THE EFFECTS OF USING A SECONDARY PROMPTER IN MOTOR IMITATION TRAINING ON THE SKILL ACQUISITION OF MOTOR IMITATION AND THE PRODUCTION OF VOCALIZATIONS

by

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(Under the Direction of Rachel Cagliani)

ABSTRACT

Previous research explored the importance of imitation and provided interventions to teach imitation. However, traditional imitation interventions where the implementer provides the instruction and prompts enable a delay in imitation responding. More recent research addresses this gap through interventions where there is an implementer that provides the task direction and model to imitate and a secondary prompter that prompts the participant to imitate the implementer's model. This study sought to replicate a previous study in which a secondary prompter was used to teach motor imitation and that led to an increase in spontaneous vocalizations. Our findings show that incorporating a secondary prompter when teaching motor imitation may lead to gradual acquisition of imitation including generalized motor imitation, vocal imitation, and the production of spontaneous vocalizations.

INDEX WORDS: Motor imitation, secondary prompter, vocalizations, autism

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CHAPTER 1

INTRODUCTION

Imitation involves one person engaging in the same behavior as someone else is engaging in (Ledford et al., 2019). Imitation typically develops in infancy (Meltzoff & Moore, 1989), but children with developmental disabilities may experience deficits in imitation skills (Dawson & Adams, 1984; Ingersoll, 2008). Babies develop imitation ability in the first year of life. One of the first observations of imitation is when a baby protrudes their tongue and opens their mouth (Jones, 2009). Imitation is a prerequisite skill for other skills, such as observational learning, and imitation ability results in more social opportunities (Ledford et al., 2019). Children learn new information frequently through varied social opportunities such as how to communicate and play (Ledford et al., 2019). Given the importance of imitation, researchers developed several imitation interventions for young children.

A 2021 systematic review analyzed 34 studies with 122 participants that underwent intervention meant to improve imitation skills (Ledford & Windsor, 2021). Ledford and Windsor (2021) categorized all articles into four intervention types: video-based massed trials (VBMT), live-model massed trials (LMMT), play-based embedded trial (PBET), and classroom-based embedded trial (CBET; Ledford & Windsor, 2021). Intervention effectiveness varied across type, but generalization was a point of concern consistently across all interventions (Ledford & Windsor, 2021).

Although PBET was the most widely implemented intervention type, a LMMT intervention for imitation may be selected over other intervention types due to its simplicity. Presumably, LMMT is a preferred intervention due to the minimal level of training and planning required to implement and in settings where children are often paired 1:1 with an adult. Ledford and Windsor reviewed 11 LMMT studies (32 participants) where trained implementers applied systematic prompting and error correction. Consequences for imitative behaviors included tangible reinforcers, social reinforcers, and a combination of both. In their systematic review, Ledford and Windsor (2021) found that six out of the 11 studies that evaluated LMMT demonstrated a functional relation. Additionally, they identified maintenance results for LMMT as a strength compared to the other intervention types.

Previous imitation studies included interventions in which the implementer models the response immediately before using a prompt (Bravo & Schwartz, 2021). Bravo and Schwartz (2021) administered most-to-least prompting (full physical, partial physical, light touch, and model prompts) to teach correct imitation responses to preschoolers with autism spectrum disorder (ASD). This type of intervention requires the implementor to stop engaging in the model in order to prompt the participant to imitate. This delay in response enables the participant to attend to the prompt rather than the model presented. Alternatively, a secondary prompter could address this gap by providing a prompt simultaneously with the implementer's model for the participant to imitate.

A 2018 study reported the use of a secondary prompter as more successful than the use of least-to-most prompts when teaching a young child with autism to imitate

(Valentino et al., 2018). The intervention with a secondary prompter avoided the occurrence of delayed imitation and wielded a higher percentage of correct imitation responses than the least-to-most prompt condition. Similarly, Idichandy et al. (2022) incorporated three teaching trials with a secondary prompter for each target to reduce the delay and found the use of a secondary prompter to be effective in the acquisition of motor imitation. The researcher also reported an increase in vocalization imitation for two participants.

The purpose of this study is to replicate and extend Idichandy et al. (2022) to determine if teaching motor imitation with a secondary prompter will generalize to vocal imitation and spontaneous vocalizations. The researchers sought to answer the following research questions: a) Does a secondary prompter during motor imitation training improve motor imitation in preschoolers with ASD? b) Does systematic instruction with a secondary prompter to teach motor imitation improve generalized motor imitation in preschoolers with ASD? c) Does systematic instruction with a secondary prompter to teach motor imitation improve vocal imitation in preschoolers with ASD? d) Does systematic instruction with a secondary prompter to teach motor imitation improve spontaneous vocalizations during 10-min observations during free play in preschoolers with ASD?

CHAPTER 2

METHOD

We selected participants based on the inclusion criteria of a score less than eight on the Motor Imitation Scale (MIS; Stone et al., 1997). Participants were excluded from the study if they were unable to sit at the table for more than 10 min. We recruited participants from a preschool clinic-based program that incorporated applied behavior analysis principles. The researchers conducted the MIS for four candidates but only two students met inclusion criteria. The two students that met inclusion criteria became the participants for this study.

Mason

Mason was a 4-year-old Black boy diagnosed with ASD. On the MIS, he scored one point indicating a deficit in imitation skills. His primary form of communication was gestures and picture exchange. During the study, he received instruction for picture exchange and had progressed through Picture Exchange Communication System Phase II (PECS; Frost & Bondy, 2002) When presented with a picture of a preferred item, he consistently exchanged the picture to request for preferred edibles and toys (e.g.,Legos, magnets, animals). Mason's caregivers emphasized concern in his lack of social interactions with peers in his clinical intake packet. His caregivers' main priorities for Mason were communication, social interactions, and toilet training. Mason engaged in interfering behavior in the form of aggression (e.g., biting, scratching, hitting) and

dropping to the ground during non-preferred activities. He did not engage in aggression or dropping during sessions.

