Effects of multiple exemplar instruction on naming

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A study was conducted with three participants from The Jigsaw CABAS® School to test the effects of multiple exemplar instruction (MEI) on the development of naming. The participants all had a diagnosis of autism and were aged 12-16 years. The MEI procedure was implemented by randomly rotating learn units across listener and speaker responding, using a set of contrived stimuli (e.g. symbols assigned names based on foreign language words or nonsense words). Adaptations of MEI were made for each of the participants. One adaptation included adding an echoic component to listener responding for two participants and the second adaptation involved changing the MEI procedure and probes to include sign language. The study measured the number of correct responses in probe trials of listener and speaker responses to the contrived stimuli, following mastery of matching. If naming was not present in these probe trials, echoic responding was added to composition of learn units in the next phase. Probes were conducted for naming prior to, and post, the MEI procedure. The results showed that in the second post-MEI probe set naming was present for all three participants.

Keywords: autism, naming, multiple exemplar instruction

Horne and Lowe (1996) were the first to identify and experimentally isolate naming as a behavioural phenomenon. Catania (2007) defined naming as a higher order class of operants, where a higher order operant refers to a learnt operant that is novel behaviour not directly taught, but is derived from other learnt operants as a result of reinforcement or specific instructional history. Catania described naming as a bidirectional capability, meaning that both listener and speaker capabilities are acquired in a symmetrical fashion.

Greer and Ross (2008) further expanded the naming definition, and operationally defined bidirectionality, by describing naming as the capability to acquire a pure or impure tact and a listener response after observing another individual tact the stimulus. An example of

naming in a typical interaction might occur when a child spends a day at the zoo with a parent or caregiver; they both see a baboon and for the first time the child hears the caregiver tact the baboon. Later without the benefit of explicit instruction the child emits the correct use of the term baboon across any one of several response topographies (as a listener by pointing to a baboon on the television or showing someone a toy baboon; or as a speaker by tacting a baboon either following a non-verbal antecedent (pure tact) or following a verbal antecedent such as "What's this?" (impure tact)). Basically, the child observes the tact and subsequently responds to that stimulus accurately in a multitude of ways. Once naming has been induced, this may lead to the enhancement of existing verbal capabilities and also develop additional verbal capabilities.

In typically developing children naming is generated from the everyday language interactions between children and the individuals in

their environment such as parents, siblings and caregivers (Greer, Stolfi, Chavez-Brown, & Rivera-Valdez, 2005). These interactions are coupled with an individual coming into contact with corresponding environmental stimuli. The addition of naming to a child's repertoire can exponentially provide both additional incidental learning experiences and an expansion of an individual's skill set across academic, social, and problem solving repertoires (Greer & Ross, 2008). For children who have a learning disability or who come from a lower socio-economic background it is important that they can learn incidentally. It is important that they have naming. Both Greer and Ross (2008) and Hart and Risley (1995, 1999) estimated that the presence of naming may set the stage for more than 63,000 language experiences to occur in a meaningful way for children from homes with fewer numbers of rich language interactions. These additional language experiences may enable children to learn multiple responses after explicit instruction in only one response form (i.e. as a listener only), as well as the possibility of learning novel words without direct instruction.

Once it has been determined that naming is absent from a child's repertoire, certain procedures have shown to be beneficial towards inducing this crucial verbal capability. Recent basic and applied research has demonstrated success in teaching this skill set by using multiple exemplar instruction (MEI) across response topographies (Fiorile & Greer 2007; Gilic, 2005; Greer et al., 2005; Greer, Stolfi, & Pistoljevic, 2007). MEI specific to these studies extends from general case instruction to include the random rotation of instructional stimuli across response topographies. This procedure simulates incidental experiences necessary for language development in typically developing children. Greer and Keohane (2005) argued that individuals with gaps in their verbal development repertoires could have those gaps filled through MEI implemented in this fashion and thus move forward in their language development.

Although MEI across response topographies has been effective in inducing naming for a number of individuals, the procedure has not been successful for some individuals with larger developmental gaps and instructional histories with fewer language experiences. Further adaptations of MEI have been explored to isolate the components creating the gaps. One such exploration by Longano (2008) has specifically focused on investigating the role reinforcement history for echoic responding plays in language development.

