INTRODUCTION TO SELECTION-BASED AND TOPOGRAPHY-BASED VERBAL BEHAVIOR

The behavioral and conceptual analysis of the differences between selection-based (SB) and topography-based (TB) verbal behavior was offered by Jack Michael (1985).

This analysis is not widely recognized outside of the behavior analytic community. It serves as the foundation for my discussion on this topic.

This difference is more commonly referred to as the difference between aided (symbol-based) and unaided (sign language and gesture) methods of augmentative communication.

When analyzed behaviorally and conceptually, it becomes clear that the two systems are actually quite different from the perspective of the speaker and therefore need a more thorough comparison beyond variables related to concreteness of the stimuli, visual nature of the learner, strength of the learner’s motor skills, and number of competent listeners.
In the field of autism, practitioners must often choose between a SB symbol system, a TB method such as sign language, or some combination for their non-vocal learners.

Let’s look at the differences between the two forms of communication to help guide our choices in this very important area.

See Slide Below

### SELECTION-BASED AND TOPOGRAPHY-BASED VERBAL BEHAVIOR (cont.)

<table>
<thead>
<tr>
<th>Topography-Based (sign)</th>
<th>Selection-Based (pointing, exchanging)</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Different motor movement for each controlling relation</td>
<td></td>
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<tr>
<td>▪ Example: the mand (sign) for candy requires a different topography (motor movement) than the mand (sign) for shoes</td>
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<tr>
<td>▪ The “speaker” makes virtually the same motor movement for each controlling relation (pointing, exchanging)</td>
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<tr>
<td>▪ Example: the mand (point, exchange) for candy requires the same topography (motor movement) as the mand (point, exchange) for shoes</td>
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</table>

This analysis leads to the conclusion that signing and talking are quite similar, while selection-based systems share very few characteristics with talking.
• While there are substantial differences in TB and SB forms of verbal behavior the research literature contains support for the use of manual sign language, PECS and SGD to develop functional communication in children with autism

• In the next couple of slides there are recent research studies that have demonstrated these findings.
A further comparison of manual signing, picture exchange, and speech-generating devices as communication modes for children with autism spectrum disorders

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ABSTRACT

We compared acquisition of and preference for manual signing (MS), picture exchange (PE), and speech-generating devices (SGDs) in four children with autism spectrum disorders (ASD). Intervention was introduced across participants in a non-concurrent multiple-baseline design and the acquisition of the three communication modes was compared in an alternating treatments design. Children’s preference for using MS, PE or the SGD was also assessed. With intervention, all four participants learned to make specific requests using at least one of the three communication modes. The children also showed a preference for one mode. These results extend previous studies by demonstrating that four children with ASD have different preferences for, and interpersonal preferences for, three commonly used alternative communication modes. The present results suggest that further research on the acquisition and maintenance of preferred modes. The conclusion that children’s preferences for MS, PE, and SGD should be considered when designing and implementing augmentative and alternative communication interventions.

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Review article

Comparing communication systems for individuals with developmental disabilities: A review of single-case research studies

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ABSTRACT

Studies that have compared different communication systems for individuals with developmental disabilities were systematically reviewed in an effort to provide information useful for clinical decision making and directions for future research. Specifically, 28 studies that compared (a) non-electronic picture systems to speech-generating devices, (b) aided AAC (e.g., picture exchange systems and SGD) to unaided AAC systems (manual signs), or (c) AAC to speech-language interventions were included in this review. Dependent variables forming the basis for comparison included: (a) effectiveness (e.g., acquisition of systems and/or rate of use); (b) efficiency and rate of skill acquisition (e.g., participants’ preference for systems, (c) occurrence of vocalizations and problem behavior, and (c) generalization across communication partners, settings, and time (i.e., maintenance). Results suggest that clear and consistent differences between communication systems are rare, precluding definitive statements regarding a universal best approach for all people with developmental disabilities. Instead, findings of this review support the consideration of an individual’s existing skills, goals and preferences as part of the process of selecting an approach to communication.