Tyler

Tyler was a 4-year-old Black male with an educational eligibility for special education services under the category of ASD. On the MIS, he scored five points. Tyler communicated using gestures and picture exchange at the PECS Phase IIIB level (Frost & Bondy, 2002). While communicating with PECS, he was able to discriminate from an array of five pictures including preferred and non-preferred items. Tyler's caregivers indicated concern for his social interactions with peers and learning to identify and sort colors. Tyler engaged in biting and dropping during transitions and non-preferred activities. His BCBA hypothesized his challenging behavior was maintained by positive reinforcement in the form of access to tangibles based on indirect and direct assessments. During research sessions, aggression did not occur and dropping occurred infrequently. His BCBA conducted a multiple stimulus without replacement preference assessment prior to this study. His BCBA identified Tyler's preferred items to include sour patch kids, fruit snacks, and any toy that played loud music.

Setting

We conducted the study in a university-based preschool classroom within an on-campus building. The researchers conducted sessions at a 24"H x 48"W table with three 14.5"D x 13.5"W x 20.5"H chairs. Implementers included students pursuing graduate degrees in ABA. The first author trained all implementers using behavioral skills training (BST; Miltenberger et al., 2015) to implement the study protocol prior to conducting

sessions. Prior to baseline, the participants became familiar with all implementers as they worked in their classroom for several weeks prior to this study.

Materials

Materials included a set for the implementer to model with and a set for the participant to imitate with. Materials for body movements were not needed. Tables 1 and 2 summarize the targets and materials required for each participant. Other materials included two timers and data sheets (i.e., baseline, intervention, and novel targets). Data sheets for IOA and fidelity were needed for baseline, intervention, novel targets, and the EESA. Table 3 displayed all of the materials required to run the MIS (Stone et al., 1997).

Response Definitions and Measurement Procedures

Prior to pre-baseline, we selected six targets for each participant from the Assessment of Basic Language and Learning Skills (ABLLS; 2021) at random. For each participant, we selected two body movement imitation targets, two functional object imitation targets, and two non-functional object imitation targets. All targets are listed in Tables 1 and 2. We selected one additional target from each category to evaluate generalization. The researchers defined motor imitation as any instance in which the participants copied the actions of the implementer within 3 s of the task direction “do this”. If the participant used the researcher’s materials or other materials to perform the action, then it was not scored as imitation. The researchers defined vocal imitation as any instance in which the participant repeated the correct word within 3 s of the implementer’s task direction of “say __”. Spontaneous vocalizations included any instance in which a participant vocally said a full word or approximation of a full word.

Procedures

Pre-Baseline

We conducted the MIS (Stone et al., 1997) and early echoic skills assessment (EESA; Sundberg, 2008) with potential participants prior to baseline sessions. Prior to conducting the MIS, we ensured the environment was clear of distractions. We brought the MIS materials (Table 3) in a box and presented one task at a time. We presented the task direction "do this" followed by a model and recorded a score for the best response out of three opportunities on the data sheet. We conducted the EESA at the table and started the assessment by gaining the student's attention. We stated "Say ____(target from EESA)" and waited three seconds. We repeated this three times giving the participant three opportunities to imitate the target response. We recorded a score for the best response out of three opportunities on the EESA data sheet. A zero indicated incorrect responses, a one indicated independent responses, and we recorded partial credit (½) for approximations. Throughout these assessments, we provided edibles and social praise for on-task behavior on a variable schedule.

General Procedures

The participants' BCBA shared results of the participants' free-operant preference assessments. The preference assessment results identified potential reinforcers that the researchers offered the participants to work for in research sessions. The primary researcher kept track of session duration by starting a stopwatch when the session began and stopping it at the end of the session.

Baseline

During baseline, a secondary prompter sat behind the participant but did not prompt the participant. Before each session, the primary researcher asked the participant what they wanted to work for, presented three potential reinforcers previously identified in their preference assessment, and allowed the participant to select one. At the start of each probe trial, the implementer stated the task direction "do this" and modeled the target action for 5 s. If the participant independently imitated within 3 s of the task direction, we provided the participant with their preferred stimulus (e.g., sour patch kids, starbursts) and delivered praise (e.g., good job, you got it). If the participant did not respond correctly, we did not deliver the preferred stimulus and moved to the next target. We did not implement teaching trials during baseline.

Spontaneous Vocalization Observations

We conducted 10 min observations during free play to collect data on spontaneous vocalizations. The first observation occurred in baseline, then more observations occurred contingent upon mastering a target in intervention. If a participant mastered two targets within a week, then only one observation was conducted.

Novel Probe Sessions

The researcher conducted novel probe sessions every third baseline session, once before intervention, and every third intervention session. The purpose of novel probe sessions was to evaluate generalized imitation to other targets that did not receive instruction. Procedures were the same as baseline procedures for novel probe sessions.

Intervention

A secondary prompter sat behind the participant and provided a full physical prompt during teaching trials. Before each session, we asked the participant what they wanted to work for, presented three potential reinforcers previously identified in their preference assessment, and allowed the participant to select one. At the start of each probe trial, the implementer stated the task direction "do this" and modeled the target action for 5 s. If the participant independently imitated within 3 s of the task direction, the researcher provided what the participant selected to work for and praise. Following the probe trial, the researcher implemented 10 teaching trials. The implementer said "do this" followed by a model of the target behavior and the secondary prompter immediately implemented a full physical prompt. The primary research delivered what the participant selected to work for and praise following each teaching trial. Upon mastering their first target, maintenance sessions occurred once per week with the mastered target(s). After every mastered target, the researcher conducted the EESA and recorded a 10 min observation.