In Longano's (2008) study, an echoic component was added to the MEI procedure. For example, following the vocal antecedent, "point to horse" the child only received reinforcement when they echoed "horse" and pointed to the picture of the horse. Naming was induced in participants for whom multiple exemplar instruction without the echoic component had previously been unsuccessful. Prior to the study by Longano (2008), a link between echoic behaviour and naming was theorised by Horne and Lowe (1996); they identified echoic behaviour as a possible source of reinforcement for the typical development of the naming repertoire. Horne and Lowe (1996) additionally noted that the echoic repertoire is crucial to the development of a child's emergent language. When a child begins to emit echoic behaviour, as part of their vocal utterances, this behaviour is normally reinforced by caregivers (Horne & Lowe, 1996). However, as the child acquires more independent language skills, the reinforcement of echoic behaviour moves from an overt level to being covert. That is, previous speaker behaviour such as overtly emitting an echoic tact of "lilac" moves towards a listener emitting the immediate echoic response covertly, consequently moving towards a joining of speaker and listener behaviour. This joining of speaker and listener behaviour can arguably be a defining aspect in the acquisition of naming (Greer & Keohane, 2005).

The MEI procedure was taught using learn units (Greer, 2002; Greer & McDonough, 1999). The learn unit is the most fundamental component of teacher-student interactions. It is comprised of interlocking 3-term contingencies between teacher presentations, pupil responses, and teacher consequation of pupil responses. A

learn unit does not exist unless all of these components for the pupil and the teacher are present. They are termed learn units because they are the basic units of teaching. That is, unless the appropriate antecedent is learned together with the appropriate response and consequence then the function of the behaviour is not learned. In addition there exists a context in which the learn unit occurs. The context includes variables such as setting events and motivational variables, the instructional history of the individual and what the individual possesses both phylogenetically and has acquired ontogenically.

The current study investigated the effect of MEI on naming in individuals where naming was not present prior to the MEI procedure. For two participants the echoic component was added to the procedure and for the third participant the MEI procedure was adapted to include sign language. MEI was selected as the appropriate tactic to induce naming due to the previous research literature demonstrating its effectiveness in an applied setting (Fiorile & Greer, 2007; Gilic, 2005; Greer et al., 2005; Greer, Stolfi, & Pistoljevic, 2007) and to extend the research being carried out at The Jigsaw CABAS® School in this area (Hawkins, Charnock & Gautreaux, 2007).

Method

Participants

Three pupils participated in this study, all with a diagnosis of autism. Participant A was a 15-year-old male. His level of verbal behaviour was described as listener, speaker, reader, writer and emergent self-editor. For example, this participant responded reliably to following one-step directions, emitted mands and tacts, textually responded to 200 sight words, used writing to mand and made corrections to his writing using a checklist. Participant B was also a 15-year-old male. His level of verbal behaviour was described as listener, speaker, emergent reader, emergent writer and emergent self editor. Participant C was a 12-year-old female who was non-vocal, but used words printed on flashcards (a word exchange communication system) or sign language to communicate as a speaker.

Participant C also had a listener repertoire and an early reader repertoire. All the participants possessed generalised mand and tact repertoires, meaning that they were able to mand and tact items (vocally, through sign or by exchanging the written word) in a non-instructional setting. Each of the participants used an individualised token economy point system within the classroom, and received instruction in both one to one and small group settings.

Setting

All participants attended The Jigsaw CABAS® School, an independent day school for 36 pupils aged 5-19 years diagnosed with autism. CABAS® is an acronym for the Comprehensive Application of Behaviour Analysis to Schooling. All instruction was individualised and taught using learn units (Greer, 2002; Greer & McDonough, 1999).

There were eight classrooms which measured approximately 7-m x 10-m and contained a chair and table for each pupil, a larger table for group work, an interactive whiteboard and at least two computer stations. The pupils were placed in classes based on their level of verbal behaviour, i.e. all the pupils termed as pre-listeners were placed with one another as were the pupils with a self-management repertoire. Participants A and B were members of the same classroom, whereas Participant C was placed in a classroom with pupils with a similar level of verbal behaviour.

Dependent Variable

The dependent variable in the study was naming. The presence of such a capability was determined following match-to-sample instruction, delivered in the form of learn unit instruction with a novel set of contrived stimuli. After the match-to-sample instruction was conducted to a criterion level (18/20 correct responses over two consecutive sessions), probe trials were conducted with the same stimuli across the untaught topographies of point-to, tact, and intraverbal responding. No reinforcement or corrections were presented during the probe trials. The number of correct responses in probe trials determined the presence or absence

of naming (with 80% being the criterion level for the presence of naming).

