Wave					
8. Touch Mouth					
9. Hug Self					
10. Touch Shoulders					
11. Thumbs Up					
12. Wiggle Fingers					
13. Point					
14. Rub Table					
15. Open & Close Hands					
16. Rub Hands					
17. Pointer Fingers Together					
18. Knock on Table					
19. Kissy Face (puckered lips)					
20. Open and Close Mouth					
21. Shake Head (side-to-side)					
22. Shake Head (up & down)					
23. Jump Up (standing)					
24. Turn Around (standing)					
25. Lift One leg (seated or standing)					

Figure A: Data sheet for generalization probes.



FP			FP			FP			FP		
W			W			W			W		
FA			FA			FA			FA		
E			E			E			E		
S			S			S			S		
I			I			I			I		

Date/Initials			Date/Initials			Date/Initials			Date/Initials		
TH			OH			TH			OH		
OH			TH			OH			TH		
TH			TH			TH			TH		
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OH			OH			OH			TH		
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FP			FP			FP			FP		
W			W			W			W		
FA			FA			FA			FA		
E			E			E			E		
S			S			S			S		
I			I			I			I		

Date/Initials			Date/Initials			Date/Initials			Date/Initials		
TH			OH			OH			TH		
TH			OH			TH			OH		
OH			TH			OH			TH		
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Legend
AU = Arms up
CH = Clap hands
TM = Touch mouth
TD = Tap desk
TW = Tap wall
PL = Pat legs
PT = Pat tummy

Prompt hierarchy
Hand-over-hand (FP)
PP Wrist (W)
PP Forearm (FA)
PP Elbow (E)
PP Shoulder (S)
Independent (I)

Prompt fading	
3 consec. correct trials	Circle next trial of that target. Reduce prompt level by 1.
2 consec. incorrect trials	Square next trial of that target. Increase prompt level by 1.

(+) = correct
(-) = incorrect
(S) = scrolling

On the top column, indicate which targets the child is working on and tally next to their current prompt level how many consecutive trials they have responded correctly for that target at that prompt level.

Figure B: Data sheet for mirror condition sessions for Richie. Other data sheets were the same but with different targets.

