Critical review: the efficacy of Reciprocal Imitation Training as a treatment for imitation deficits in young children with Autism Spectrum Disorder

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This critical review investigates the efficacy of Reciprocal Imitation Training (RIT): a play-based treatment protocol, intended to treat imitation deficits in young children with Autism Spectrum Disorder. The search terms "Reciprocal Imitation Training" and "Autism" were used to search for relevant peer-reviewed articles in online databases. The resulting 9 studies (7 single-subject, multiple baseline studies, and 2 randomized control trial studies) were reviewed. This research provides strongly suggestive evidence that RIT is an effective tool for imitation therapy in young children with autism.

Imitation is an early skill: typically developing children begin to imitate sounds by 4-8mo (University of Pittsburg, Office of Child Development, n.d.) and can imitate actions with objects by 9 months (Toth et al, 2006). Imitation facilitates social interaction in young infants (Ingersoll, 2008) and is an important means of early communication in parent-child dyads and between peers (Eckerman, Davis & Didow, 1989, Ingersoll 2008, Toth et al, 2006). In typically developing children, early imitation skills are predictive of later language skills (Toth et al., 2006).

It is widely accepted that children diagnosed with Autism Spectrum Disorder (ASD) have impaired imitation skills (Rogers et al, 2003, Williams, Whiten & Singh, 2004) and the implications of this impairment can be extensive. In children with ASD, imitation skills have been found to predict many communicative behaviours including play, language, and joint attention (Ingersoll & Gergans, 2005). For example, imitation performance on the Early Social Communication Scales is correlated with ability to initiate joint attention (Ingersoll, 2008) and motor imitation skills at age 2 predict spoken language abilities at age 4 in ASD groups (Stone & Yoder, 2001). Immediate imitation skills are positively correlated with concurrent language skills for 3-4 year olds with ASD and predictive of language competence 6 months later (Ingersoll, Lewis & Kroman, 2007, Toth et al, 2006). Higher imitators amongst children with ASD verbalize to experimenters more than low imitators and there is a positive relationship between vocal imitation and expressive language (Ingersoll, 2008). Action imitation skills in 2 year old children with ASD are also predictive of play skills at age 3 (Ingersoll, 2008).

As the body of literature supporting the link between imitation skills and social communication skills grows, it is increasingly important to find an effective method of treating imitation deficits. Discrete trial training, pivotal response training, milieu training (Ingersoll, 2008), and Video Modeling (Cardon & Wilcox, 2011) have been used to train imitation skills in the past.

Reciprocal Imitation Training (RIT) was first described by Ingersoll and Schreibman (2006) as a naturalistic intervention intended to improve imitation skills of children with autism. They proposed that RIT can be used to treat both object and gesture imitation deficits. Ingersoll and Schreibman (2006) described the RIT protocol as a series of 5 training phases:

> I - clinician contingently imitates child.
> II - clinician models familiar actions with the same toy as the child
> III- clinician models familiar and novel actions with the same toy as the child
> IV- using a different toy than the child, clinician models familiar actions
> V - using a different toy than the child, clinician models familiar and novel actions.

This therapy program is play based: trainer-child dyads play with toys together in natural settings. During phases II-V, children are given three chances to imitate their adult partner. Verbal markers are used to draw attention to the action (verbal markers vary between objects). If no imitation occurs within 10s of the third trainer model, the adult uses hand-over-hand prompting to help the child to complete the action (Ingersoll, 2010). All imitation attempts and physical prompts are followed by verbal phrase and continued access to toys. Two identical sets of toys are used during intervention:

one set for the child, one for the trainer (Ingersoll & Schreibman, 2006). Toys are varied between training sessions to encourage skill generalization.

Objectives

The primary objective of this paper is to critically review current evidence regarding the efficacy of Reciprocal Imitation Training (RIT) as a treatment for imitation deficits in young children with ASD.