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Research Support for Teaching Manual Sign Language

• I have highlighted some additional support for the use of Manual Sign Language with children with autism because of the strong bias against this form of alternative communication in the practitioner ranks.

• First of all, here is sufficient empirical support to conclude that sign language along with PECS and SGDs can be an effective forms of alternative communication. (Gevarter, et al. 2013)

• There are several reports that conclude that the use of manual sign manding will produce a functional communication repertoire. (see Millar, Light, & Schlosser, 2006, Schlosser & Wendt, 2008a).

• Schlosser and Wendt (2008a) in their review chapter write:
  The available body of research on manual sign and gestures for children with autism reveals strong intervention effectiveness scores for symbol acquisition and production, as well as related outcomes such as speech comprehension and speech production. These results suggest that the use of manual signing gestures is a very effective communication option for children with autism. (p.370).
In the 2013 review of the literature, Gevarter, et al. found there were a total of 33 participants responding across 10 studies. SGDs, PECS and MANUAL SIGN LANGUAGE were all effective. In support of manual sign they found that “… the use of manual sign is likely to be an effective and viable AAC system for many individuals with developmental disabilities” (p.4428)

**CONSIDERATIONS IN CHOOSING ALTERNATIVE METHOD OF VERBAL BEHAVIOR**

“The Big 5” (Esch, 2010)
- Fast
- Easy
- Cheap
- Effective
- Always accessible
Three Additional Considerations

1. Efficiency- supports problem behavior reduction.
2. Ease of Acquisition
3. Development of Vocal Production

EFFICIENCY OF THE RESPONSES

- An important consideration in choosing an augmentative form of communication is how efficient it is in replacing problem behavior.

- Several studies have examined the ease of acquisition and efficiency issues.

- On the issue of efficiency and response effort there is empirical support for the superiority of sign compared to visual symbol systems in reducing problem behavior (Richman, et al. 2001). In addition, the learner almost always chose the sign over the symbol to replace problem behavior in this study.

- A task analysis of the motor movements necessary to communicate with a symbol (i.e. scanning, selecting, placement on a Velcro strip) shows the difference in efficiency between SB and TB.
RESPONSE EFFICIENCY DURING FUNCTIONAL COMMUNICATION TRAINING: EFFECTS OF EFFORT ON RESPONSE ALLOCATION

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An analogue functional analysis revealed that the problem behavior of a young child with developmental delays was maintained by positive reinforcement. A concurrent-schedule procedure was then used to vary the amount of effort required to emit mands. Results suggested that response effort can be an important variable when developing effective functional communication training programs.

DESCRIPTORS: functional analysis, functional communication training, aggression, concurrent schedules, mands, developmental disabilities

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Figure 1. Top panel depicts the percentage of 6-s intervals with aggression during Mike’s functional analysis. Bottom panel depicts responses per minute of aggression and manding (card vs. “please”) during the mand analysis.
### NUMBER OF RESPONSES FOR TB & SB RESPONSES

**Sign Mand for Water**

MO → sign water (1) → receives water

**Selection Based Mand for Water**

MO → scans for book (1) → moves to book (2) → opens book (3) and scans to picture (4) → picks up picture (5) → scans for “I want” (6) → places picture (7) → scans for “I want” (8) selects “I want” (9) → places “I want” (10) → (9) gives strip to listener (11) → receives water

### Recent Research

- Two more recent studies found similar results demonstrating that the most efficient response based upon level of proficiency was emitted most often and was strongest in reducing problem behavior. (Ringdahl, et al. 2009; Winborn-Kemmerer, et al, 2010)

- When the sign was the most proficient it was emitted and when the picture was most proficient it was emitted
• It can be difficult to ensure that the “speaker” always has the relevant symbols available. And, when an item suddenly becomes effective as a reinforcer and the symbol is not available due to space limitations or other reasons an episode of problem behavior could occur.