Appendix B

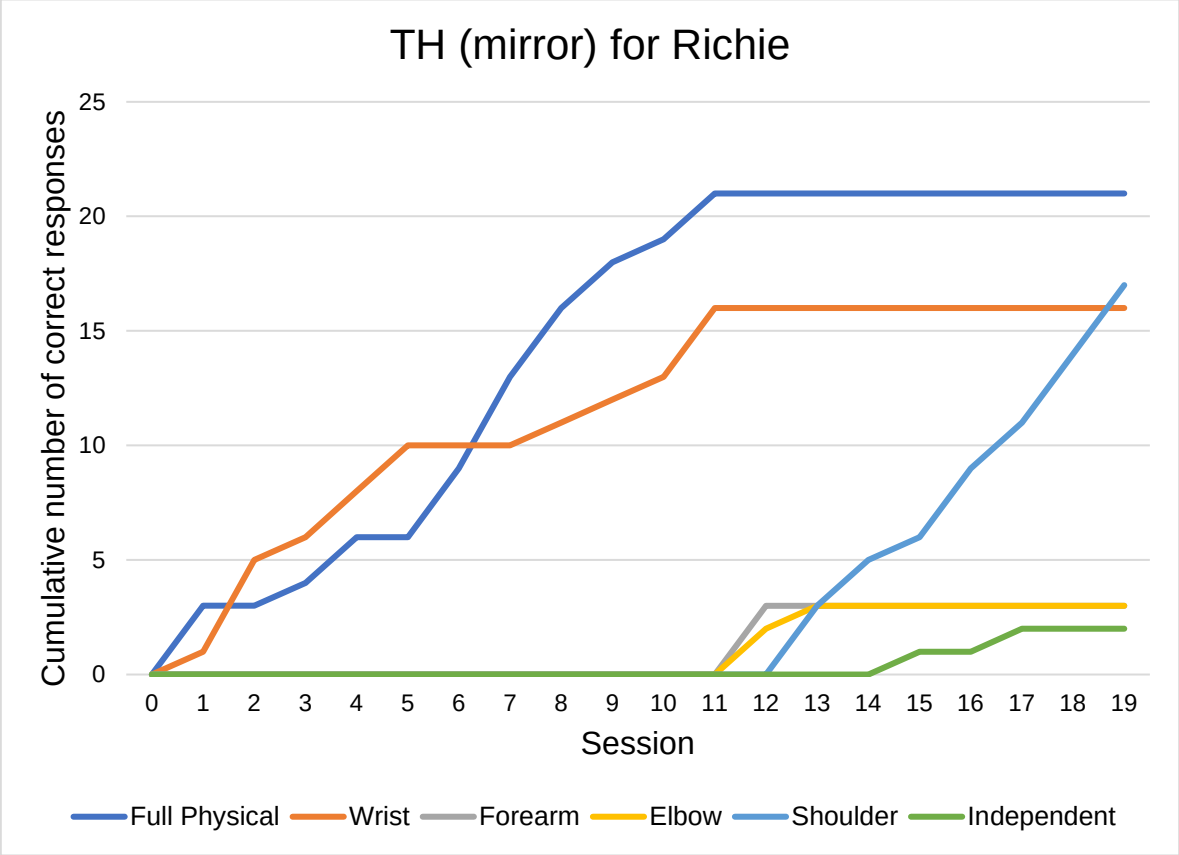

Figure A: Cumulative record graph for Richie's response of touch head with mirror condition.

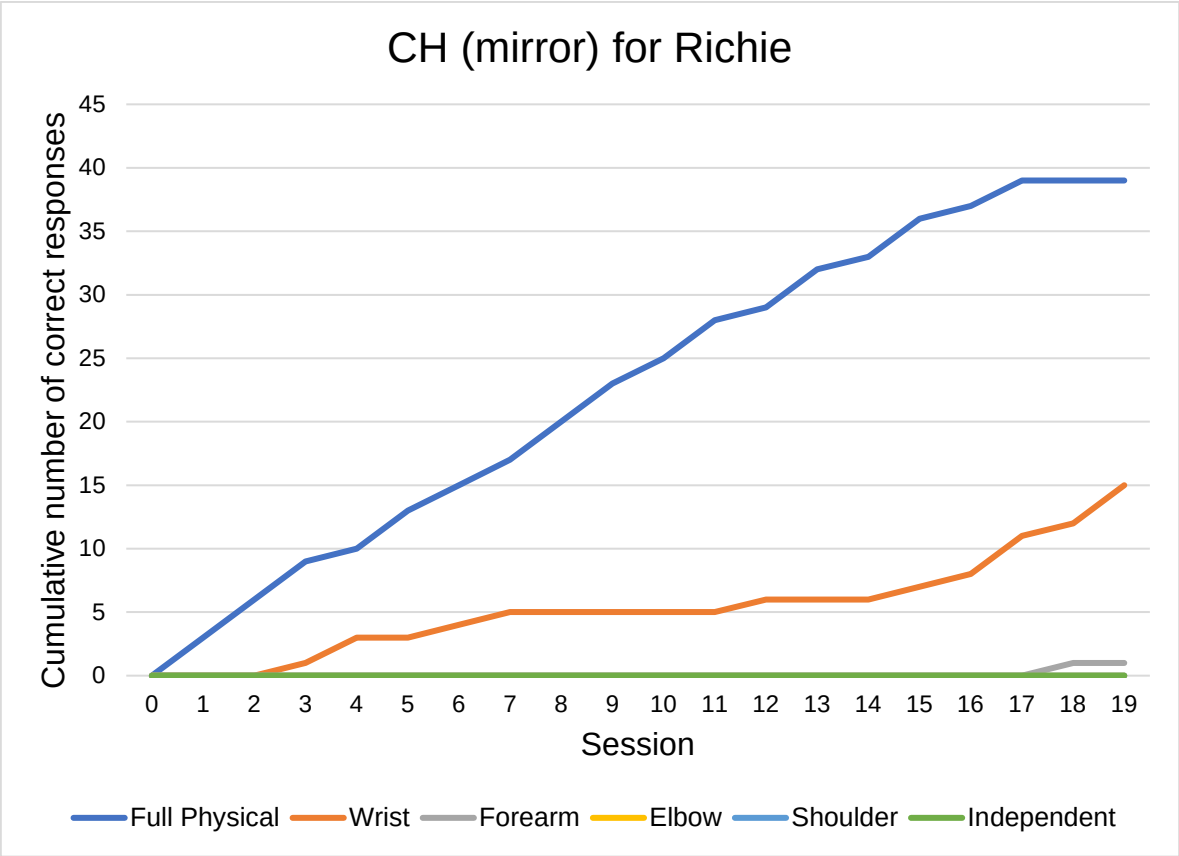

Figure B: Cumulative record graph for Richie's response of clap hands with mirror condition.