Reliability

Procedural Fidelity and IOA

The secondary prompter collected procedural fidelity data and reliability data by calculating interobserver agreement (IOA) for a minimum of 33% of sessions for each condition (i.e., pre-baseline, baseline, intervention). Prior to each session, the first author reviewed the fidelity sheets and modeled how to collect reliability data and calculate IOA with the secondary prompter. Reliability data and procedural fidelity data occurred in 83% of sessions across all conditions. Reliability data was collected for 100% of

screening sessions for both participants. For Mason, reliability data was collected for 80% of baseline sessions, 75% of novel probe sessions, and 100% of intervention sessions. For Tyler, reliability data was collected for 70% of baseline sessions, 84.85% of intervention sessions, 100% of EESA sessions, 100% of novel probe sessions, and 70% of maintenance sessions. Both IOA and procedural fidelity data yielded a score of 100% accuracy for baseline, intervention, EESA probes, maintenance probes, and generalization probes.

Research Design

The researchers intended to use a nonconcurrent multiple baseline design across two participants (Ledford & Zimmerman, 2022) to evaluate the effectiveness of a secondary prompter on motor imitation. In order to strengthen the design, we followed procedures outlined by Ledford and Zimmerman (2022) including randomly assigning participants to different baseline lengths. Prior to baseline, the researchers randomly assigned targets and a set number of baseline sessions to complete before intervention. The researchers intended to assign the first participant to five sessions of baseline, second participant to ten sessions, and third participant to 15 sessions. One participant began imitating during baseline and therefore did not continue with the study. The second participant to enroll moved following three sessions of intervention. Due to attrition, we evaluated the effects of the intervention with an A-B design. This change in design prevented the researchers from evaluating a functional relation.

CHAPTER 3

RESULTS

Mason

During screening, Mason scored one point on the EESA (Figure 2) and one point on the MIS. In baseline, Mason demonstrated stable data of incorrect responses for all six imitation targets across five consecutive sessions (Figure 1). Mason participated in three intervention sessions and engaged in incorrect responding across all three probe sessions (Figures 1 and 4). In the baseline spontaneous vocalization observation, Mason engaged in one spontaneous vocalization. We discontinued Mason's participation in the study following the participant moving.

Tyler

Two weeks after Mason left the study, Tyler became the only participant for this study. In his initial assessments, he scored five points on the MIS and two and a half points on the EESA (Figure 8). His last EESA probe score was two and a half points, but during the second intervention EESA probe he received four points (Figure 8). During baseline, Tyler independently imitated one target correctly across six sessions (Figure 5). He independently hit the drum, imitating the researcher's behavior for four out of ten baseline sessions. Additionally, he did not engage in any spontaneous vocalizations during his baseline observation.

Tyler displayed higher levels of correct responding in intervention (Figure 5). For five intervention sessions the participant worked on all six goals, then the researchers

changed the criteria to working on only three targets at a time (Figure 5). Researchers hoped to improve attending and motivation with this change. Once Tyler mastered a target, the researchers added another target from the original set of six targets. Tyler mastered the first target (tap drum) on the seventh intervention session, his second mastered target (push block with finger) on the ninth intervention session, and his third mastered target (tap block on table) on the 21st intervention session (Figures 5 and 6). Tyler engaged in eight spontaneous vocalizations when observed after mastering his first and second targets. Later, he engaged in five spontaneous vocalizations after mastering his third target. Tyler maintained the mastered imitation targets as demonstrated in weekly maintenance sessions (Figure 7). After 28 intervention sessions, Tyler plateaued in correct responses, so the implementers added a behavior momentum component in which the implementers probed a mastered target immediately before an unmastered target (Figure 5). Tyler did not master any more targets (Figure 6). Tyler continued to engage in 100% accuracy for all mastered targets except for two sessions where he engaged in two out of three targets correctly (Figure 7). During novel probe sessions, he scored one correct in session 30, two correct in session 37, but zero in all other sessions (Figure 7).

CHAPTER 4

DISCUSSION

The researchers sought to explore the impact of a secondary prompter on the: a) skill acquisition of motor imitation; b) generalization of motor imitation skills; c) generalization of vocal imitation; d) production of spontaneous vocalizations. Our findings show that incorporating a secondary prompter when teaching motor imitation may lead to gradual acquisition of imitation including generalized motor imitation and vocal imitation. The gradual increase in imitation occurred for Tyler as he mastered half of his targets within 20 intervention sessions (Figures 5 and 6). After Tyler mastered two targets, he began to inconsistently respond correctly to the novel probes indicating some generalized motor imitation developed (Figure 7). Likewise, after mastering two targets, his EESA score increased to four points (Figure 8). Prior to intervention, his EESA score averaged 2.25 points. Tyler's EESA scores averaged three points within intervention. Overall, his average EESA score was two point seven points (Figure 8). Lastly, Tyler did not engage in spontaneous vocalizations in baseline, and his spontaneous vocalizations increased in intervention to 13 total across two observations. On the other hand, Mason did not engage in a correct response for any of his motor imitation targets or novel probes (Figures 1, 3 and 4), which indicates that he did not learn to imitate with a secondary prompter. It should be noted that Mason participated in three intervention sessions while Tyler participated in 21 intervention sessions. Due to Mason leaving the study, we do not have any intervention data for vocal imitation and spontaneous vocalizations to compare

to his baseline data. Although Mason left the study due to moving, Tyler's results reflect previous findings (Valentino et al., 2018; Idichandy et al., 2022) where an intervention with a secondary prompter increased imitation ability.

