The Jigsaw CABAS® School: Protocols for Increasing Appropriate Behaviour and Evoking Verbal Capabilities

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We report the results of implementing four protocols that are designed to impact verbal repertoires and describe the framework that is integral to CABAS® classrooms in order to carry out these protocols. The supporting data were provided from The Jigsaw CABAS® School to show the efficacy of these protocols by evaluating pupil performance. All the pupils at the school were diagnosed with an Autism Spectrum Disorder. A stimulus-stimulus pairing procedure was used to provide the individual with a new conditioned reinforcer and led to a reduction in stereotypy throughout the day. Intensive tact instruction was a procedure that led to an increase in pure tacts and conversational units in the non-instructional setting. Multiple exemplar instruction was shown to evoke the verbal capability of naming and the yoked contingency procedure induced observational learning.

Key Words: verbal capability, learn unit, stimulus-stimulus pairing procedure, tact, naming, observational learning

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The Jigsaw CABAS® School is an independent day school for 30 pupils aged 4-15 years diagnosed with an Autism Spectrum Disorder. There are four classrooms within the school and pupils are organised within the classes according to their level of verbal behaviour. CABAS® is an acronym for the Comprehensive Application of Behaviour Analysis to Schooling. CABAS® provides a system-wide application of behaviour analysis to all of the components of education for teaching all aspects of curricula. The system has accrued an extensive data base for developing and maintaining quality applications. Some of the components of CABAS® include: performance standards of teaching as applied behaviour analysis, curricula for teachers and other professionals, research-based tools to train and monitor professionals and curriculum-revisions for pupils occasioned by the research (Greer, Keohane, & Healy, 2002).

We intend to describe some of the fundamental tactics that are integral to a CABAS® school. We also describe in detail some basic features of the CABAS® system and four protocols frequently used in CABAS® classrooms. We will also provide supporting data to show the progress of the pupils. The protocols to be described are:

1. A stimulus-stimulus pairing procedure to condition reinforcers
2. An intensive tact instruction
3. Multiple exemplar instruction to evoke naming
4. A peer yoked contingency procedure

System Components

There are several school-wide procedures that are relevant to all the teaching at Jigsaw and are foundational system components of all CABAS® schools. All instruction in CABAS® schools are

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measured in 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. Learn units can be scripted by teachers; they can occur incidentally or can be captured across settings. 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.

A performance monitoring procedure is used in CABAS® schools to collect data on pupil and teacher responding and to convert responses to rates of teacher and pupil behaviour. This procedure termed TPRA (Teacher Performance Rate/Accuracy; Greer, 2002; Ingham & Greer, 1992) provides both procedural integrity and inter-observer agreement to the delivery of instruction. The supervisory staff record data on the teacher's antecedent, the pupil's behaviour, the teacher's consequence and rate of learn unit presentation. Data are recorded on whether the teacher's antecedent was accurate or inaccurate. To begin, the teacher must ensure that the student is attending (i.e. an establishing operation must be in place) to the teacher before the antecedent is presented and the correct discriminative stimulus is to be presented for it to be counted as a correct antecedent. The supervisor then records inter-observer reliability on the pupil's response. Data are then recorded on the teacher's consequence – whether it was accurately reinforced or corrected. Basically, the supervisory staff are collecting data on whether the learn unit presentation results in an actual learn unit. The 20-learn unit presentation is also timed to convert the responses to rates of teacher and pupil behaviour.

Ingham and Greer (1992) found that when these performance monitoring measures were in place an increase in both the total number of learn units presented and correct responses to learn units occurred.

Most programmes are graphed in increments of 20 learn units. If increments of 20 learn units are not possible then percentage graphs are used. The criterion is set at 18/20 (90%) correct learn units over two consecutive sessions. Once the criterion is achieved a new short-term objective is written as another step towards meeting the long-term goal. A decision protocol is also a characteristic component of all CABAS® schools. The decision tree is a guide for determining where instructional programming decisions are made (Greer, 2002; Keohane & Greer, 2005). If three ascending data paths occur a decision is made to continue with that short-term objective. If three descending or no trend data paths occur then a decision is made to change the instructional procedures. Applied tactics from the behaviour analytic literature are used to address problems in the context of the learn unit and subsequently lead to the achievement of the short-term objective. If after five data paths the overall trend is ascending again, a decision is made to continue with that level of instruction. If after five data paths the overall trend is descending or no trend then a decision is made to change the instructional design.

Alongside these three main tenets of the CABAS® system there are a multitude of tactics in place at The Jigsaw CABAS® School. All tactics draw on the basic principles of behaviour and are implemented vis-à-vis the moment to moment analysis of student responses. Furthermore, there are several protocols in place that have accrued an extensive research base in the applied literature (Greer, 2002; Greer & Ross, 2008). Research cited in Greer and Ross (2008) has been published in peer-reviewed journals such as The Journal of Early Intensive Behavioral Intervention and The Analysis of Verbal Behavior.

It is important to distinguish the differences between tactics and protocols. While tactics are typically implemented to occasion the desired or targeted behavior of a specific objective,

protocols based on the development of verbal capabilities are considerably broader in scope and have an overarching affect on a multitude of skills. Specifically, it is those skills that comprise the hierarchy of verbal development milestones. Greer and Keohane (2005) described this hierarchy in a fashion that specifies how to detect verbal operants that are missing and how to arrange procedures to teach these missing components. This is critical for individuals with limited verbal capabilities as the acquisition of these verbal operants allows the individual to reach levels of verbal development which were previously inaccessible. Another distinction between tactics and protocols is that protocols impact the efficiency of instruction on a macro level. Layering one tactic over another may eventually allow the individual to achieve a short term objective but only after many sessions and in a circuitous fashion. In turn the achievement of long term objectives are subsequently affected. The implementation of these protocols has produced a growing body of research in verbal behavior analysis and has served to equip the practitioner with an arsenal of procedures that address missing verbal capabilities (see Appendix 1 for an example of pre-reader capabilities). It is the intent of this paper to discuss the protocols leading to the development of a variety of verbal operants and describe the procedures used to implement them in applied settings.

Protocol 1: Stimulus-stimulus pairing procedure to condition reinforcers

The purpose of this procedure is to increase the pupils' community of reinforcers and to decrease stereotypy and passivity.

Greer, Becker, Saxe, and Mirabella (1985) carried out two experiments with five developmentally disabled individuals testing the relationship between toys as conditioned reinforcers and stereotypy. With the first experiment two participants were chosen because of their history of playing with preferred toys. They did not have a history of stereotypy. Results showed that removal of the toys occasioned stereotypy and reinstatement of the toys eliminated stereotypy.

The second experiment was carried out with three young adults who were selected because they had low or nonexistent toy play and high rates of stereotypy. A multiple baseline across subjects design was used. After baseline, they were conditioned to play with toys during training sessions and observed in separate free operant conditions (i.e. the same as baseline conditions). Results showed that the training sessions affected the free operant behaviour of each subject to variable degrees. The participants all engaged in substantially less stereotypy and substantially more toy play. Six months later when the toys were reinstated without additional training, stereotypy was low and toy play high. It was concluded that conditioned reinforcers for play, such as toys, may result in a durable and possibly cost effective procedure for dealing with stereotypy.

Nuzzolo-Gomez, Leonard, Ortiz, Rivera, and Greer (2002) carried out a more recent study using the same stimulus-stimulus pairing procedure as is used at The Jigsaw CABAS® School. They tested the relationship between either toys or books as conditioned reinforcers for observing or playing and their effect on stereotypy and passivity. Experiment 1 consisted of a single preschool pupil with an Autism Spectrum Disorder who emitted frequent intervals of passive behaviour and infrequent intervals of looking at books in a free play setting. After systematic training sessions involving pairings of reinforcers with looking at books, he engaged in looking at books significantly more than in his baseline in free play with decreased intervals of passivity.

Experiment 2 involved a multiple baseline across 3 participants with an Autism Spectrum Disorder. Baseline data were collected in the same way as experiment 1; 5 minute free play observation; 5 second interval recording. Baseline data were followed by toy-play conditioning sessions run concurrently with free play observations. The two participants who emitted frequent rates of stereotypy in baseline had significantly fewer intervals of stereotypy after toys were conditioned as reinforcers and toy play increased for all 3 participants.

Case Example

The pupil who participated in this study (Participant A) was an 8 year-old male. He was described as an emergent listener and emergent speaker using PECS. He was able to imitate some actions following the teacher's instruction, "do this," but he did not have generalised motor imitation. He could match some 3D objects, but not novel objects and could follow the direction, "come here."