• In addition, the speed of the SB communication is generally slower compared to signing or talking. This may effect the stimulus control of the speaker (i.e. I forgot what I had to say while searching the symbol) or the stimulus control of the listener (i.e. no longer interested in what you have to say).

• This may partially account for why persons with both SB and TB verbal repertoires will generally prefer to engage in TB responding given a capable audience.

• The SB response in general may be shorter due to time and effort limitations.

EASE OF ACQUISITION

• The data in this area are mixed within studies that have compared SB and TB related to ease of acquisition. For an early review of research on this topic see Potter and Brown (1997).

• The studies reviewed by Potter & Brown all showed that persons with developmental disabilities acquired TB skills more quickly, with less errors, and developed receptive responses to the same stimuli while heir SB repertoires developed more slowly with more errors and less development of receptive responses.

• Conflicting data on efficiency has been presented by Adkins and Axelrod (2000) but there were some methodological flaws.

• Michael’s conceptual behavioral analysis of the differences between SB and TB would suggest quicker acquisition rates with TB vs SB.

• This difference is partially related to the extra level of conditionality in the discrimination between SB and TB.
DIAGRAMS OF THE METHODS OF COMMUNICATION

**Topography-Based VB Diagram**

1. MO/S\textsuperscript{D} → 2. R → 3. Sr\textsuperscript{+}

**Selection-Based VB Diagram**

1. MO/S\textsuperscript{D} → 2. scan response → 3. Sr\textsuperscript{+} (finding the picture)

4. MO/S\textsuperscript{D} (seeing the picture) → 5. response (selection) → 6. Sr\textsuperscript{+}

An additional level of discrimination is required in SB verbal behavior.

- In the case of SB there must always be two stimuli present, two responses, and a mediating scanning response between them. In the case of TB (sign) there need only be one stimulus present to produce a response while eliminating the need for a scanning response.

- Not only must two stimuli be present but a conditional relationship must be strengthened between the specific stimuli and some type of selection response. You only point to a picture of a cup when the presence of the picture makes it an S\textsuperscript{D} for selecting it while all other stimuli are S\textsuperscript{A} for the selection response. This is a very difficult discrimination to learn and is not required when teaching signing.

- A study by Grow, et al. (2011) documented this finding.
A COMPARISON OF METHODS FOR TEACHING RECEPTIVE LABELING TO CHILDREN WITH AUTISM SPECTRUM DISORDERS

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Many early intervention curricula manuals recommend teaching auditory-visual conditional discriminations (i.e., receptive labeling) using the simple-conditional method in which component simple discriminations are taught in isolation and in the presence of a distractor stimulus before the latter is removed to respond conditionally. Some have argued that this procedure might be susceptible to isolate stimulus control such as stimulus overactivity (Green, 2001). Consequently, there has been a call for the use of alternative teaching procedures such as the conditional-only method, which involves conditional discrimination training from the onset of intervention. The purpose of the present study was to compare the simple-conditional and conditional-only methods for teaching receptive labeling to 3 young children diagnosed with autism spectrum disorders. The data indicated that the conditional-only method was a more reliable and efficient teaching procedure. In addition, several error patterns emerged during training using the simple-conditional method. The implications of the results in terms of current teaching practices in early intervention programs are discussed.

Key words: autism, conditional discrimination training, early intervention, receptive labeling, stimulus control

The Analysis of Verbal Behavior

Comparing Acquisition of Exchange-Based and Signed Mands With Children With Autism

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Sarah K. Slocum, University of Florida
Sarah J. Miller, Louisiana State University

Therapists and educators frequently teach alternative-communication systems, such as picture exchanges or manual signs, to individuals with developmental disabilities who present with expressive language deficits. Michael (1985) recommended a taxonomy for alternative communication systems that differentiated between selection-based systems in which each response is topographically identical (e.g., card selection and exchange systems) and topography-based systems in which each response is topographically distinct (e.g., signed language). We compared the efficiency of training picture exchanges and signs with 3 participants who presented with severe language deficits; all participants acquired the picture-exchange responses more readily.