This study replicated Idichandy et al. (2022) in which the researcher explored if participants would engage in spontaneous vocalizations after learning motor imitation from an intervention with a secondary prompter. The authors (2022) found an increase in vocal imitation as measured by the EESA. To expand upon this finding, we probed the EESA and conducted 10 min observations once in baseline and after each mastered target. Similar to Idichandy et al. (2022), participant vocal imitation increased slightly as measured with the EESA. Additionally, in comparison to the beginning of the study, Tyler engaged in more spontaneous vocalizations. This increase of vocalizations may be due to the intervention, time passing, or another unknown variable. Tyler's results reflect previous findings (Idichandy et al., 2022) in that the use of a secondary prompter yielded motor imitation skill acquisition and increased vocal imitation. However, our study involved more sessions with less mastered targets (Figures 5 and 6). Participants in the 2022 study had the same variable EESA score data as Tyler, but lower percentages of maintenance probes were reported. Furthermore, maintenance probes indicate that Tyler maintained the mastered targets over time (Figure 7), which supports the results Ledford and Windsor (2021) reported where LMMT studies lead to prolonged maintenance in comparison to other intervention types.

Limitations

It may not be feasible to conduct this study in all contexts due to long intervention session durations. Sessions with all six intervention targets averaged 29.83 min in

duration. When the researchers decreased the number of targets per session from six to three, the average intervention session duration decreased to 12 min. The practicality of a shorter session duration with fewer targets to run may be more feasible to implement in other contexts. The longer the session duration, the higher the likelihood the participant's motivation decreased resulting in a lack of attending that further increased session duration. To avoid low motivation, the researchers allowed participants at least five min of free play prior to sessions. Additionally, the implementer allowed the participants the opportunity to change which reinforcer they wanted to work for throughout sessions to maintain motivation. When the participant's attending decreased, the implementer represented the opportunity to choose their reinforcer with a new array of reinforcer options.

We selected participants from a limited pool of potential participants in which only two students met inclusion criteria. During the start of intervention, the first participant moved leaving only one student eligible to participate. Tyler's data suggests that the use of a secondary prompter can increase the acquisition of motor and vocal imitation as well as increase spontaneous vocalizations. However, these findings lack replication across participants within this study. The nonconcurrent multiple baseline research design the researchers intended to use turned into an AB design without a demonstration of a functional relation. More rigorous studies are necessary to fully understand the impact of a secondary prompter on imitation acquisition.

Recommendations for Practice

Practitioners should consider incorporating a secondary prompter when teaching imitation. To maintain interest and motivation, practitioners should focus on a few targets per session and allow for frequent opportunities to take breaks during sessions.

Clinical implications derived from this study include learning to imitate may lead to the generalization of vocal imitation, increase in spontaneous vocalizations, and the development of observational learning. Practitioners should consider opening fewer targets with more teaching trials as this could potentially result in faster skill acquisition.

It is essential for researchers to continue to develop intervention methods for children with autism to learn how to imitate. Traditional imitation interventions create a delay in imitation as an implementer cannot model the response and physically prompt the participant at the same time (Bravo & Schwartz, 2021). A secondary prompter addresses this limitation and is more effective in improving imitation (Valentino et al., 2018; Idichandy et al., 2022). Results indicate that the acquisition of motor imitation may have led to an increase in vocal imitation and introduced the possibility that spontaneous vocalizations can develop after learning to imitate.

CHAPTER 5

TABLES AND FIGURES

Table 1

Mason's assigned targets, definitions, and materials

Target Type	Target	Definition	Materials
Body	Wave	One hand moves from side to side at face level	None
Body	Hands on knee	Both hands touch the individuals knee/thigh region	None
Object Meaningful	Tap drum	Individual holds the drum stick one hand and makes contact with the drum (up and down motion) at least twice	Two drums and two drumsticks
Object Meaningful	Stack block	Individual picks up one block and places it on top of another block	Four blocks
Object Non-meaningful	Put block on book	Individual grasp the block from the table and lifts directly up and places on top of book without the block falling off of the book	Two books and two blocks
Object Non-meaningful	Push block with finger	Uses one finger to move block from one location to another at least 3 in from original location, the block must always keep contact with the table	Two blocks

Novel Probe	Arms up	Both hands lift above individual's head/shoulder region	None
Novel Probe	Draw line	Individual holds a writing utensil and makes a left to right motion on the paper (does not have to actually draw a line just copy the motor movement with the writing utensil)	Two papers and two utensils
Novel Probe	Tap block on table	Grasping the block from the table and lifting them directly up, then placing it back down in the same spot at least two times within 2 seconds of the initial lift	Two blocks

Table 2

Tyler's assigned targets, definitions, and materials.

Target Type	Target	Definition	Materials
Body	Arms up	Both hands lift above individual's head/shoulder region	None
Body	Hands on head	Both hands making contact with the top of the individual's head	None
Object Meaningful	Rocking a baby	Individual holds the baby doll with both hands and swings arms side to side	Two drums and two drumsticks
Object Meaningful	Tap drum	Individual holds the drum stick one hand and makes contact with the drum (up and down motion) at least twice	Four blocks

Object Non-meaningful	Push block with finger	Uses one finger to move block from one location to another at least 3 in from original location, the block must always keep contact with the table	Two books and two blocks
Object Non-meaningful	Tap block on table	Grasping the block from the table and lifting them directly up, then placing it back down in the same spot at least two times within 2 seconds of the initial lift	Two blocks
Novel Probe (Body)	Hands on knee	Both hands touch the individuals knee/thigh region	None
Novel Probe (Object Meaningful)	Draw line	Individual holds a writing utensil and makes a left to right motion on the paper (does not have to actually draw a line just copy the motor movement with the writing utensil)	Two papers and two utensils
Novel Probe (Object Non-meaningful)	Wave drumstick	Holds drumstick at face level, moves it once in each direction (right and left), can be either direction first	Two blocks

Table 3

A list of materials required to conduct the Motor Imitation Scale Assessment (Stone et al., 1997).