The dependent variable was to play on the computer independently for 5 minutes without emitting any stereotypy or passivity. He was required to move the mouse around to colour a picture on the computer screen and to look at the screen while doing this. The crayon colouring program on the 'Reader Rabbit' CD-ROM was used.

A multiple probe design was used. An initial probe was conducted followed by follow-up probes each time criterion was reached on the stimulus-stimulus pairing procedure (at 5 seconds, 10 seconds and 20 seconds).

An initial baseline was carried out to determine how much time the participant was already spending emitting the target behaviour of playing on the computer appropriately. The baseline was carried out for 5 minutes. No attention, interaction, reinforcement or correction was delivered by the teacher during this time. Whole-interval recording was used. The 5-minute baseline was divided into 60 5-second intervals. The teacher measured whether the target behaviour, passivity, stereotypy or an incorrect response (engaging in a different activity) was emitted during this time.

For the first treatment phase 5 seconds of pairing took place followed by a 5-second independent interval. During the pairing interval the participant received reinforcement on a VR3 schedule. Data were collected on whether the participant emitted the target behaviour during the independent interval. The criterion was set at 18/20 correct intervals over 2 consecutive sessions. A more detailed description of the procedure can be found in Greer & Ross (2008).

Once the criterion was met a return to baseline phase was carried out. 10-second intervals were then targeted to criterion followed by a return to baseline phase again. 20-second intervals were then targeted followed by a final return to baseline phase.

Figure 1 shows the initial baseline and subsequent return to baseline phases. It shows that Participant A scored 3 whole intervals of emitting the target behaviour during the initial baseline. Having met the criterion on 5 second intervals of pairing he then scored 33 whole intervals of emitting the target behaviour. Once he had met the criterion on 10 second intervals of pairing he scored 42 out of 60 correct intervals and finally after the 20 seconds of pairing he scored 50 intervals of correct responding.

Figure 2 shows the data for the stimulus-stimulus pairing procedure. The first phase is the 5 seconds of pairing then the 10 seconds of pairing and then the 20 seconds of pairing. After the criterion was met on each phase a return to baseline was carried out as the previous graph showed.

This study was educationally significant for this pupil because post-treatment he was spending more time playing on the computer. We had successfully expanded his community of reinforcers.

The stimulus-stimulus pairing procedure to condition reinforcers is used to increase various target behaviours in the classroom, such as looking at books, building with blocks, playing with pegboards, playing with toys, playing with outside playground toys, listening to a story being read and completing puzzles. With each programme an initial baseline is carried out and then the stimulus-stimulus pairing procedure is introduced. Once the pupil has met the criterion with the pairing procedure then a return to baseline probe is carried out.

Protocol 2: Intensive tact instruction

Children with deficits in verbal capabilities often do not emit spontaneous speech in non-instructional settings. In many cases this may be a result of faulty teaching operations or a lack of sufficient experiences with tacts in the students' instructional history. If these deficits are noted, it is imperative to increase the tact repertoire by exponentially increasing the

number of tacts presented to the student. This is done by adding 100 tacts above and beyond the existing programmes. The accrual of this cumulative experience may serve to provide a sufficient context for the emission of pure tacts in non-instructional settings.

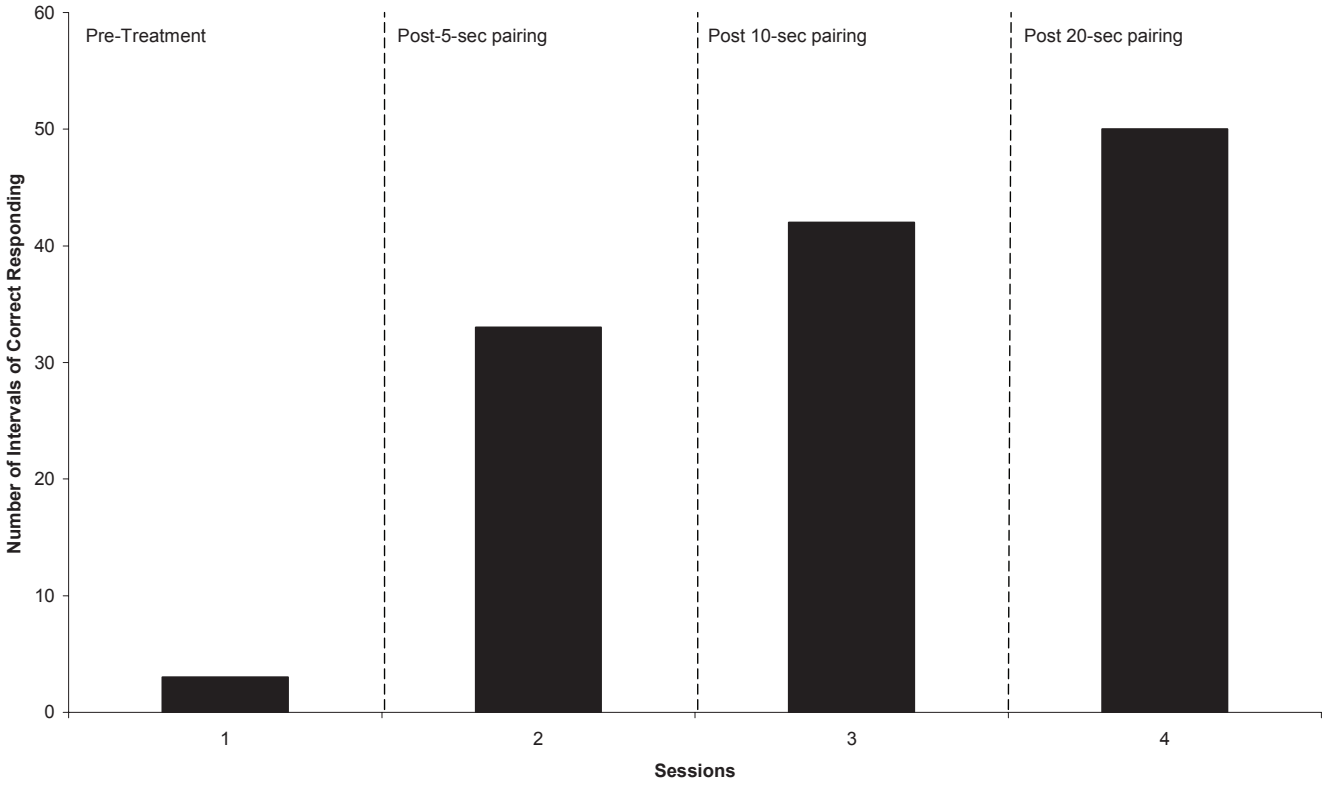

Figure 1. The number of whole-intervals of playing appropriately on the computer in each phase for Participant A.