Methods

The search terms "Reciprocal Imitation Training" and "Autism" were used to search for relevant peer-reviewed articles in CINAHL, JSTOR, Ovid, PsychInfo, ProQuest, PubMed, ScienceDirect, and Scopus online databases. This search yielded 69 articles. Duplicates were excluded as were those studies involving children over the age of 8. Articles that summarized the current state of evidence for the primary purpose of information sharing were not critically reviewed as they did not provide new data. The remaining 9 articles were included in this review: 7 multiple-baseline studies and 2 randomized control studies. The level of evidence provided by these papers was quantified using a 5-point scale (equivocal, slightly suggestive, suggestive, strongly suggestive, compelling).

Results

The majority of articles included in this review (7/9 studies) discuss single-subject, multiple baseline experiments. Though the small sample sizes of these studies limits the extent to which these study results can be generalized to a larger population, they provide important preliminary data about the efficacy of RIT. The extended baseline periods used in these studies allows researchers to monitor skill level before, during, and after treatment. The 2 randomized control trial studies provide greater generalization information.

All 9 studies included in this review used the 5-phase RIT protocol detailed in this paper's introduction. The authors of each study confirmed participant diagnoses before proceeding with therapy (the Autism Diagnostic Observation Schedule and the Childhood Autism Rating Scale were frequently used for this purpose).

Schreibman and Ingersoll (2006) conducted a single-subject, multiple baseline study looking at the efficacy of object-focused RIT in 5 children with ASD (29-45 mo). Participants completed eight 20-min sessions per week for 12-20 weeks (2 wk staggered baseline, followed by 10 weeks of treatment). Percentage of clinician actions spontaneously imitated by the children

was scored from video recordings of treatment sessions. Visual inspection of frequency data, a re-sampling procedure, and statistical tests (one way paired T-test) comparing pre/post scores on the Motor Imitation Scale (MIS), Joint Attention Assessment, and Structured Laboratory Observation, showed significant increases in object imitation skills. ANOVA analysis of blinded social acceptability scoring (7 point scale) also showed significant improvements in "normalcy" of play interactions.

It should be noted that study participants did not respond to treatment in a uniform matter: though all increased imitation skills, the extent of this improvement varied greatly. Treatment protocols were well described as were scoring, testing, and re-sampling procedures. Raw data was reported including: percentage of imitated actions for all baseline and treatment sessions, participant characteristics (mental age, language age, severity), and all test scores. Fidelity of treatment implementation was monitored via videotape review - each strategy was assessed independently and implementation accuracy ranged from 92.5-100% for all strategies. Video reviewers were not blinded to the purpose of the study. Kappa coefficients revealed high degrees of inter-rater agreement on all video scoring tasks. This study used a variety of outcome measures, each of which revealed changes in imitative skills. The consistency of these results is strongly suggestive.

Ingersoll, Lewis, & Kroman (2007) ran a single-subject, multiple baseline study looking at the effectiveness of RIT for treating imitation of descriptive gestures in 5 boys with autism (34-49 mo). Subjects attended six 20-min sessions per week for 10 weeks following baseline measures. Two-way Paired T tests comparing pre/post treatment scores on the MIS and visual analysis of frequency data show that gesture imitation increased for all participants with gains generalizing to novel materials, setting, and a novel partner at a 1-month follow-up session. Blinded rating (5-point scale) of child engagement, imitation, and "appropriateness" of language and play showed significant improvement following treatment (two-way paired T test).

Participants' response to treatment was variable: though all increased frequency of gesture imitation, only 3 of the 5 participants showed substantial gains in spontaneous gesture use during therapy and only 1 child maintained this gain at follow-up 1mo post-treatment. Imitation of descriptive gestures was variable, ranging from 0-50% depending on the child. Researchers did not track what gestures were used with each participant so it is unclear if participants learnt a small set of gestures or generalized imitation skills to a

large set of gesture models. It should also be noted that individuals scoring videos were not blinded as to the purpose of this study. The raw data generated through this study was reported: percentage of imitated actions for all sessions, participant characteristics (mental age, language age, severity), and pre/post MIS test scores. Definitions for target behaviours were also discussed in detail. Fidelity of treatment implementation was monitored via videotape review - each strategy was assessed independently and implementation accuracy ranged from 86.3-100% for all strategies. Kappa coefficients revealed good inter-raterr agreement (scores of 0.69 - 0.73 for each dependent measure). In summary, this study provides suggestive evidence that RIT is effective at treating gesture imitation deficits in young children with ASD.