Materials
Two spoons
Two rattles
Two toy cars

Two teacups

Two toy dogs

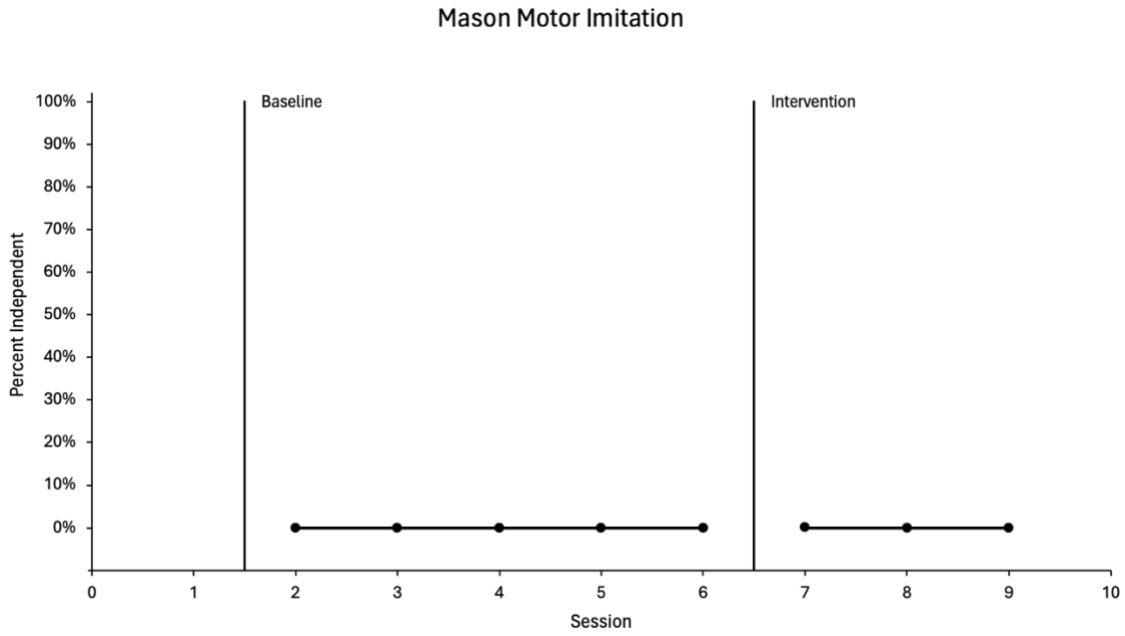
Two hairbrushes

Two small blocks

Two strings of beads

Figure 1

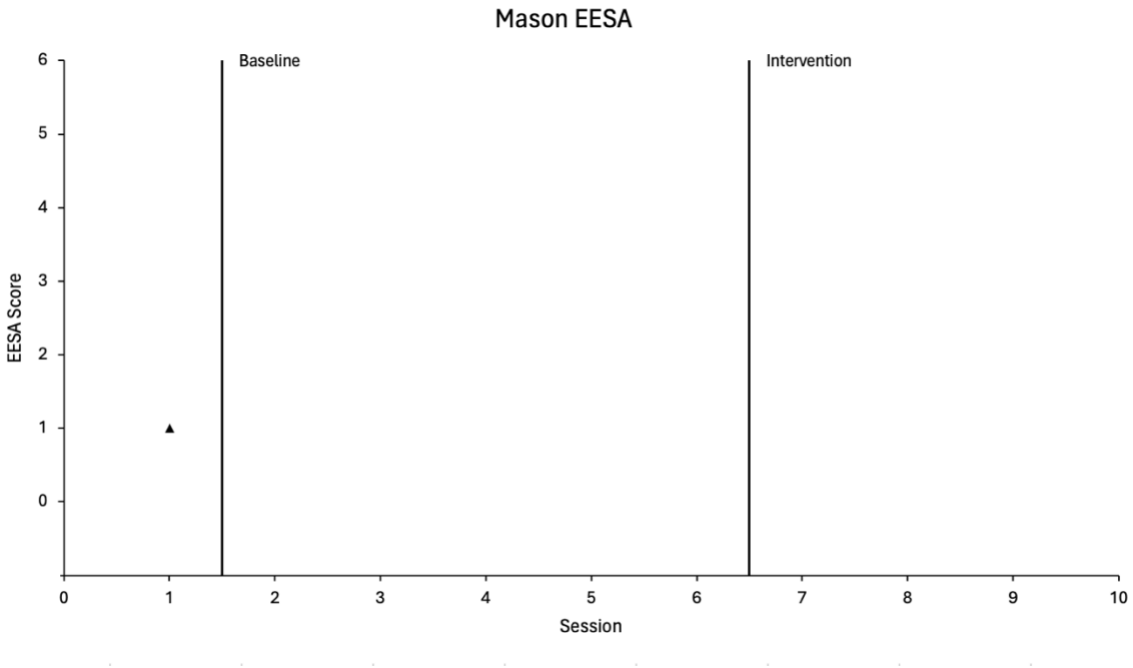
Mason's Motor Imitation Targets



Note. This figure demonstrates Mason's motor imitation targets in which he worked on all six targets. The condition change line prior to baseline indicates the screening period where no motor imitation data was collected.