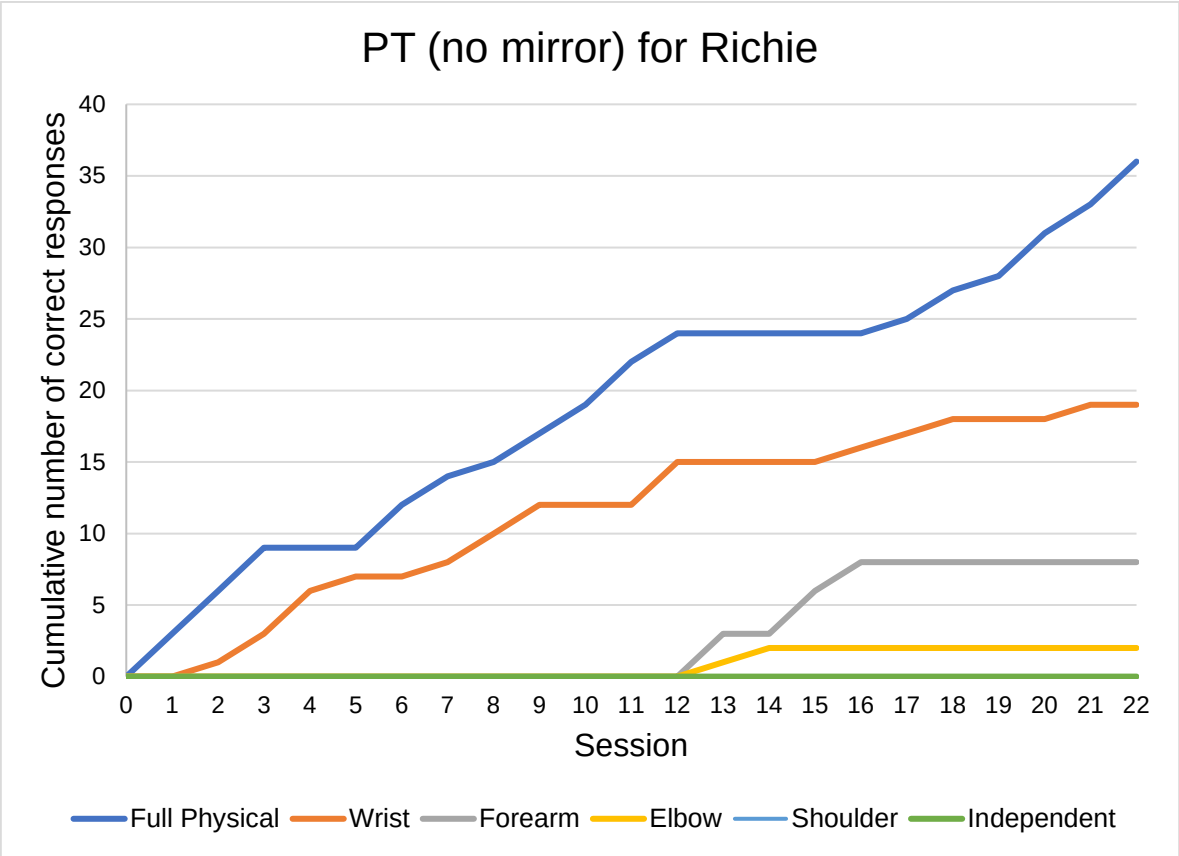

Figure C: Cumulative record graph for Richie's response of pat table with no-mirror condition.