Ingersoll and Lalonde (2010) completed a single subject multiple baseline study to determine if adding gestural RIT to an object-based RIT therapy program would improve context-appropriate language use during play activities in 4 children (1 girl) with autism (35-41 months). Following staggered baseline measures, participants attended 3 hours of treatment per week for 10 weeks. Frequency of verbal imitation in sessions was scored via video-analysis as a percentage of models imitated. Visual analysis and Wilcoxon signed-rank tests of frequency data indicate that 3 of the children used more appropriate language during play once gesture imitation trials were introduced. The fourth child became ill part way through the experiment which is thought to have affected his progress. Visual comparison of MIS and Unstructured Imitation Assessment (UIA)scores indicate all participants made object and gesture imitation gains following treatment.

Ingersoll and Lalonde (2010) clearly describe their treatment protocol, methods of implementation and scoring procedures. Their assessment measures were reasonable, valid and reliable. Therapists were trained to 90% correct implementation of the therapy protocol before they began working with the participants and consistency of implementation was monitored during the experiment (5 point rating scale). All of the raw data generated during this study was made available in this article including assessment scores and frequency data. Wilcoxon Signed-rank tests were used to compare and to measure agreement between raters and Kappa Coefficients show good inter-rater reliability on video-scoring tasks. However, visual analysis alone was used to assess change in spontaneous imitation skills - researchers reported that spontaneous imitation "increased." The primary rater acted as a therapist during the study though appropriate statistical tests were used to determine that the primary rater's scores did not vary significantly from those of the "reliability

rater." This study was conducted as part of a larger study looking at the efficacy of object focused RIT. The "baseline" measures for this study were obtained during object-oriented RIT therapy sessions so the efficacy of gesture-focused RIT alone could not be determined. Gesture-focused RIT is commonly used as a "superstep" for object-focused RIT. Overall, this study presents suggestive evidence that gesture-focused RIT leads to language gains.

In 2006, Ingersoll & Gergans carried out a single subject, multiple baseline study assessing the efficacy of parent-implemented RIT in 3 mother-child dyads (31-42 mo). Dyads attended 30-40min sessions twice a week for 10 weeks following baseline (staggered every 2 weeks) during which parents were taught to use RIT. Frequency (imitation per minute) of spontaneous imitation was determined for each child during baseline and therapy sessions via video review. Visual analysis of frequency data indicated all children increased their spontaneous object imitation following therapy. Only one child received gesture-focused RIT - he similarly showed gains in spontaneous gesture imitation (gains not maintained at 1mo follow-up).

Cohen's Kappa and Pearson's R coefficients were used to monitor inter-rater reliability on video scoring. Parents, therapists, and individuals scoring frequency data via video were not blinded to the purpose of the study. It should be noted that different fidelity measures were used to monitor treatment implementation: use of contingent imitation and linguistic mapping was scored as a percentage while imitation training was scored as strategies per minute. It is unclear if fidelity of treatment implementation impacted child performance in any individual session. Though children's imitation performance improved, the raw data indicates that the extent of this improvement varied greatly. As a frequency count was used to measure progress rather than a percentage measure, it is unclear if children improved imitation skills or were simply provided with more opportunities to imitate due to changes in parent behaviour. Despite the procedural transparency of this research, it only provides equivocal evidence of the benefit of gesture-focused RIT and slightly suggestive evidence supporting the efficacy of object-focused RIT.

Cardon, & Wilcox (2011) performed a single-subject multiple baseline study looking at the efficacy of object-focused RIT and Video Modeling in 6 children with ASD (20-48mo). Participants attended 3 sessions per week for 5 weeks following baseline (staggered every week). Frequency of imitations was counted in every session (number of imitations per session). Visual analysis of frequency data and pre/post treatment MIS scores revealed improved imitation skills. As per visual

analysis of frequency data, gains were maintained and generalized at 1 and 3 week follow up visits.