Figure 2

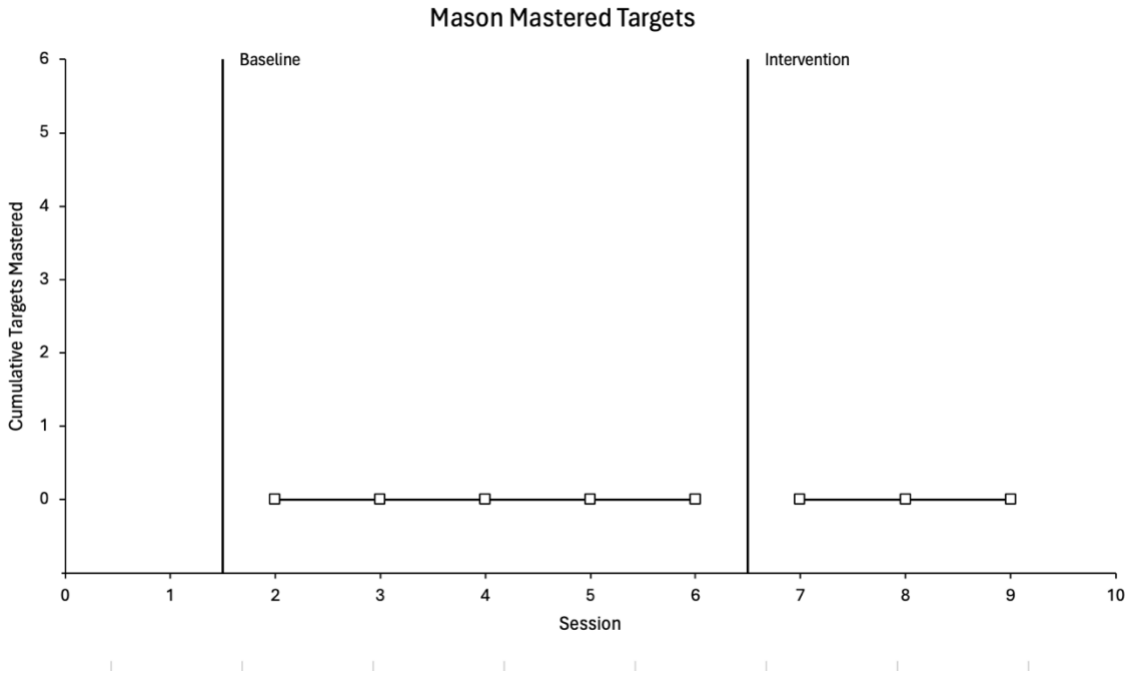
Mason's EESA Score



Note. The condition change line prior to baseline indicates the screening period where his initial EESA was conducted.

Figure 3

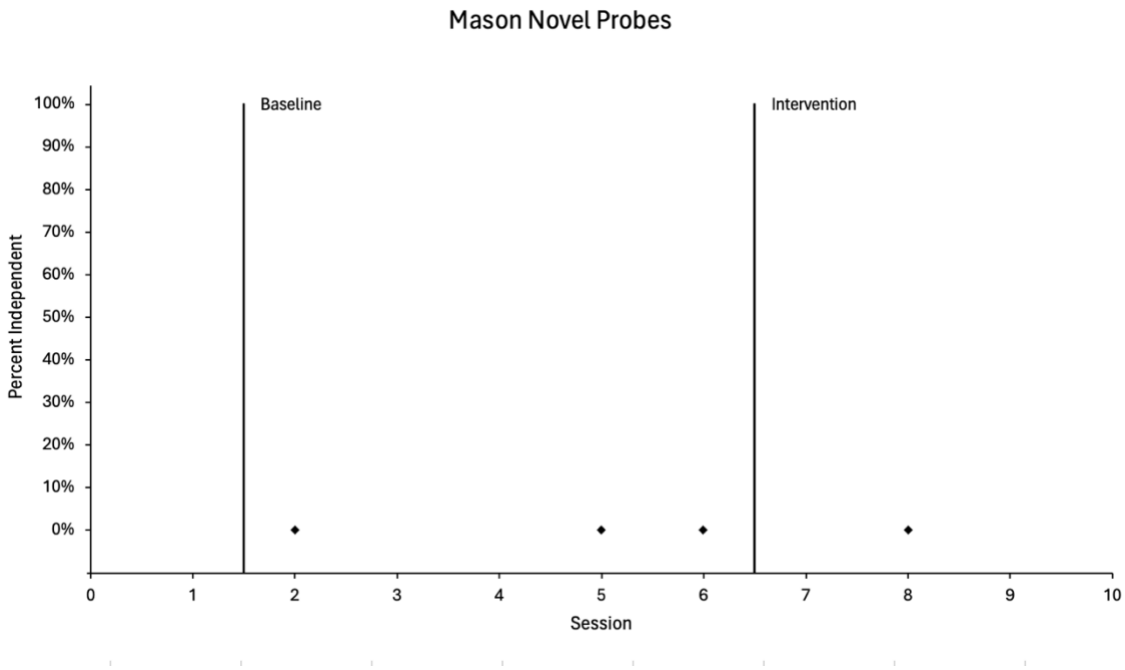
Mason's Mastered Targets



Note. The condition change line prior to baseline indicates the screening period where no motor imitation data was collected.