Independent Variable

The independent variable in the study was the use of MEI across response topographies. This instruction was implemented with and without echoic responses for Participants A and B and using sign language rather than vocalisations for Participant C. The basic MEI procedure consisted of randomly rotated instruction as learn units across the four topographies of match-to-sample, point-to, tact, and intraverbal responses. The MEI procedure with the added echoic component consisted of randomly rotated instruction as learn units across the two topographies of match-to-sample and point-to responses, with the added requirement of echoic responding. The decision to move from the first MEI procedure to the second procedure was determined when criterion level responding (80% correct responses in untaught repertoires) for naming did not occur following the completion of the initial MEI procedure.

Materials

An example of the stimuli used is shown in Table 1. All sets of stimuli were designed to include two-dimensional shapes or figures and accompanying contrived names or signs, for example symbols were assigned names based on foreign language words (e.g. "gamma") or nonsense words (e.g. "froz"). The signs were contrived as well, e.g. when presented with the symbol "oot" the participant was taught to sign 'tap leg.' Contrived names or signs were used in

Set #	Shape	Name	Sign
1		Tesh	Touch chest
		Dil	Wave
		Oot	Tap leg
		Fazz	Index finger to chin
		Pock	Index finger up

Table 1. An example of a set of stimuli used for Participant C.

order to control for incidental exposure to the stimuli. Only those responses to stimuli that were not in repertoire were selected for use in the sets. The sets of stimuli therefore differed among the participants.

Design and Procedure

A non-concurrent multiple probe design (Horner & Baer, 1978) was used with the three participants individually, meaning that each of the participants began and completed the experimental sequence independent of one another. The design was comprised of pre- and post- probes to untaught response topographies. The procedural sequence of this study followed a 13-step sequence, consisting of a combination of probes and MEI. An outline of the procedure can be seen in Table 2. In Steps 1, 4, 6, 9, and 11 novel sets of stimuli were probed. Probe trials were conducted for tacts to ensure that the responses to stimuli were not in any of the participant's repertoire. Tact responses were defined as the emission of a vocal response or a sign response when presented with the target stimulus and no accompanying vocal antecedent, for example being presented with a picture of a horse, and responding by saying "horse" or signing "horse." There were 5 stimuli per set, with only one response per stimulus, therefore totalling five probe trials per set of stimuli.

In Steps 2, 7, and 12 match-to-sample instruction was presented. Match-to-sample responses were defined as matching the same stimulus by placing the presented picture on top of its match, after being presented with a vocal antecedent. For example, the participants were presented with a field size of four pictures; the experimenter presented a picture of a horse and the vocal antecedent "match horse with horse." When using the signing procedure the teacher emitted the vocal antecedent, "match horse" alongside presenting the sign "horse." This procedure was different from traditional match-to-sample instruction in that the experimenter presented the vocal tact while presenting the pictured target. By doing so the participant was exposed simultaneously to both the visual and corresponding vocal stimulus.

Following all match-to-sample steps (Steps

3, 8 and 13), probes for naming were conducted. These probes were conducted to test for untaught listener (point-to) and speaker (tact and intraverbal) responses. Each response form was probed for 20 trials. Point-to responses were defined as pointing to or touching the correct stimuli, after being presented with the antecedent, for example the participants were presented with a field of four pictures, including a picture of a horse, and the vocal antecedent "point to horse." During the modified sign language procedure, the teacher also presented the sign of "horse" alongside the vocal antecedent. Intraverbal responses were defined as the emission of a vocal response or sign response when presented with the corresponding vocal antecedent, "what is it?" for example, being presented with a picture of a horse and the vocal antecedent "what is it?" and responding by vocalising or signing "horse." During the experimental probes if a participant scored at a criterion level, thereby indicating the presence of naming, then the procedural sequence for that participant ceased.

In Step 5, MEI rotated across the four response topographies of match, point-to, tact and intraverbal was used to teach all participants the listener and speaker responses. These response topographies adhered to the definitions already described.

The MEI sessions consisted of a total of 80 learn units, 20 learn units for each of the aforementioned response topographies. The antecedents for all listener and speaker responses were randomly rotated evenly across all stimuli within the treatment set. Sessions were provided until the participants met a criterion of 18/20 correct responses for two consecutive sessions across all topographies. After each participant met a criterion they progressed through the steps in order to be re-probed for the presence of naming.