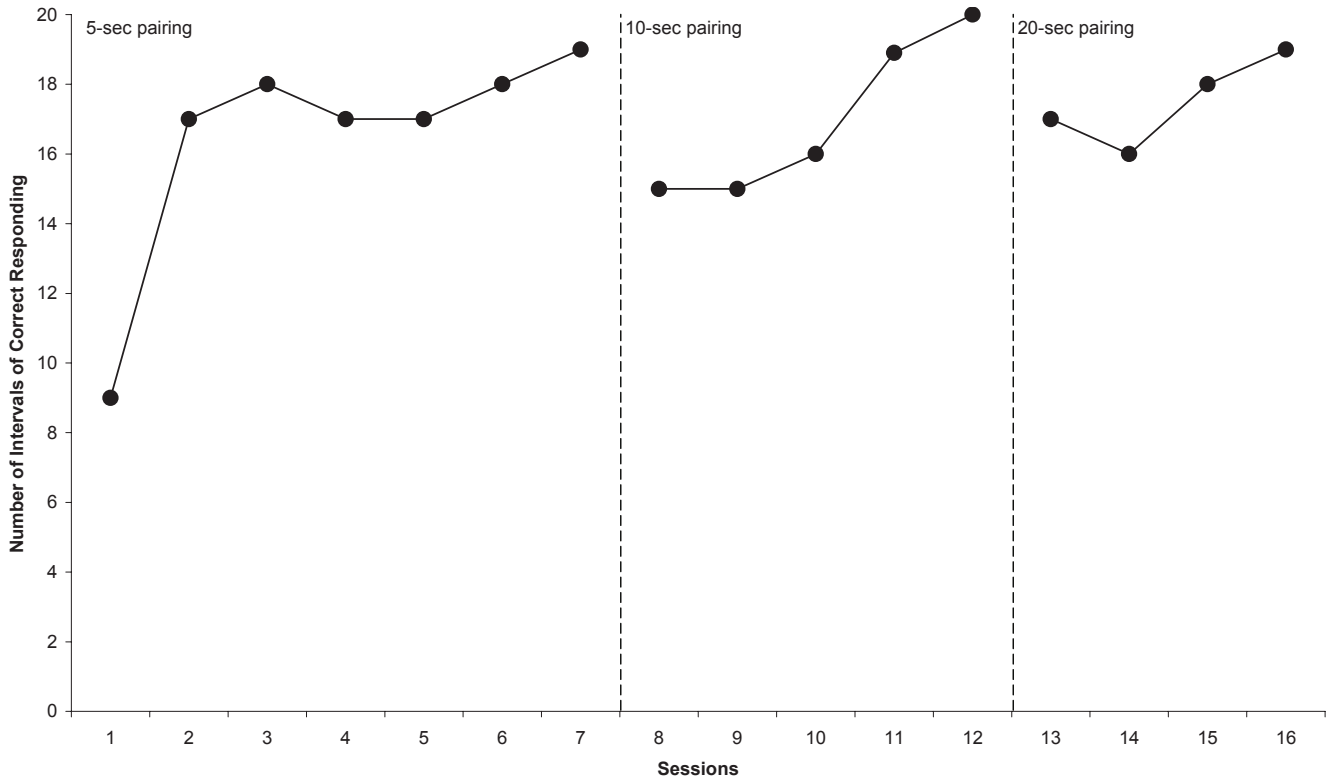

Figure 2. The number of correct test trials in each phase during the stimulus-stimulus pairing for Participant A.

Research has consistently shown that when verbal antecedents do not serve to occasion the tact operant then the individual will emit more spontaneous speech (Ross & Greer, 2003; Tsiouri & Greer, 2003; Williams & Greer, 1993). Williams and Greer (1993) incorporated establishing operations for pure mands and tacts in teaching tacts, i.e. verbal antecedents were avoided. They found that participants emitted more of what is typically characterised as spontaneous speech. These findings were replicated by Ross and Greer (2003) and also Tsiouri and Greer (2003).

Recently, two research efforts have provided compelling evidence to underscore the relationship of intensive tact instruction on the emission of vocal verbal operants across multiple settings with various types of participants. Pistoljevik and Greer (2006) showed that the implementation of intensive tact instruction increased vocal verbal operants (tacts and mands) emitted in the non-instructional setting for pupils with an Autism Spectrum Disorder. Schauffler, and Greer (2006) showed that following intensive tact instruction pupils with emotional and behavioural disorders significantly increased audience-accurate tacts and conversational units.

Case Example

Three pupils participated in this study. Participant B was male, 12-years-old and described as having listener, speaker, reader, writer and emerging self-editor repertoires. Participant C was male, aged 10 and described as having listener, speaker, emergent reader/writer and emergent self-editor repertoires. Participant D was female, aged 14 and described as having listener, speaker, emergent reader/writer and emergent self-editor repertoires.

Two categories were observed: (a) asking appropriate questions and (b) speaker/listener interactions. Asking appropriate questions was defined as any occasion the pupil initiated a wh-question to another pupil or a teacher outside if their curriculum programmes. Speaker/listener interactions were defined as attempts to engage in appropriate conversation with a peer. They were counted even if the peer did not respond to the comment.

Data were collected on asking appropriate questions as event recording throughout the school day (from 9.20am-4.00pm) for 5 whole days.

Data were collected on speaker/listener interactions as event recording for a 5-minute interval during an unstructured group session (outside of the 5-day period when the appropriate question-asking data were being collected).

The treatment package comprised two components: (a) asking wh-questions programme was implemented in their everyday curriculum; (b) intensive tact instruction targeting 80 tacts per day.

The long-term objective for asking wh-questions focused on 'where?' and 'what?' questions only. Establishing operations were put in place to evoke the desired question. For example, the pupil would be given a colouring sheet without any coloured pencils and would be told to do some colouring. The pupil would be required to ask, "Where are the pencils?" before being given access to the pencils.

The long-term objective for intensive tact instruction is to tact using multiple autoclitics for 100 items, people, activities or actions under non-verbal antecedent control. Examples of the required autoclitics are: "It is a __", "I can see a ___", "There is ___", "I can smell ___", "It smells like __", " I can hear ___", "It feels ___."

The long-term objectives are divided into four subject areas: 1) the current topic (linked to the UK National Curriculum); 2) across the senses; 3) everyday environment; and 4) hobbies and interests.

At The Jigsaw CABAS® School the decision was made to target tacts across these four categories to ensure that the pupils had an opportunity to use the tacts learnt (therefore transfer and expand them).

A multiple-probe design was used. An initial probe was carried out and further probes at 3 months and 6 months.

Figure 3 shows the results of the study. During the initial baseline only 2 questions were asked and 6 speaker/listener interactions were observed. By 3 months Participant B had mas-

tered 80 new tacts in the intensive tact instruction programme, Participant C had mastered 22 tacts and Participant D had mastered 101 tacts. The asking wh-questions long-term objective was on-going at this point. Asking appropriate questions increased to 22 at 3-months, but speaker/listener interactions decreased to 3.

By 6 months Participant B had mastered 150 tacts, Participant C had mastered 65 tacts and Participant D had mastered 162 tacts. The long-term objectives for asking wh-questions had now been met for all participants. Asking questions increased to 51 at 6-months and speaker/listener interactions increased significantly to 59.

Protocol 3: Multiple exemplar instruction to evoke naming

Catania (1998) defines naming as a higher order class of operant that is not directly taught, but is derived from other learned operants as a result of reinforcement or specific instructional history. Rosales-Ruiz and Baer (1997) have categorized naming as a behavioral cusp meaning that acquiring a naming repertoire is typically followed by marked change in the acquisition of novel verbal behavior (Greer & Keohane, 2005; Greer & Ross, 2008;)

As pioneers in the identification of naming as a verbal development phenomenon, Horne & Lowe (1996) extracted the essential bidirectional elements of naming which include both visual and vocal stimuli. An example of naming would be, if a child witnessed someone pointing to an animal and saying, 'it's a panda,' the child would then, without instruction, be able to tact the animal or answer what it is when asked. Naming is a very valuable repertoire, as once the child has the capability they can then expand their tact and mand repertoires by incidental experiences everyday. Typically developing children use the repertoire to acquire the capacity to learn verbal behaviour by observation, and it also allows typically developing children to expand their repertoire exponentially. Unfortunately it is common that many children who have an Autism Spectrum Disorder are missing the repertoire of naming. For these children the listener and speaker repertoires are independent. So the child may be able to match animals after instruction, but not be able to point to the