Figure 4

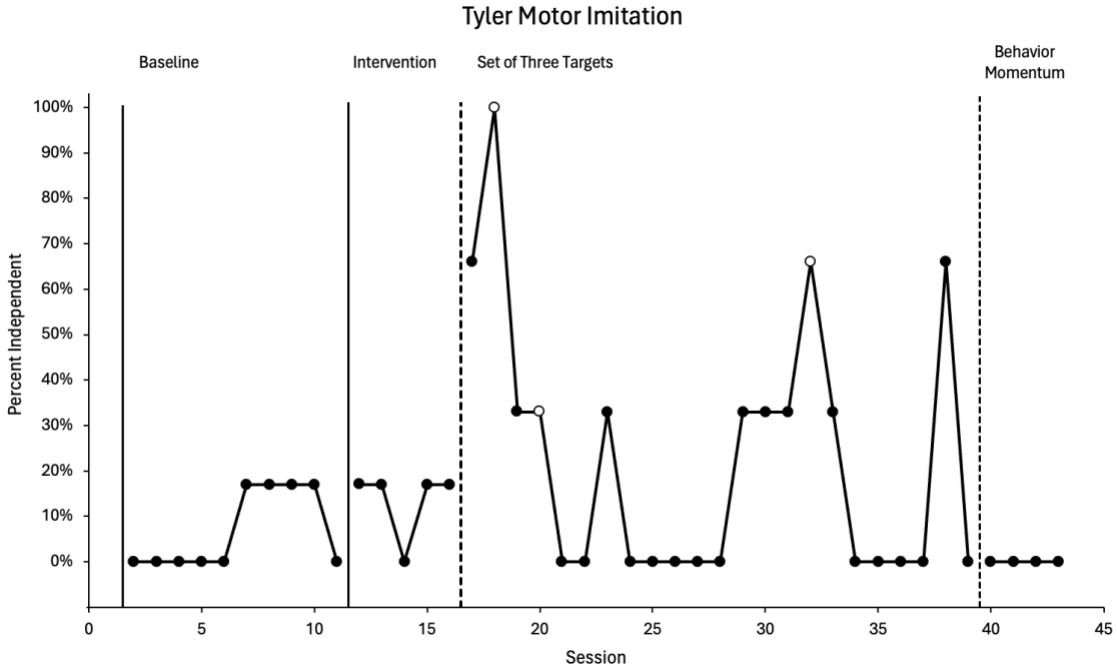
Mason's Novel Probes



Note. The condition change line prior to baseline represents the screening period in which novel probes were not conducted.

Figure 5

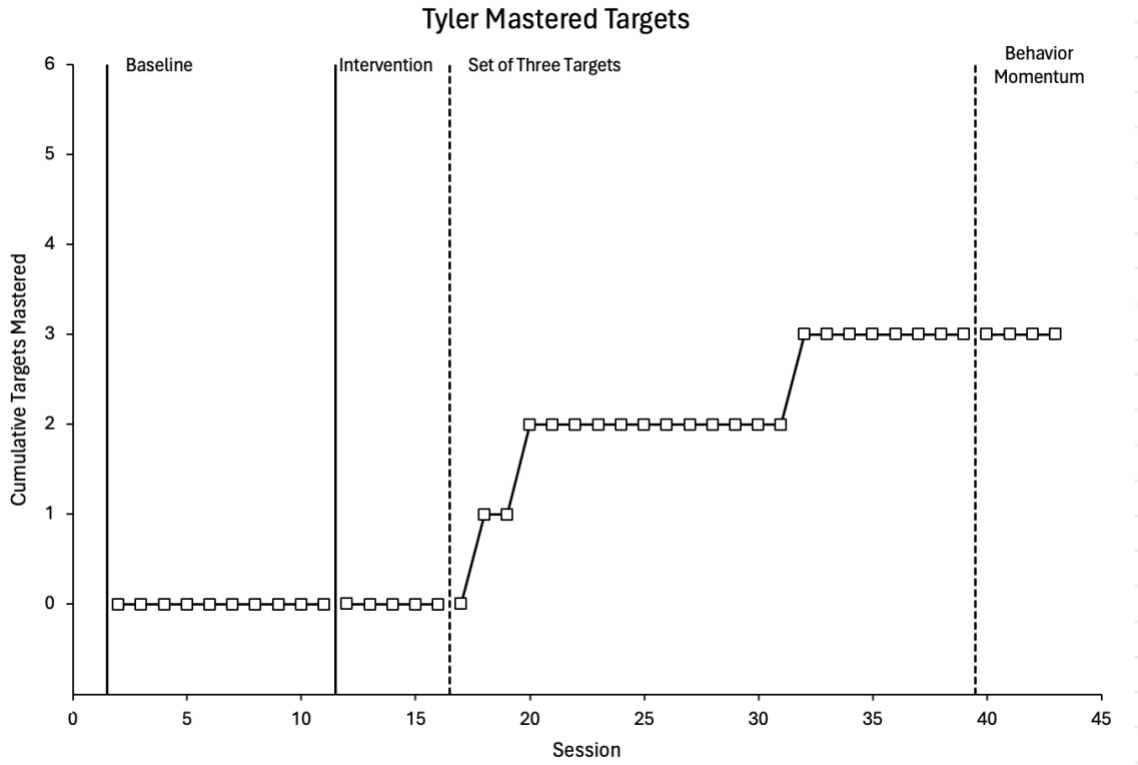
Tyler's Motor Imitation Targets



Note. The open circles represent when Tyler mastered a target. The condition change line prior to baseline indicates the screening period where no motor imitation data was collected.