This study is procedurally transparent: authors describe their methods, recruitment strategies, assessment measures, and rational in great detail. Their raw data (frequency counts and MIS scores) is also included in the paper. Fidelity of treatment implementation was tracked in 20% of sessions using a checklist and point-by-point comparison was used to determine that inter-rater reliability was high (97.8%). As a frequency count was used to measure imitation skills, it is unclear if children imitated more actions as they were provided with more opportunities to imitate actions (due to RIT protocols) or if their imitation skills improved. Therapists, video raters, and parents were not blinded as to the intent of the study. Overall, this study provides suggestive evidence supporting the efficacy of object-focused RIT.

Walton, & Ingersoll (2012) conducted a single-subject, multiple baseline study assessing the effectiveness of sibling-implemented object RIT in 6 sibling dyads. Typically developing children (ages 8-13) were trained to implement treatment techniques with a younger sibling diagnosed with ASD (45-57 months). Due to the time required to train siblings, all RIT strategies (linguistic mapping, contingent imitation, and prompting) were only used concurrently during the final three weeks of treatment. The percentage of models imitated by the child with autism was monitored throughout treatment. Visual analysis of this frequency data showed that the child with autism imitated more object actions following RIT in 4/6 dyads. MANCOVA analysis of a pre/post blinded social validity survey (7 point scale) indicated that dyad interactions were more "typical" and "positive" following therapy.

A strength of this study is its procedural transparency: all testing protocols are detailed in the article and the training materials used with older siblings are available by request from the first author (Walton). All of the raw data generated through this researcher is included in the paper (child characteristics, imitation frequency scores, fidelity of implementation, and results of statistical analysis). Pearson's R statistics and Kappa coefficients were used to track inter-rater reliability. Though fidelity of treatment implementation by the typically developing sibling was scored (percentage correct implementation), fidelity of the trainer (Walton) was not tracked. It should be noted that the impact of this treatment protocol was relatively small: children with ASD only showed consistent improvement in imitation skills in 4/6 dyads. This could be due to the relatively short treatment time (3 wks as opposed to 10 in previous studies) or low fidelity of implementation in early

stages of training. Overall, this research provides slightly suggestive evidence regarding the efficacy of RIT in young children with ASD.

Wainer & Ingersoll (2013) conducted a single-subject, multiple baseline study looking at the efficacy of object-focused RIT in 5 child-therapist dyads and 3 parent-child dyads (age 26-88mo). Adults were trained in RIT strategies through a 5-module online course and child progress was monitored through video-recordings of baseline and post-training observation sessions. Frequency of child imitation was measured with counts of imitative acts per minute (prompted and spontaneous). Visual analysis of frequency data indicates that the frequency of child imitation increased following therapy.

Pearson's R showed high inter-rater reliability on imitation frequency measures (0.98-0.99) though raters were not blinded as to the purpose of the study. Authors included all of the raw data (imitation frequency, fidelity of treatment implementation rated on a 5-point scale) and describe their experimental procedure in detail. It should be noted that changes in child imitation rates were ascertained from 2-3 10-min RIT sessions recorded on a single day following parent/therapist training. If a parent/therapist struggled to implement RIT strategies, an additional 10min RIT session was recorded. Though these measures showed improvements in child imitation skills, 2-3 data points obtained on a single day provide insufficient evidence regarding the efficacy of this therapy. This paper provides only slightly suggestive evidence in support of the efficacy of RIT in young children with ASD.

Ingersoll (2010) completed a randomized control study examining the impact of RIT on elicited and spontaneous imitation in 22 children (27-47mo) matched for expressive language age (as per Preschool Language Scales 4th edition) and randomly assigned to control/treatment groups. The test group (n=11) received 3 hours of RIT a week while the control group continued to receive intervention as per normal in the community. ANCOVA analysis of pre/post scores on the MIA and UIA showed significant gains in both elicited and spontaneous imitation of object actions and gestures following therapy.