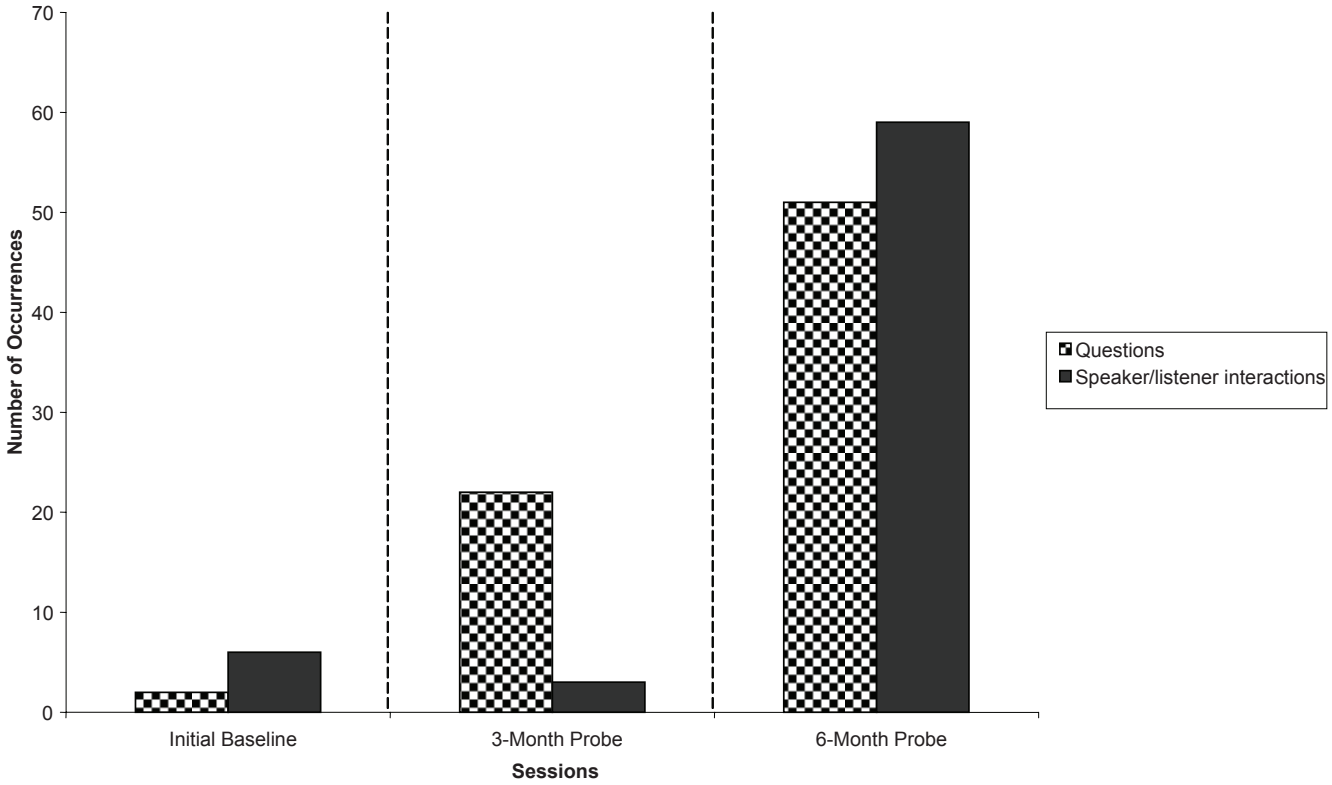

Figure 3. The number of questions and speaker/listener interactions emitted during each probe for Participants B, C and D.

animals as the response belongs to the listener repertoire rather than the visual repertoire of matching. When matching the pupil does not have to listen to the instructor, but can perform the response following the visual cues of the stimuli. The same is also found true for point to responses. The pupil may be taught to point to the animals therefore using his listener repertoire to perform a response, but would then not be able to tact the animal when asked as this involves the pupil to use their speaker repertoire. A child identified as having naming in their repertoire would only require learning one response to a stimulus under one repertoire and then automatically be able to produce all of the necessary responses without direct instruction using other repertoires.

Multiple exemplar instruction (MEI) can be used as a tactic to evoke the higher order operant of naming (Greer & Ross, 2008). MEI is an instructional procedure that combines rapidly and randomly rotating response topographies (i.e. matching, pointing and tacting) across the same stimulus resulting in the transformation of stimulus function. Providing instruction in this fashion exposes the individual to a specific experience and when this experience is sufficient will result in a single stimulus evoking responses across multiple response topographies (Gautreaux, Keohane, & Greer, 2003; Greer, Yuan, & Gautreaux, 2005; Lee-Park, 2005; Mariano-Lapidus, 2005). Another effect of MEI occurs when different establishing operations are rotated across response resulting in novel responses (Greer, Nirgudkar, & Park, 2003; Nirgudkar, 2005; Nuzzolo-Gomez & Greer, 2004).

Greer, Stolfi, Chavez-Brown, and Rivera Valdes (2005) investigated the effects of MEI on preschool children with developmental delays who did not possess a naming repertoire. Upon completion of MEI training, all of the participants acquired a naming repertoire as a function of this training.

Case Example

Three pupils participated in this study. Participant E was a 13-year-old male and Participant F was a 10 year-old male; they were both described as having listener, speaker, emergent reader and writer repertoires. Participant E had over 30 mands with autoclitics in his repertoire that he used on a daily basis, examples of some of these were 'I want sweet please', 'I want sega please'. He was also able to respond to many intraverbals related to answering questions about his personal information, and also the function of objects, for example 'what do we use a cup for'. Participant F engaged well in conversation with both teachers and peers.

Participant G was a 12-year-old male; he was described as having listener, speaker, reader, writer and emergent self-editor repertoires. The participant was able to mand vocally and in written form for his reinforcers, an example of a written mand would be: 'I want to exchange 10 academic points for the playstation please.' The pupil was also able to respond to many intraverbals within his academic programmes as well as taking part in conversational units.

A correct response was recorded during MEI when the pupil correctly followed the teacher direction, for example pointed to or matched the correct picture when given the discriminate stimulus "Match__with__/ Point to __"; or correctly tacted or answered an intraverbal question about a picture. A correct response was recorded during the naming probes following the same protocol as MEI. The dependent variable was the higher order operant of naming.

An outline of the procedure is presented in Figure 4. During Step 1 the participants were probed to ensure they did not already have the target responses in their repertoire. Participants were probed to see whether they could point to or tact (pure and impure) the stimuli in each set. Each target within the set was probed 5 times (20 trials in total) across each repertoire. If the material was unknown to the participant it could be used in the study.

All participants moved onto Step 2 where they were taught to match the material in Set 1 using the vocal antecedent, 'match ___ with ___.' Stimuli were presented in a field size of four. Following criterion the participants were then probed to see if they could point to and tact (pure and impure) the stimuli of the same set (Step 3). Again, during probes the participants

Step 1	Probe point, tact & impure tact to ensure material is unknown
Step 2	Teach Set 1 match
Step 3	Probe Set 1 point, tact, impure tact
Step 4	Teach Set 2 MEI
Step 5	Teach Set 1 match
Step 6	Probe Set 1 point, tact, impure tact
Step 7	Teach Set 3 MEI
Step 8	Probe Set 1 point, tact, impure tact
Step 9	Teach Set 4 match
Step 10	Probe Set 4 point, tact, impure tact

Figure 4. Table outlining experimental procedure for teaching multiple exemplar instruction (MEI).

received no reinforcement or correction. As in initial probes each target was targeted 5 times leading to a total of 20 trials for each repertoire. This was true for all following probes. The point to probes were always presented in a field size of four.

At Step 4 each participant followed a different procedure. Participant E continued through the steps listed here. Participants F and G continued with their usual instruction until Participant E had passed through all the steps of the procedure. Participant G continued for longer with his usual instruction until Participant F had passed through all the steps of the procedure.

During Step 4 Participant E was taught Set 2 using MEI until the criterion was met across all four repertoires. Once the participant met the criterion, naming probes were conducted for Set 1 to see if naming had emerged following the MEI. Prior to probes the participant was taught the match for Set 1 again as a long time had passed since he had seen the material. A novel set was then introduced where the participant was taught the match for the material and then naming probes were conducted to see if the participant could point to and tact (pure and impure) the material.

Step 7 was the same as Step 4 for a new set of stimuli.

Once Participant E had completed Step 6, Participant F conducted another set of naming probes following the procedure in Set 2, to ensure that nothing within the participants' environment had changed to cause naming to emerge.

Participant F then followed the same procedure as Participant E did for steps 4-7. However Participant F did not probe a novel set following his first set of MEI instruction. A second set of novel stimuli were probed following the first novel set naming probes as it was felt the pupil had an instructional history with the material of the set.

The participants did not use the same sets of materials due to their different instructional histories.

Participant E showed an increase in each repertoire following MEI, but did not reach criterion levels for any as Figure 5 shows. The results do however indicate that MEI played a successful role in increasing each repertoire.

Figure 6 shows the actual MEI training. During MEI, Participant E met the criterion for the first set of MEI after 4 data paths, where the criterion for the match was met after one data path, three data paths for the point, and the tact (pure and impure) after the third data path. For the second set of MEI training the participant met the criterion for each repertoire after 8 data paths, where the criterion for the match was met after one data path, six data paths for the point and pure tact, and eight data paths for the impure tact. Each data point was plotted following 20 learn units of each repertoire.

Participant F's results again showed an increase in each repertoire especially in the tact (pure and impure) repertoires (see Figure 7).