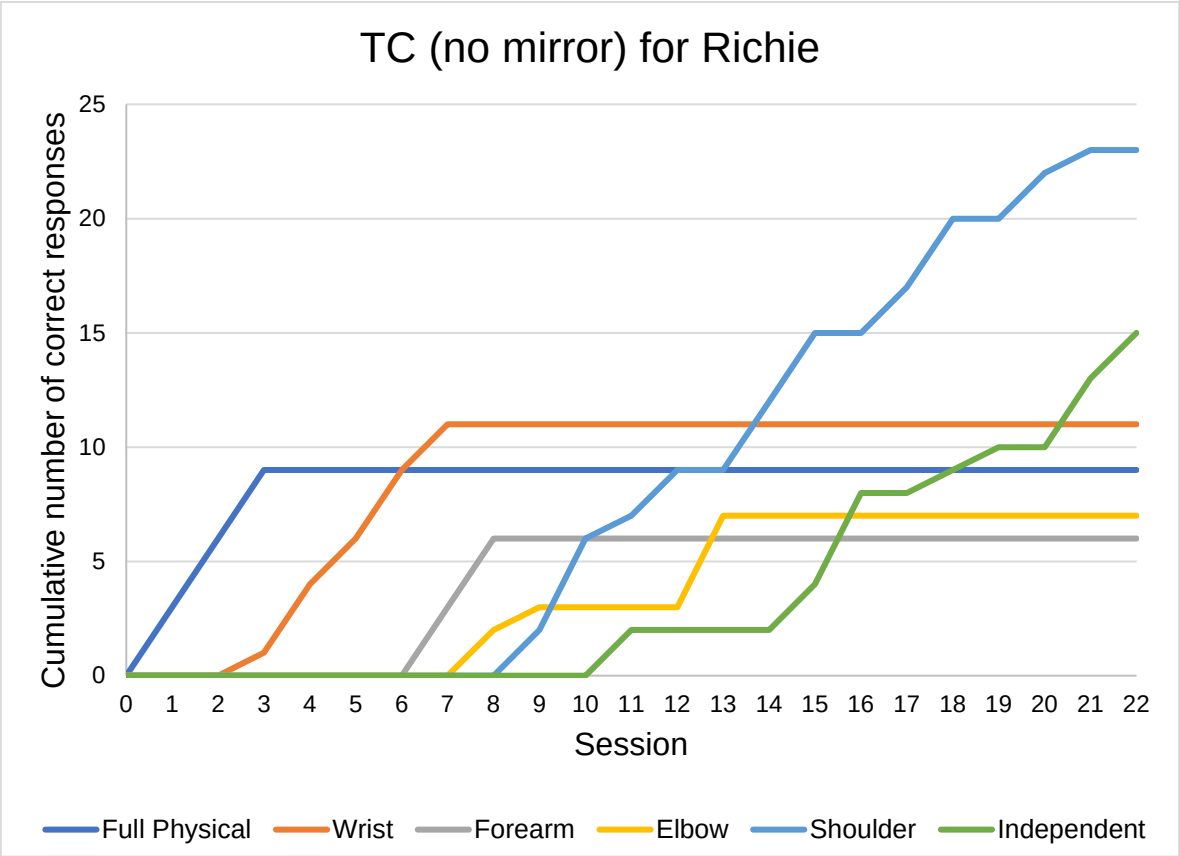

Figure D: Cumulative record graph for Richie's response of touch cheeks with no-mirror condition.