It should be noted that 2 of the 11 children in the test group only received object-focused RIT due to their low developmental age. (as opposed to object-focused and gesture-focused RIT). Treatment sessions were conducted by trained research assistants: fidelity of implementation was scored for 10% of sessions via video recording using a 5 point rating scale (mean fidelity 4.7/5). Researchers acknowledged and controlled for differences in baseline imitation skills

between the trial and control groups using appropriate statistical analysis (one-way ANCOVA using post-test score as the dependent variable). Recruitment strategies, treatment procedures, and outcome measures were clearly explained in this paper. Overall, this research provides strongly suggestive evidence in support of the efficacy of RIT training as a treatment for imitation deficits in young children with ASD.

Ingersoll (2012) carried out a randomized control trial looking at effect of clinician-mediated RIT on initiation of joint attention and social-emotional functioning in 27 children with ASD (27-47mo) matched for expressive language age (as per Preschool Language Scales 4th edition) and randomly assigned to control/treatment groups. The test group (n=14) received 3 hours of RIT a week while the control group continued to receive intervention as per normal in the community. A mixed-model ANOVA analysis of pre-therapy, post-therapy and follow-up measures (2-3mo post treatment) showed that children receiving RIT made greater gains than controls with respect to social-emotional functioning and initiation of joint attention tasks. The Early Social Communication Scales, Social-Emotional Scale of the Maybel Scales of Infant Development (3rd ed.), the MIS, and the UIA were used to monitor child progress.

MIA and UIA assessment data for 22 of the participants in this study were previously reported (Ingersoll 2010, discussed above). Therapists, examiners, and parents were not blinded to the purpose of this study which may have biased results: parents consistently rated their children higher on the Social-Emotional Scale following therapy. The eligibility criteria, procedure, and outcome measures are well described in this paper. Furthermore, the outcome measures used in this researcher are reasonable, reliable, and valid tools. It should be noted that children in the treatment group worked with 3 different therapists to promote skill generalization to novel partners. Overall, this study provides strongly suggestive evidence in support of the efficacy of RIT training as a treatment for imitation deficits in young children with ASD.

Discussion

The 9 articles included in this review detail a progression from early feasibility testing to randomized control studies. Results of earlier studies are duplicated in later research: though methodologies vary between studies, RIT consistently results in improved spontaneous imitation skills. Improvements in imitation skills were even seen when fidelity of RIT implementation was low due to trainer characteristics (e.g. Sibling-mediated therapy, Walton & Ingersoll,

2012). These results should, however, be interpreted cautiously:

- Though visual analysis is an accepted method of data analysis, it is less robust than statistical analysis of standardized test measures. 4/9 studies in this review used visual analysis alone to assess changes in imitation frequency.
- Therapists, parents, and individuals scoring frequency data were not consistently blinded to research purposes: scores may have been inflated due to expectations of improvement.
- No long term data is available: post-treatment measures all occurred 1-3mo after therapy was completed.
- The precise mechanism of action is unknown: RIT encompasses several different language facilitation strategies including contingent imitation, linguistic mapping, and physical prompting.
- Ingersoll is involved in 8/9 studies included in this critical review. Replication of results by other researchers is needed.

Conclusion

Overall, these studies provide strongly suggestive evidence that Reciprocal Imitation Training is an effective method of imitation therapy for young children with Autism Spectrum Disorder.

Clinical Implications

Evidence suggests that RIT is an effective therapy tool that can be used with children as young as 20mo to improve imitation skills. However, several 'gaps' in current research may limit this protocol's clinical utility at this time:

- The majority of study participants were verbal communicators: there is insufficient evidence to evaluate efficacy of RIT in nonverbal children.
- Therapy sessions were conducted 2-3x per week during these studies and children often interacted with multiple therapists to encourage skill generalization. This degree of treatment intensity may not be possible in a clinical environment.
- Finally, RIT has only been compared to one other method of imitation therapy - Video Modeling. To date, there has been no evaluation of RIT efficacy relative to other established therapy protocols (e.g. ABA, milieu, discrete trial training).

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