The results also provide evidence that it is MEI that has been responsible in the increases in naming for each pupil as although the point repertoire did increase in the second naming probe prior to the implementation of MEI the other repertoires were not found to increase during the period in which the participant resumed normal teaching methods. Again the criterion levels of naming where not met by the pupil, but the implementation of further MEI

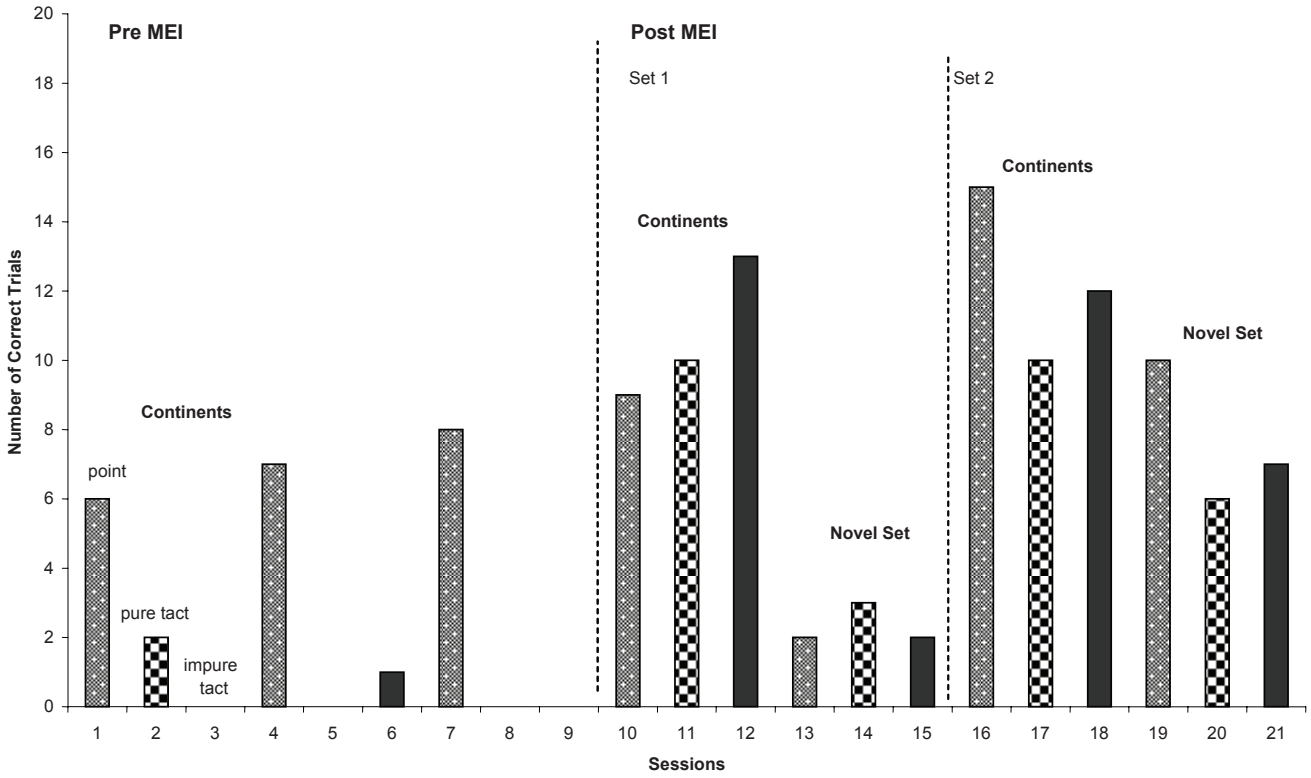

Figure 5. The number of correct trials pre- and post-multiple exemplar instruction for Participant E.

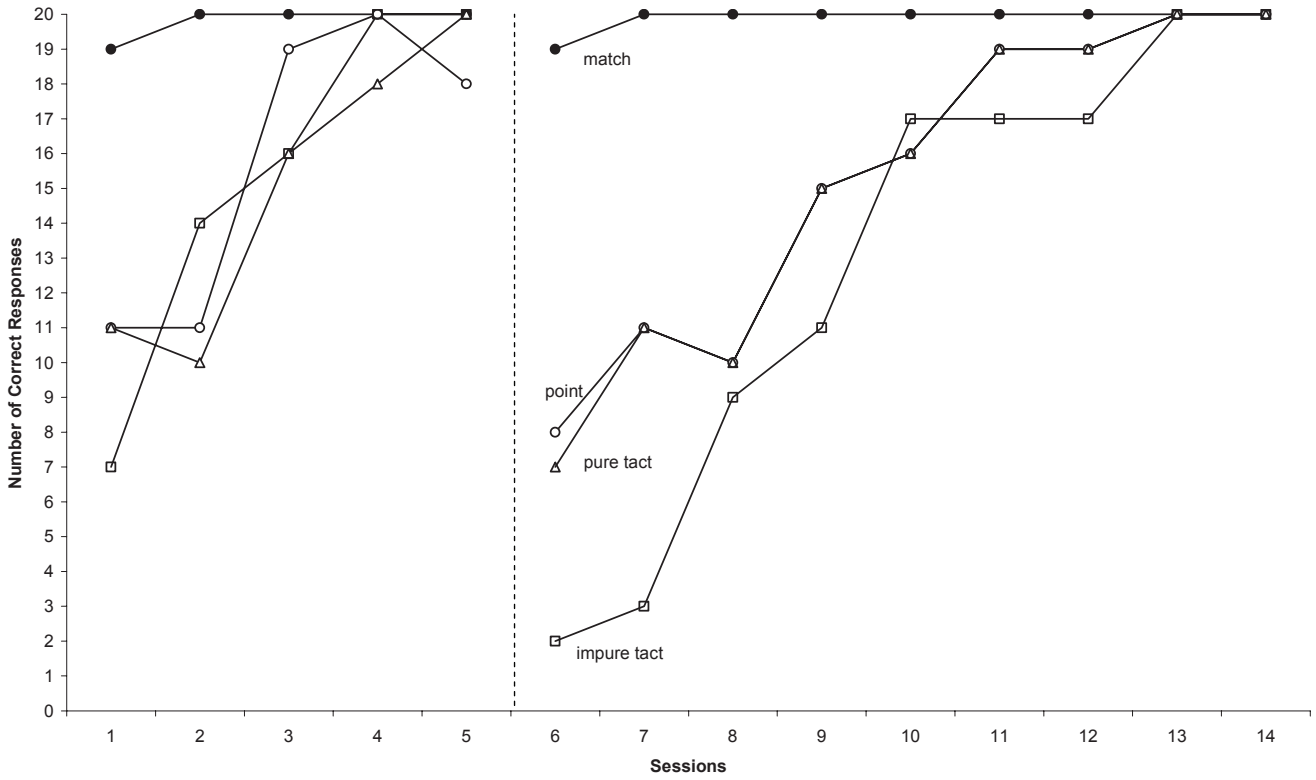

Figure 6. Number of correct responses during MEI training for Participant E.

may hopefully increase the naming repertoire for the participant.

During MEI for participant F, the criterion was met for the first set of MEI after two data

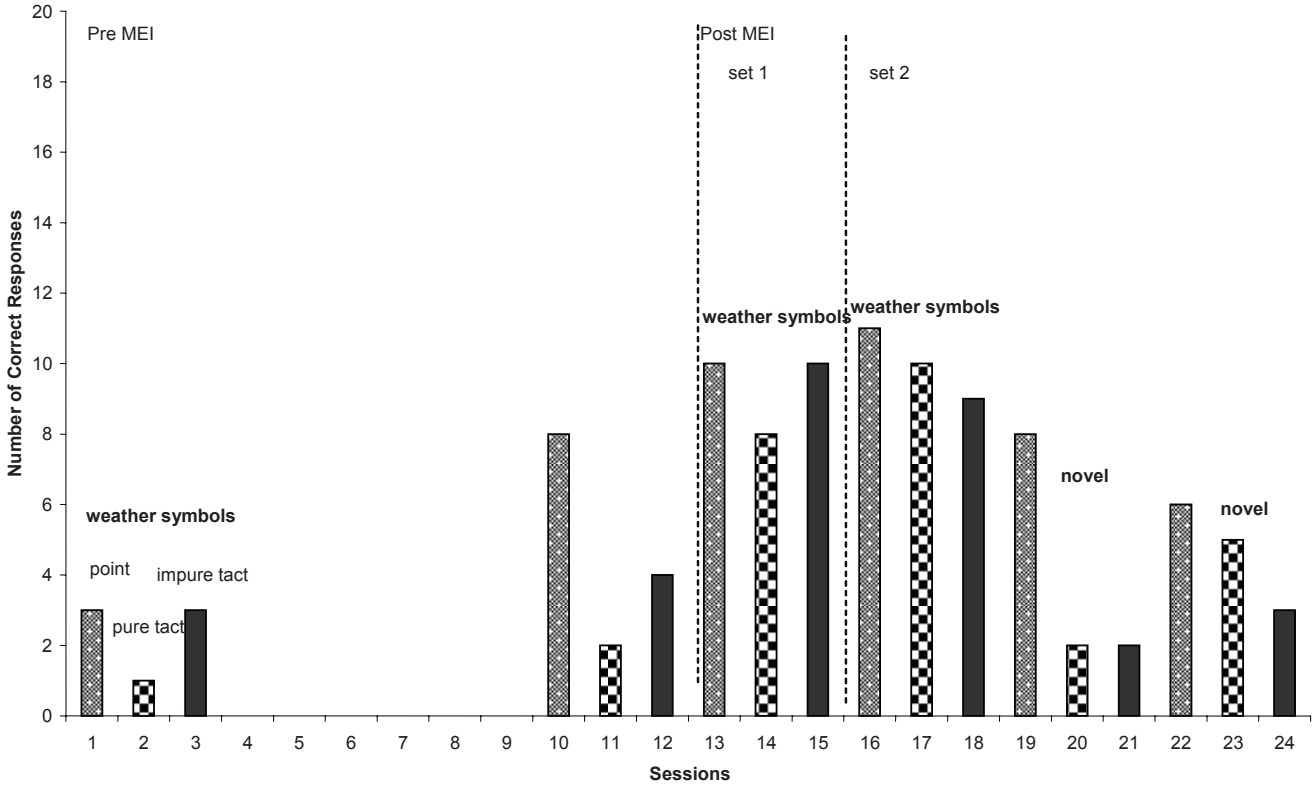

Figure 7. The number of correct trials pre- and post-multiple exemplar instruction for Participant F.