Appendix C

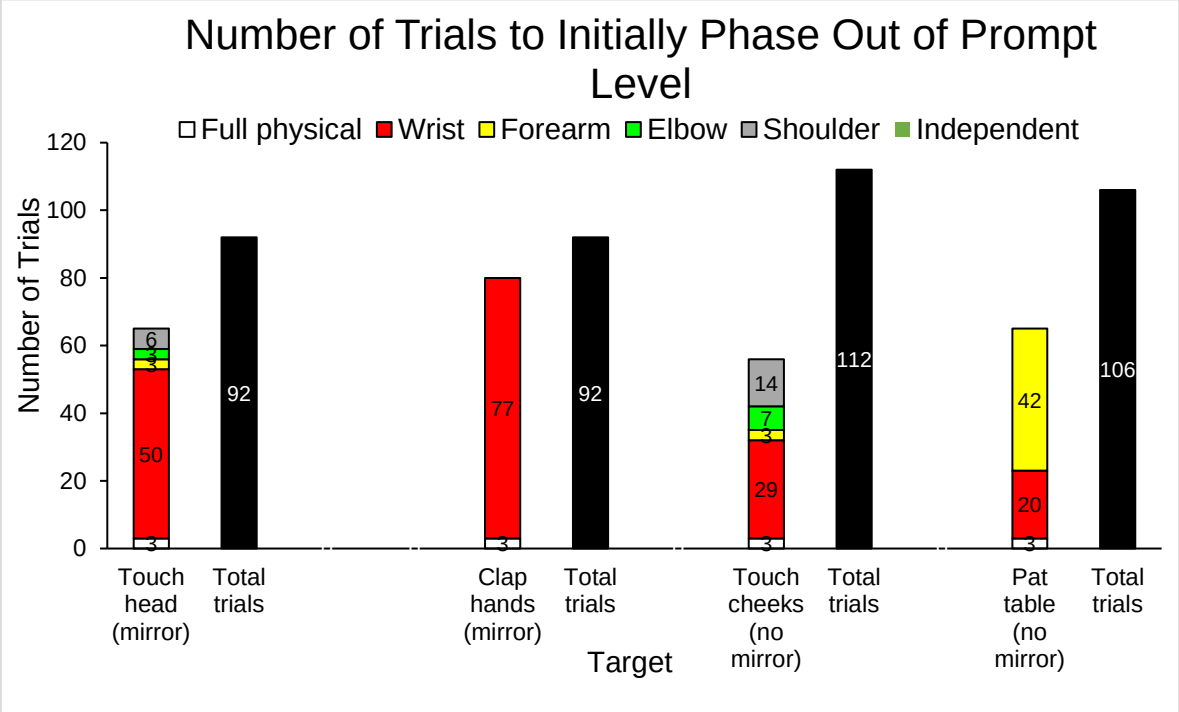

Figure A: Graph showing the number of trials it took for Richie to initially phase out of each prompt level, compared to the amount of total trials.

Appendix D

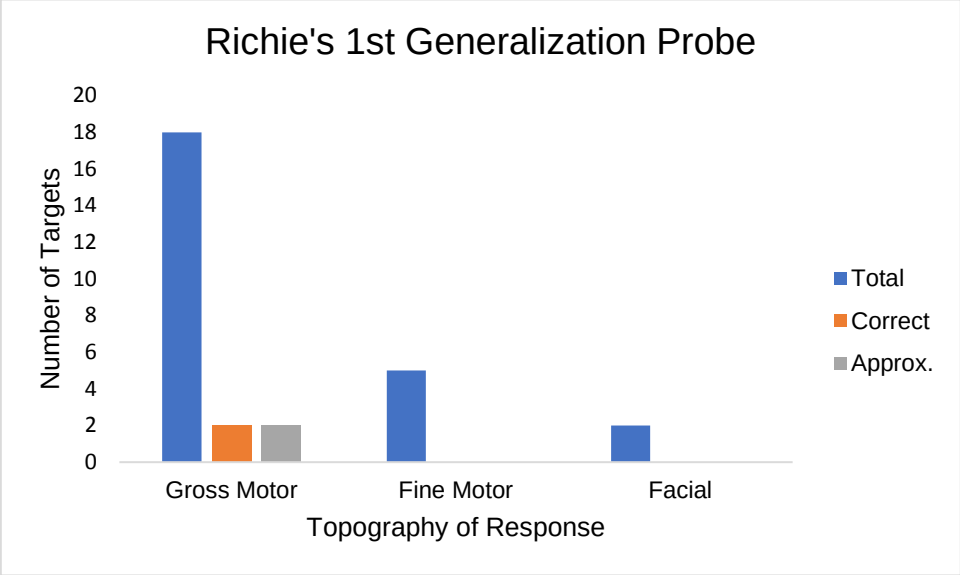

Figure A: Graph showing total, correct, and approximated imitative responses for Richie's first generalization probe.

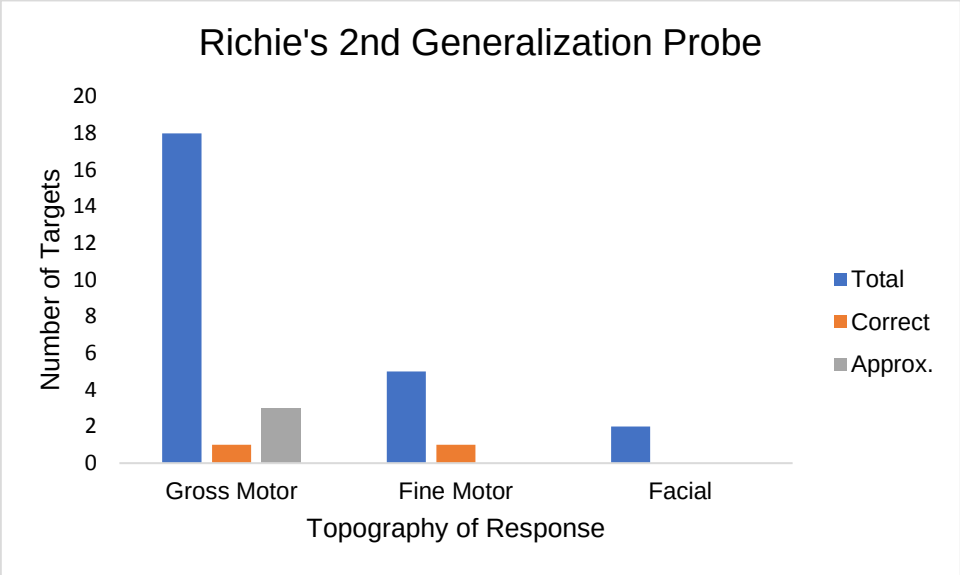

Figure B: Graph showing total, correct, and approximated imitative responses for Richie's second generalization probe.