Figure 6

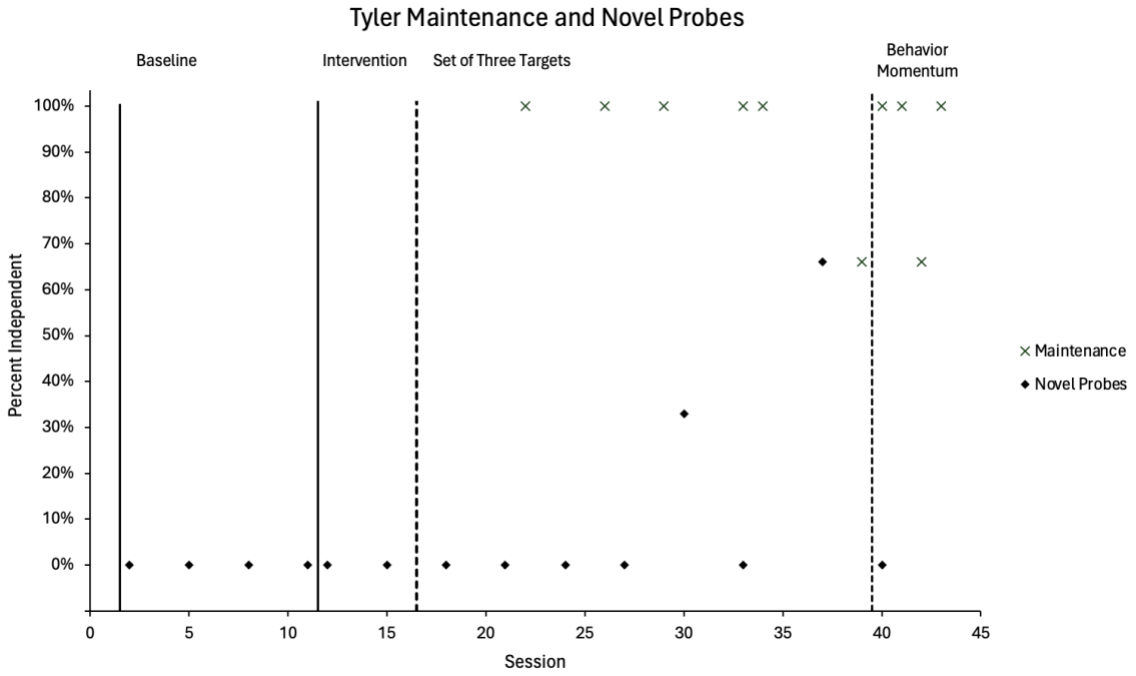
Tyler's Mastered Targets



Note. The condition change line prior to baseline indicates the screening period where no motor imitation data was collected.

Figure 7

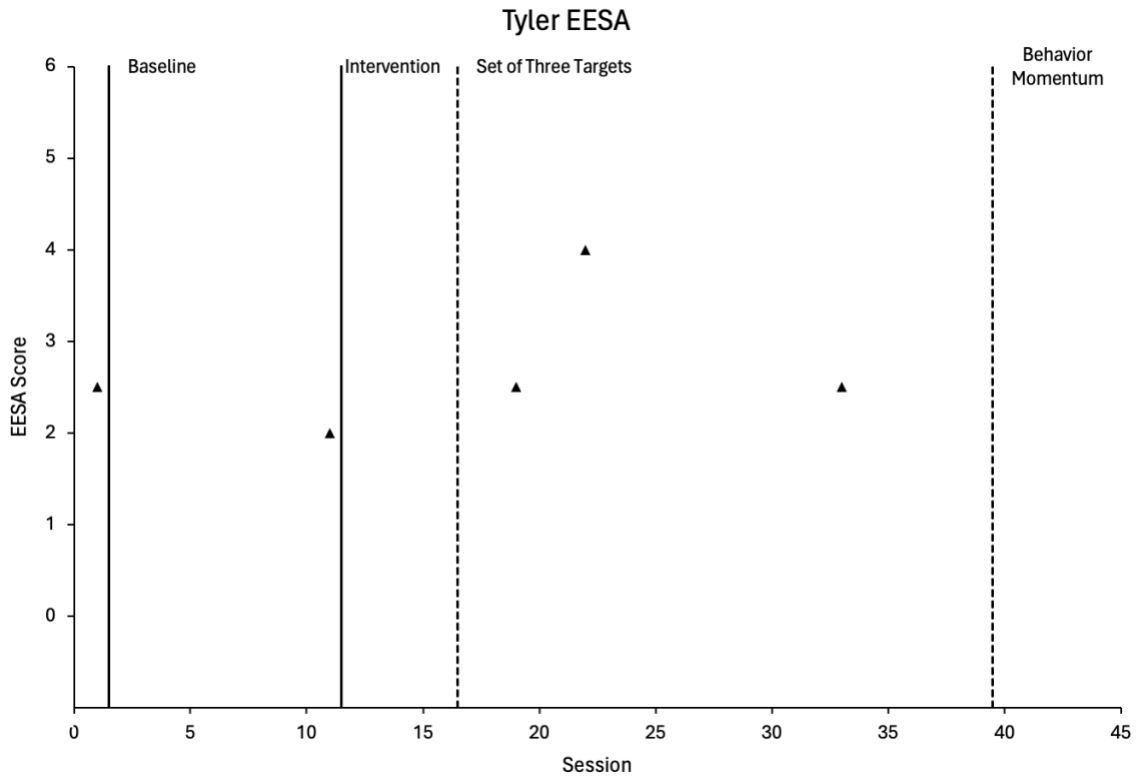
Tyler's Maintenance and Novel Probes



Note. The condition change line prior to baseline indicates the screening period where no motor imitation data was collected.

Figure 8

Tyler's EESA Scores



Note. The condition change line prior to baseline indicates the screening period in which his initial ESSA was conducted.

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