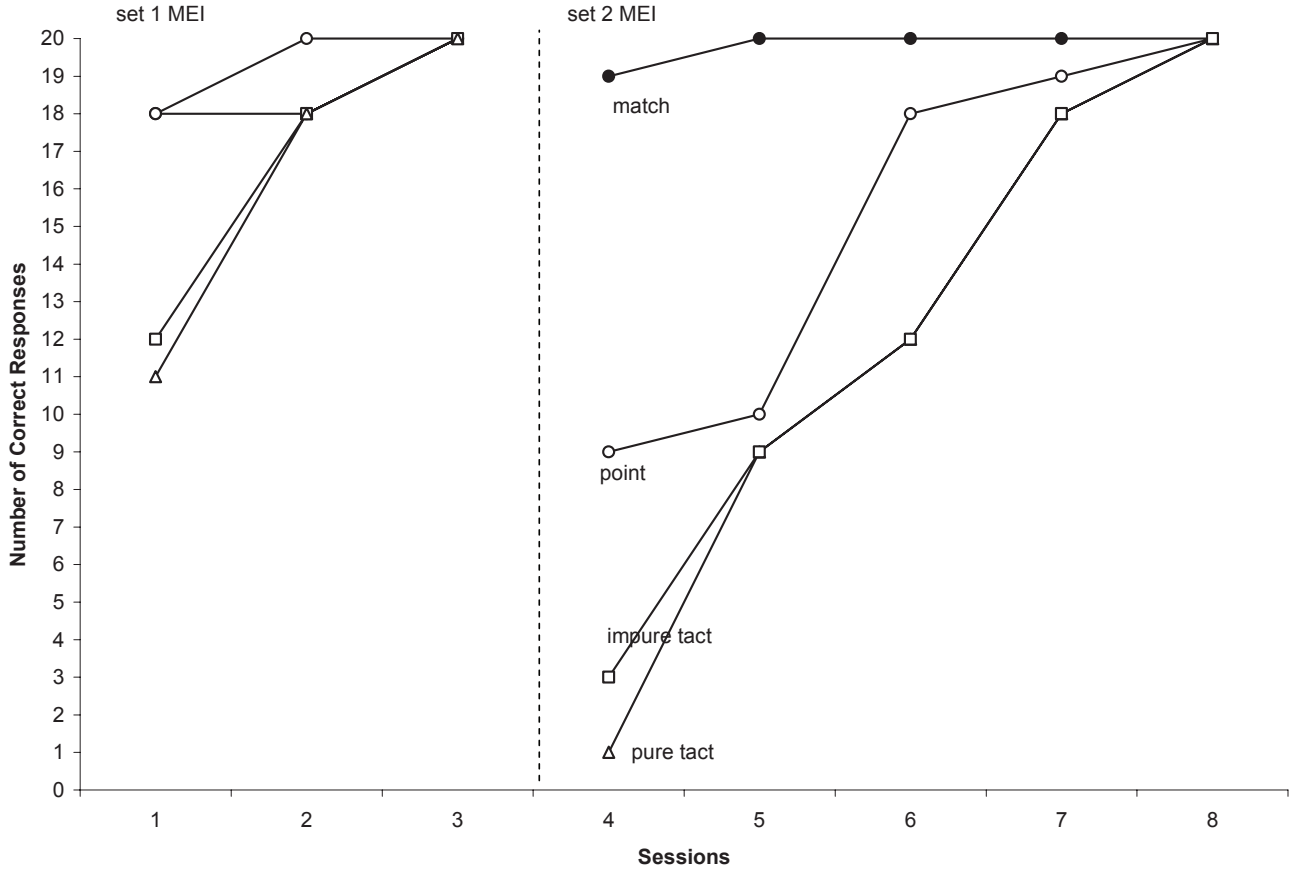

Figure 8. Number of correct responses during MEI training for Participant F.

paths (see Figure 8). During MEI for Participant F, the criterion was met for the first set of MEI after two data paths. The criterion for the match and point repertoire were met after 1 data path, and the criterion for the tact (pure and impure) were both met after the second data path. For the second set of MEI the criterion for all the repertoires was met after four data paths, where the criterion for the match repertoire was met after one data path, the point and impure tact after three data paths and finally the pure tact repertoire after the fourth data path. The criterion for the match and point repertoire were met after 1 data path, and the criterion for the tact (pure and impure) were both met after the second data path. For the second set of MEI the criterion for all the repertoires was met after four data paths, where the criterion for the match repertoire was met after one data path, the point and impure tact after three data paths and finally the pure tact repertoire after the fourth data path.

Participants E and F are now involved in observational learning training to test whether this will evoke naming.

For Participant G the results showed that the participant acquired the speaker part of naming following MEI (see Figure 9). In the initial naming probe it was shown that the participant already had the listener part of naming, as, after being taught the 'match' response only the 'point' response emerged. After MEI the participant met the naming criterion after 2 naming probes as the tact reached 90% on the first probe but the impure tact only reached the criterion level in the second probe.

During MEI Participant G met the criterion on the match, point, tact and impure tact for set 1 after 2 data paths (see Figure 10). The participant met the criterion after 2 data paths with set 2, taught with MEI.

Protocol 4: Peer Yoked Contingency Procedure

One of the most effective ways humans learn is through observation and it is an important repertoire and a major educational achievement. The presence of an observational learning repertoire for an individual is likely a predictor for success in educational, vocational and social environments. Until recently, obser-

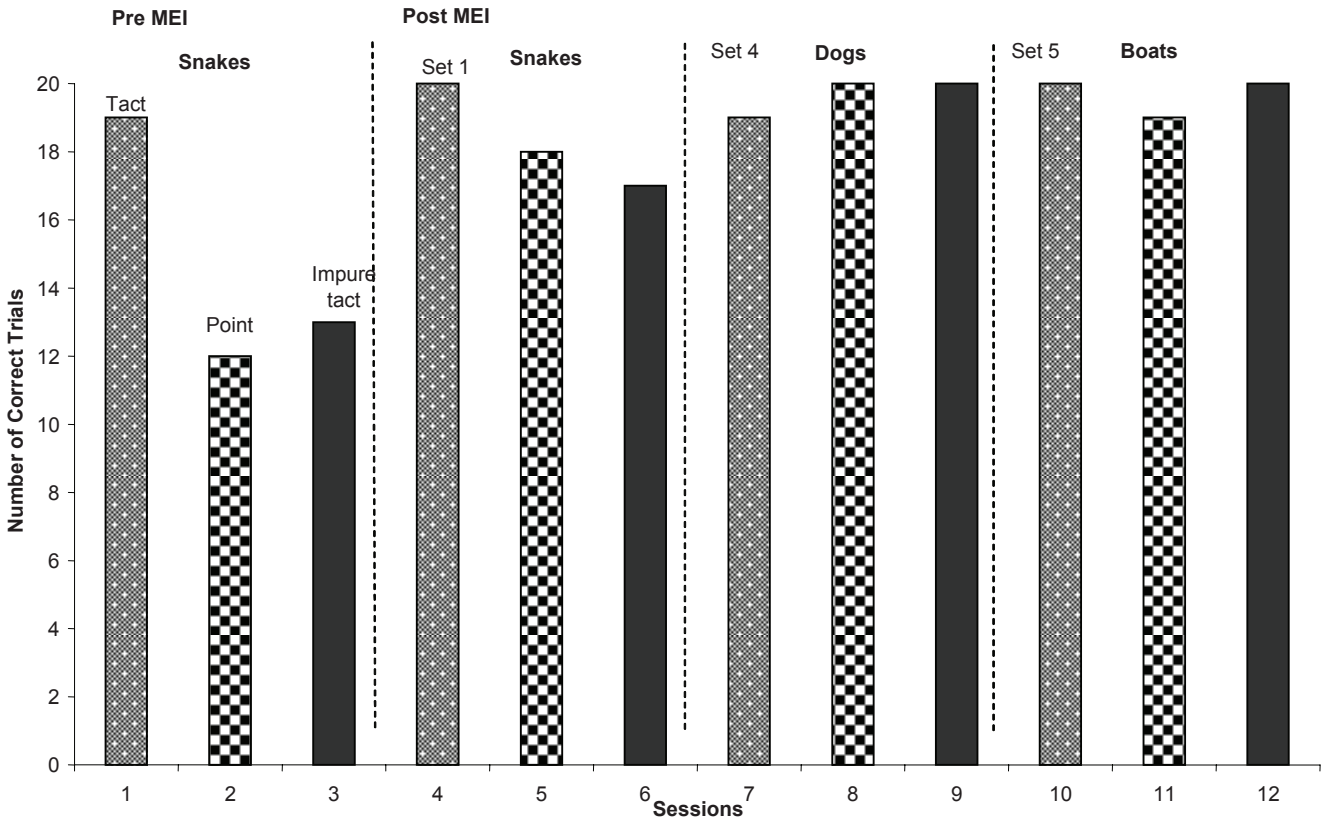

Figure 9. The number of correct trials pre- and post-multiple exemplar instruction for Participant G.