In Step 10 (the echoic procedure for Participants A and B), MEI rotated across the two response topographies of match and point-to with the added element of echoic responding. Echoic responses were defined as the emission of a vocal response with point-to-point vocal correspondence to the name of the stimulus emitted in the experimenter's antecedent. For example, the participants were presented with a field of four pictures, including a picture of a horse, and the vocal antecedent "point to horse." The participants responded by echoing "horse" as well as pointing to the picture of the horse.

For this extended procedure, the MEI sessions consisted of a total of 40 learn units, 20 learn units for each of the two listener response topographies. The antecedents for all responses were randomly rotated evenly across all stimuli within the treatment set. In addition the participants were required to emit an echoic response

Step 1	Pre-probe Set 1 stimuli.
Step 2	Match-to-sample instruction with Set 1 stimuli.
Step 3	Probe untaught listener (point-to) and speaker (tact and intraverbal) responses to Set 1 stimuli.
Step 4	Pre-probe Set 2 stimuli.
Step 5	Multiple exemplar instruction training across 4 repertoires with Set 2 stimuli.
Step 6	Pre-probe Set 3 stimuli.
Step 7	Match-to-sample instruction with Set 3 stimuli.
Step 8	Probe untaught listener (point-to) and speaker (tact and intraverbal) responses to Set 3 stimuli.
Step 9	Pre-probe Set 4 stimuli.
Step 10	Multiple exemplar instruction training across 2 repertoires, with an added requirement of echoic responding, with Set 4 stimuli.
Step 11	Pre-probe Set 5 stimuli.
Step 12	Match-to-sample instruction with Set 5 stimuli.
Step 13	Probe untaught listener (point-to) and speaker (tact and intraverbal) responses to Set 5 stimuli.

Table 2. Table outlining the procedural course of the study.

when emitting a match or point-to response. This procedure differed from the match-to-sample learn units in the previously described sections, in that the participants were required to match-to-sample as well echo the name of the stimulus. For point-to learn units the participants were required to point to or touch the correct stimulus, as well as echo the name of the stimulus. Instruction across both match and point topographies was provided until the participants met a criterion of 18/20 correct responses for two consecutive sessions across both topographies. After each participant met a criterion they progressed through the steps and were re-probed for the presence of naming.

Inter-observer agreement

Inter-observer agreement was calculated by using the Teacher Performance Rate and Accuracy (TPRA; Ingham & Greer, 1992) procedure. As part of the TPRA, data are collected on teacher antecedents, pupil responses to those antecedents and subsequent teacher consequences by an independent observer. Eight sessions in total were subjected to TPRA observations with 100% accuracy between the observer's data and the teacher's data.

Results

In the initial probes, neither participant had evidence of naming. Following MEI and the combination of MEI and echoic responding, naming was present for Participants A and B (see Figures 1 & 2). In the second set of probes for naming following MEI rotated across four response topographies, both participants showed gains in the levels of untaught responses, but the full naming capability was not present. Participant A had evidence of the listener component of naming, by surpassing the criterion level of 80% correct responses of untaught point-to responses. Participant B surpassed the criterion level of 80% correct responses of untaught intraverbal responses. In the final set of probes for naming following MEI rotated across two response topographies and an added element of echoic responding, full naming was present in both participants.