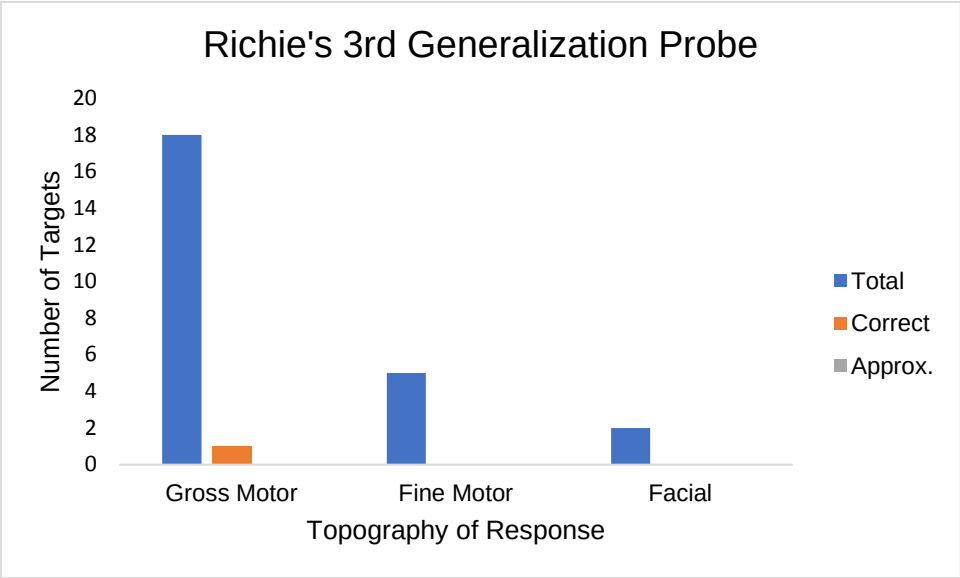

Figure C: Graph showing total, correct, and approximated imitative responses for Richie's third generalization probe.

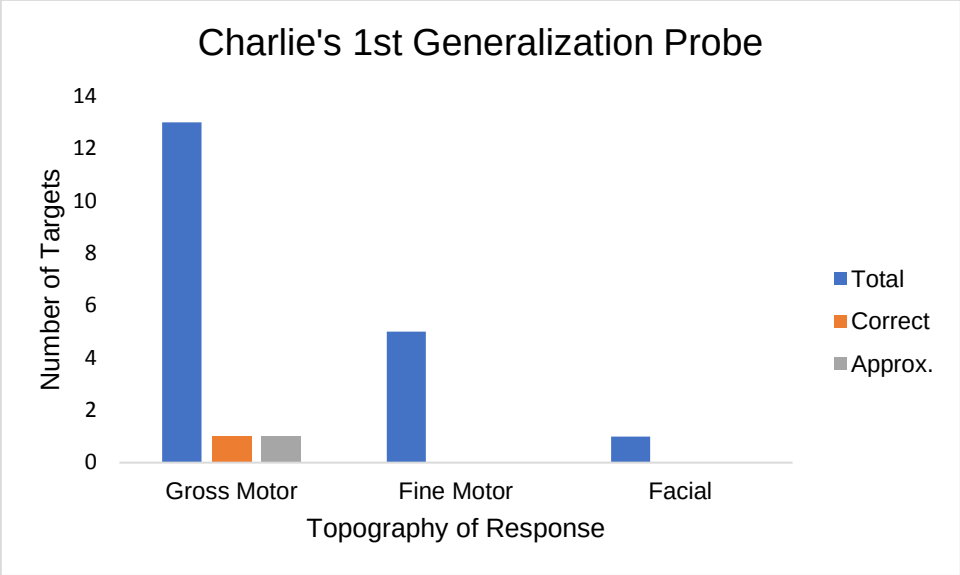

Figure D: Graph showing total, correct, and approximated imitative responses for Charlie's first generalization probe.