vational learning was considered a behavioural phenomenon which appeared to be part of an individual's repertoire. Of the many studies conducted addressing observational learning, most of them approached this type of learning as an independent variable meaning that observational learning was used to teach another target skill. It appears that the current research trend is to select individuals who do not reliably learn via observation and subsequently implement a procedure which will induce this repertoire. The yoked contingency procedure is a component of the observational system of instruction (OSI) and is designed to create a contingency that will evoke the *need to learn* from peers.

The rationale for establishing an observational system of instruction is far reaching. OSI as an instructional design can allow teachers to individualize instruction to groups while maximizing the number of learn units each individual receives. For pupils, OSI prepares them to function as tutors while teaching them self-management skills through peer and self monitoring. While data on OSI are still emerging, the components that make up the system have been the focus of a recent corpus of research (Davies-Lackey, 2005; Gautreaux, 2005; Pereira-Delgado, 2005; Rothstein & Gautreaux, 2007; Stolfi, 2005).

Greer, Singer-Dudek and Gautreaux (2006) described observational learning taking on several distinctive forms. Implementing a peer yoked contingency addresses two of those forms. One of which is the acquisition of a new repertoire or response and the other is the acquisition of an entire observational learning repertoire.

Once the pupil acquires observational learning as a repertoire he or she can learn from others across a variety of settings. In addition vicarious reinforcement can now serve to shape and maintain behavior.

Case Example

Two pupils participated in this study. Participant H was a twelve year old male and Participant I was an eleven year old male; both participants were described as having listener, speaker, reader/writer, emergent self-editor repertoires. Neither participants displayed the repertoire of learning through observation, but were able to play paired games and had self-management skills. The dependent variable was observational learning.

The participants were initially probed on 20 sets of stimuli to ensure that the stimuli selected were novel. These were run as trials - the participant was given no consequence to his response i.e. no correction or reinforcement; he was however reinforced for appropriate behaviours on a VR4 schedule.

Two sets of stimuli were chosen per par-

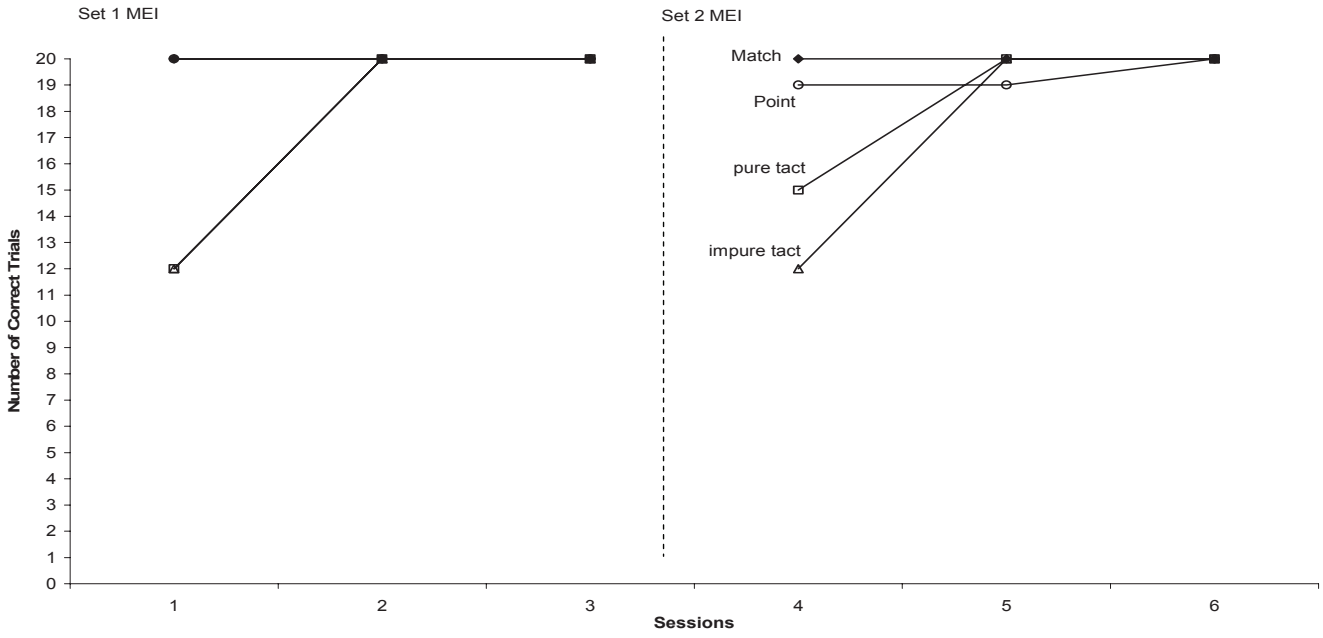

Figure 10. Number of correct responses during MEI training for Participant G.

ticipant for his observational probes. One set of these were the stimuli that were probed after every 20 learn unit session of the yoked contingency game. During these probes one participant observed his confederate receive 20 learn units on the stimuli, the observing participant then had the same stimuli presented to him as probes (no reinforcement or correction for the responses). When a participant met the criterion on one set of stimuli the other set of stimuli was then probed for observational learning; when the criteria were met on both sets a novel set was probed for observational learning.

The participants selected a game board and a player piece for their team, the teacher had a counter or similar as her player piece. A preferred reinforcer was chosen by the pupils as the winning prize. Each pupil received academic literacy curricular instruction from:

a) direct instruction learn units (DLU)
b) observing learn units (OLU) presented to the other pupil

Reinforcement was yoked such that correct responses to an OLU probe resulted in reinforcement for the team (gaining a move up the Yoked Contingency game board) and all correct responses for DLU resulted in reinforcement for the individual (vocal praise and individual points). Therefore two reinforcement schedules ran concurrently, one for each pupil and one for the team.

Incorrect OLU responses resulted in the teacher gaining a move of the teacher's player piece up the Yoked Contingency game board.

The teacher presented target stimuli for both participants following a presentation schedule which mixed up direct learn units and observational presentations so no pattern occurred. When the teacher presented the direct learn units to the pupils; their responses were either reinforced or corrected; when an observational presentation occurred the teacher told the pupils that this response was for a move. If the pupil's response was correct the teacher reinforced and the confederates moved one place on the board, if the response was incorrect the teacher moved one place on the board and did not give a correction to the response. The winner was either the confederate team or the teacher – dependant upon how many observational presentations were correct. If the confederates won they had a short interval with a preferred reinforcer; if the teacher won she had a short interval with the preferred reinforcer. The teacher recorded