Figure 3 represents the results for Participant C. In the initial probes for naming, the participant did not show any evidence of the naming capability. In the second set of probes for naming following MEI rotated across four response topographies, the participant showed
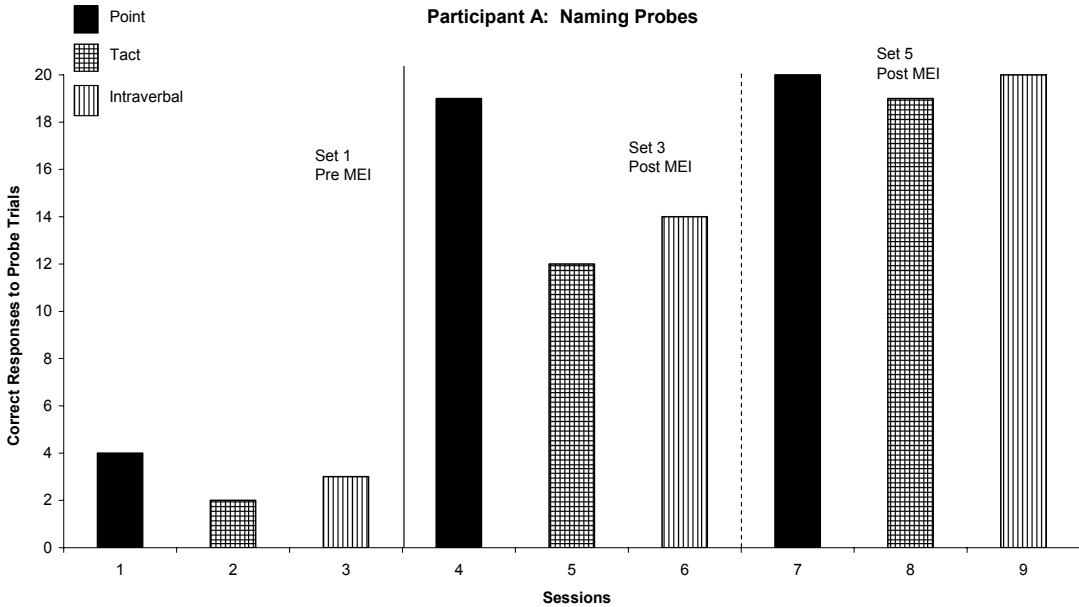

Figure 1. The number of correct trials pre- and post- the multiple exemplar instructional sequence for Participant A.
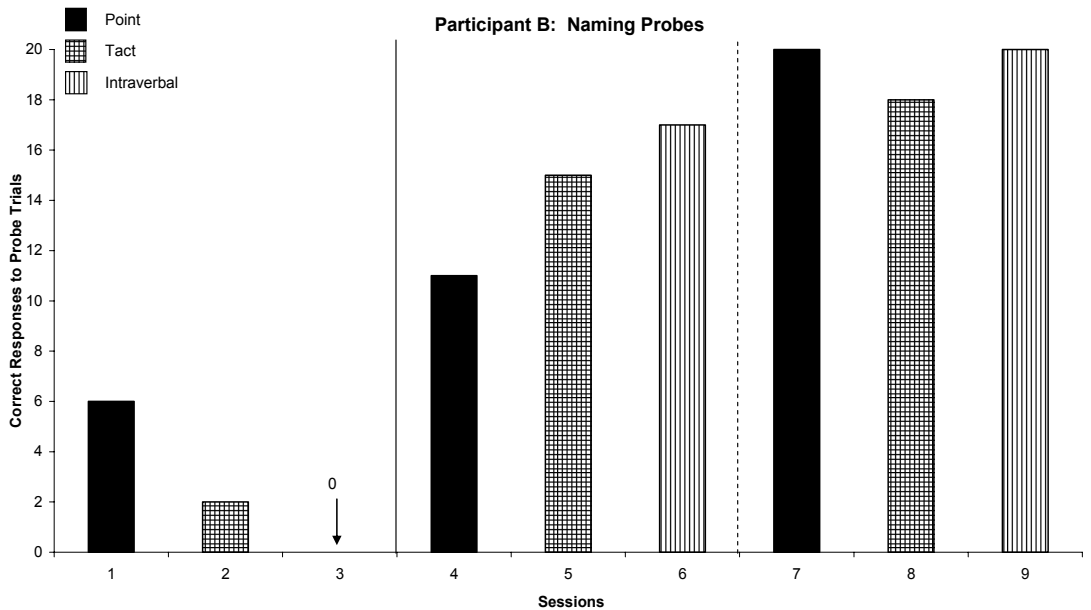
Figure 2. The number of correct trials pre- and post- the multiple exemplar instructional sequence for Participant B.
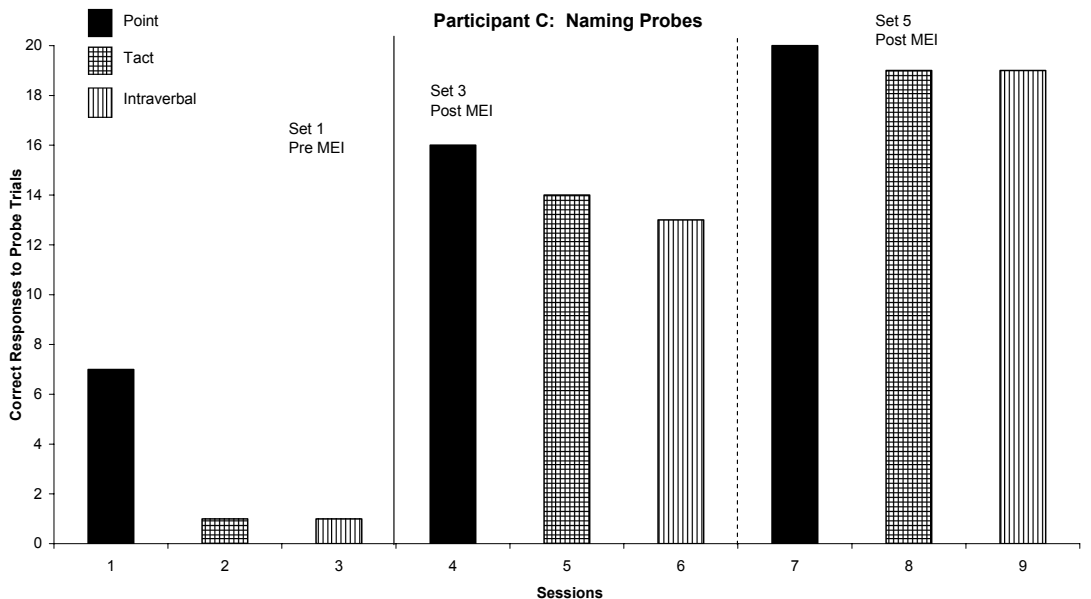