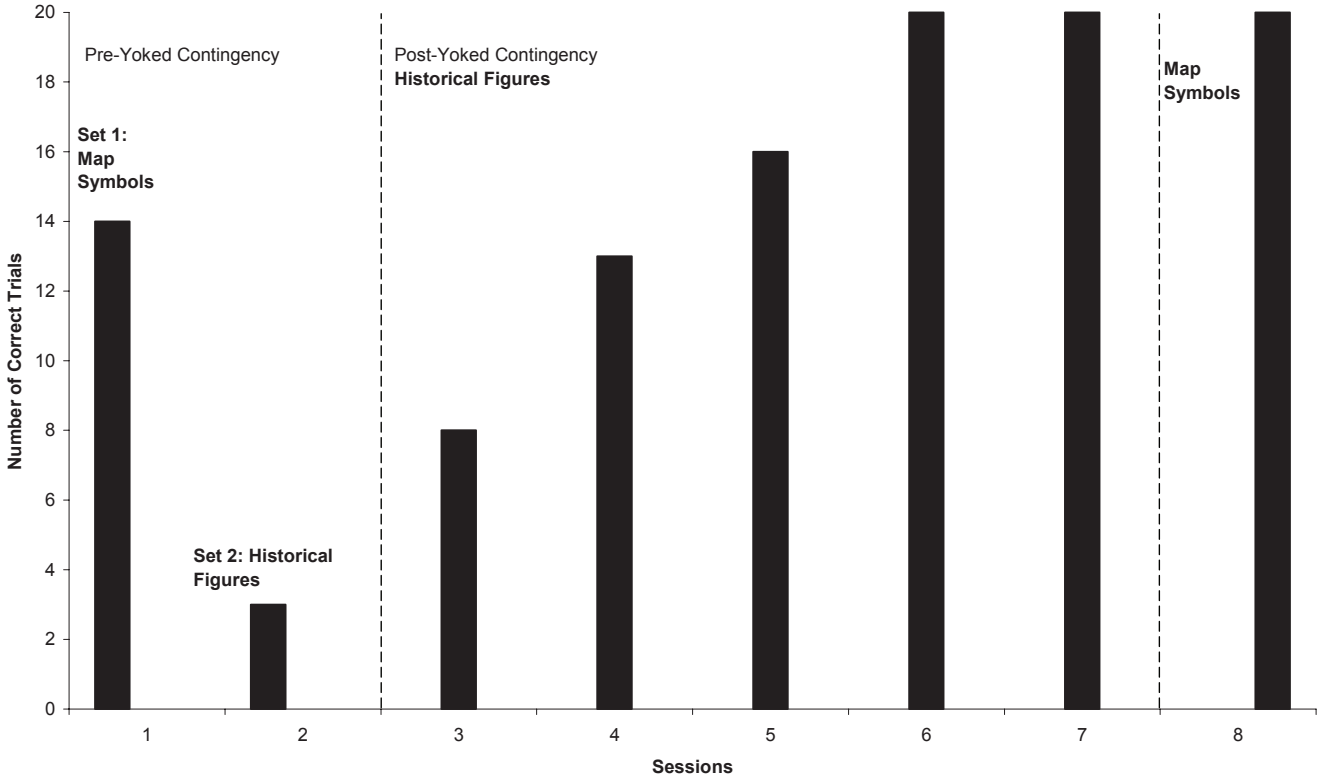

Figure 11. Number of correct trials pre- and post-yoked contingency for Participant H.

data on the presentation sheet and data were graphed after every 40 presentations (20 direct & 20 observational).

Figure 11 shows the data for Participant H. Participant H scored 8/20 and 3/20 for his initial (pre-yoked contingency) probes. After the yoked contingency game was implemented he met the criterion on his first set of stimuli after 6 observational probes; following a further 3 observational probes he met the criterion on his second set of stimuli. Participant I scored 14/20 and 3/20 for his initial (pre-yoked contingency) probes. After the yoked contingency game was implemented he met the criterion on his first set of stimuli after 5 observational probes. He then met the criterion on his second set of stimuli on the next observational probe.

Both participants moved on to self monitoring the yoked contingency games. The teacher checked the participant's data for inter-observer agreement with her data. Both participants met the criterion on the self-monitoring component of OSI when they independently scored 2 successive sessions of 100% agreement with a teacher for 5 OSI programmes. Both participants are now moving on to the peer tutoring component of observational learning.

General Discussion

Within a school that teaches using an applied behaviour analysis approach, it is imperative to draw from all research-based literature to find interventions that allow for achievement of both short and long term objectives and ensure quality of instruction. Analysing from a micro level, short-term objectives are sometimes skewed by the multitude of tactics needed for the individual to achieve that objective. At times objectives become morphed and take on a track much different from the original intent. While identifying problems in the context of the learn unit and selecting a matching intervention is certainly within the scope of applied behaviour analysis, it may not allow for analysis on a macro level. In considering analysis on a larger scale, practitioners need to identify a common component affecting performance across a series of similar programmes. Such a common component is a likely indication of a missing verbal capability; one that is more efficiently addressed by a protocol designed to induce a milestone of verbal development. The procedures described herein address this specific area. The stimulus-stimulus pairing procedure is one that provided

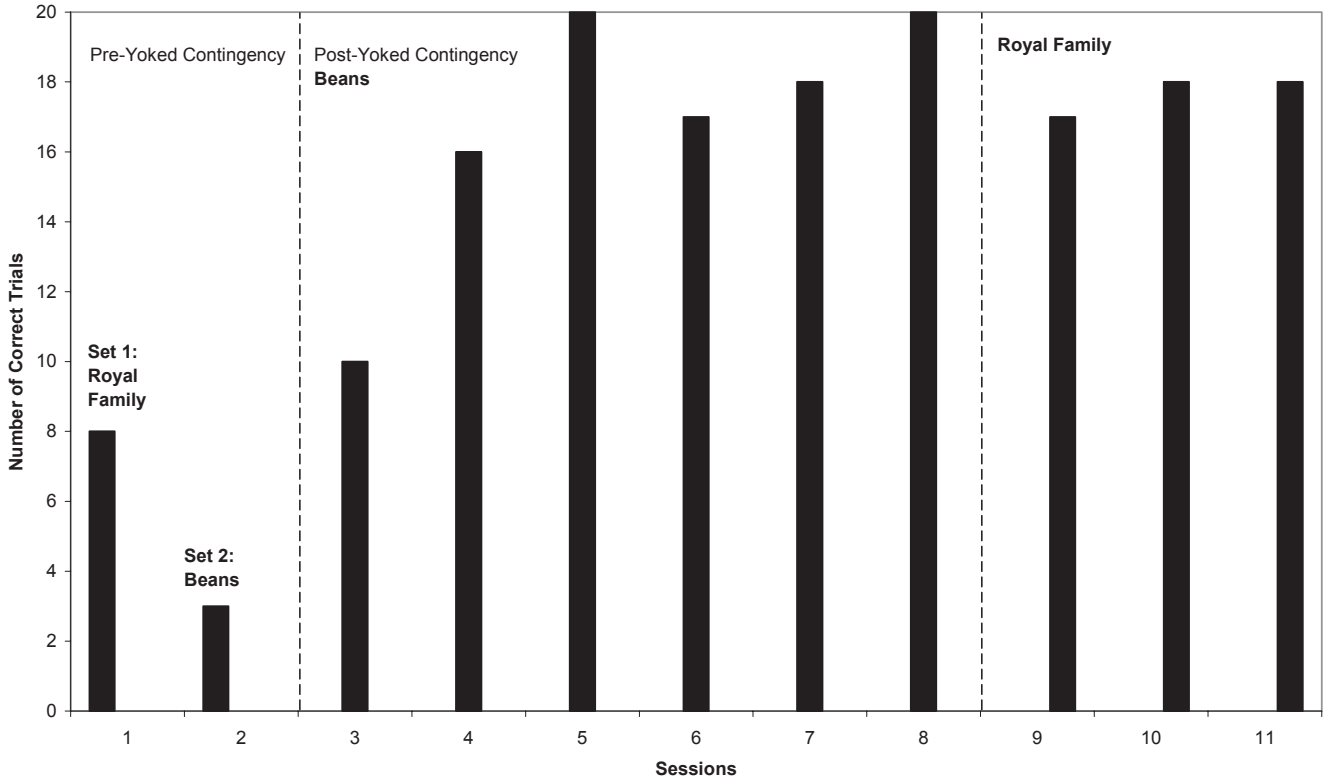

Figure 12. Number of correct trials pre- and post-yoked contingency for Participant I.

the individual with a new conditioned reinforcer which likely led to a reduction in stereotypy throughout the day by displacing the stereotypy with an appropriate behaviour. Intensive tact instruction led to an increase in pure tacts and conversational units in the non-instructional setting. Multiple exemplar instruction was effective in evoking the verbal capability of naming and the yoked contingency procedure induced observational learning. In each of these experiments, the verbal repertoires of the participants were expanded and created opportunities for accessing the verbal community on levels which were previously not possible. In schools operating within a comprehensive application of behaviour analysis framework all aspects of the system are constantly being analyzed resulting because data collection is perpetual and multidimensional.

Because CABAS® is a systems approach to behaviour analysis these studies serve to replicate and expand the research base which drives programming and procedures. Data collections described herein enabled practitioners to respond to instructional problems as they occurred and in a scientific fashion. The research in CABAS® schools has contributed to greatly expanding the applied research in verbal behaviour. Recently, these contributions have helped to identify specific behavioural cusps necessary for individuals to expand their access to the verbal community.

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Appendix 1

Pre-Reader Capabilities
From Greer & Ross (2008)
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