Figure 3. The number of correct trials pre- and post- the multiple exemplar instructional sequence for Participant C.

gains in the levels of untaught responses, but the full naming capability was not present. For this participant the same procedure was repeated (instead of implementing step 10, steps 5-9 were repeated with a novel set of stimuli) and the naming capability was then present.

Discussion

The current study investigated the effect of MEI on naming in individuals where naming was not present prior to the MEI procedure. After one set of MEI all participants made gains in the number of untaught repertoires that emerged, but naming was still not in their repertoire. For two participants the echoic component was added to the procedure and naming was present in their repertoire following this addition to the MEI procedure. For the third participant, who followed the adapted procedure to include sign language, naming was present following a second set of MEI.

There were limitations to the results reported herein, primarily the lack of experimental control between the dependent and independent variable. The data collected on each of the participants occurred at various times in the school year. This led the experimenters to report the results in an isolated fashion rather than as one cohesive experiment. Subsequently this affected the ability of the experimenters to stagger or delay the pre and post MEI probes. Because the study was conducted in a school setting, the participants in this study were selected independently at various points in time based on individualised data analysis. In other words MEI was implemented for each participant based on when the individual data indicated this type of intervention was necessary and not dictated by the need to establish clear control through experimental design. Collecting more data during the pre MEI phase would have allowed the experimenters to examine trends over time prior to the onset of the MEI intervention. The use of a counterbalancing or extending the MEI procedures without the echoic component would have allowed for more confidence in attributing the acquisition of naming to the modified implementation of the MEI procedure.

The length of the experimental procedures and the extensive procedural steps involving with the intervention may obviously have allowed for maturation effects to occur. Due to these apparent threats to internal validity (Shadish, Cook, & Campbell, 2002) the experimenters suggest approaching the findings with caution to avoid inferring a functional relationship between naming and MEI procedures described herein. Nonetheless, naming was present for each of the participants after the implementation of MEI and thus supports the efficacy of the intervention found in previous studies (Fiorile & Greer, 2007; Gilic, 2005; Greer, Stolfi, & Pistoljevic, 2007; Greer et al., 2005; Greer & Nirgudkar, 2005; Nirgudkar, & Park, 2003).

In the MEI plus echoic component procedure and in the MEI procedure modified with sign language, the participants emitted responses post-intervention which were not part of their repertoires prior to the intervention. Naming will now allow for exponential and incidental learning across multiple environments. This could lead to these participants learning from indirect episodes of language interactions and experiences previously not possible. Subsequently for each of the participants it is likely that because some critical gaps in their verbal developmental milestones have been filled they will be capable of making additional progress on new verbal capabilities. Future research initiatives should focus on the replication of the procedures accompanied by tighter experimental control. Furthermore, additional research should be conducted with participants who lack a naming repertoire and are also without a diagnosis of autism (or other native disabilities) such as children from families with of low numbers of language interactions (Greer, 2008). Doing so may have implications for expanding a behaviour analytic account of the acquisition higher order verbal skills for all individuals.

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