Key words: autism, mands, picture exchanges, selection-based communication, signs, topography-based communication, verbal behavior
• A more recent review of the research literature suggests that the earlier work seemed to demonstrate that tacts and intraverbals were more easily acquired with TB methods and that the more recent research suggests mands are more easily acquired using SB methods such as PECS (Barlow, Tiger, Slocum, & Miller, 2013).

• The later studies (Chambers & Rehfeldt, 2003; Gregory, DeLeon, & Richman, 2009; Tincani, 2004; Ziomek & Rehfeldt, 2008) that concluded exchanged based methods was acquired more easily were all plagued with the same methodological flaw related to presenting one single picture stimulus therefore precluding responding within a conditional discrimination arrangement. This will favor quicker acquisition of exchanged based methods over sign.

• An attempt at a more rigorous study by Barlow, et al. (2013), also reported that exchanged based methods may be more easily acquired by some children with autism. All three participants showed acquisition patterns similar to those presented on the following slide.

![Comparing Mand-Training Efficiency](image.png)

*Figure 1. The percentage of trials Jory engaged in independent selection-based (SB) and topography-based (TB) mands across the iPod, Chip, and Milk.*
• Barlow et al. (2013) attempted to control for the failure to program a conditional discrimination from the start of the study. In other words, the presentation of only one stimulus during the SB sessions would strongly favor quicker acquisition initially of SB responding.

• While Barlow, et al. (2013) attempted to control for the level of conditionality however they actually failed to do so.

(Barlow, et al., 2013, p.61)
• In presenting an array of 3 stimuli to select in the PECS treatment sessions they always presented distractors that were never taught as mands.

• The children then learned to always choose the one they have chosen previously even when the MO may have been for a different item. You can not conclude there was correspondence between the MO and item selected.

This is not a true discrimination since the targeted items were only available when the participant wanted them and never available when the participant wanted something else (didn’t want them) therefore precluding a conditional discrimination

Consequently, the findings in favor of exchanged based methods may have been skewed by the ease of acquisition associated with a simpler discrimination established by the researchers and not a true difference between sign and PECs.

See Next Slide
One final point, none of the participants in the Barlow study had imitative responding in their repertoires and more importantly, sign responses necessary for a correct score may have been too difficult. For example the required sign for chip for a 2 year old with autism, Joey, was the “…presentation of one hand, palm facing up and the in a “c” formation with at least 2.5 cm between the thumb and the other four fingers, the hand in the “c” formation had to move across the palm of the bottom hand at least one time”. (p.62) The authors cite this as a possible limitation of the study.
Finally, on the issue of ease of acquisition, it appears that pre-requisite skills may play a role on the ease of acquisition.

Gregory, et al, 2009, found that children who exhibited strong motor imitation and matching skills acquire both PECS and sign very effectively.

Children without these skills had difficulty in acquiring either communication method.
Other issues comparing manual sign language and PECS are listed below.

- It is not possible to teach truly spontaneous manding solely under the control of just the motivation using SB methods. Because the picture or symbol must always be present to produce the mand response, it is always multiply controlled and therefore spontaneous manding is never achieved.

- Within SB verbal behavior systems it becomes difficult to develop symbols that effectively control the behavior of the “speaker” and listener as the concepts become more complex. This may reduce speed of acquisition and limit number of responses that can be acquired (i.e. symbol for beautiful, help).

- TB verbal behavior may allow for a greater number of opportunities to communicate since additional environmental supports are not necessary. This may mean that you can acquire communication responses in more environments and more often (e.g. swimming pool, bed, bathroom, picnic, on a swing, on play equipment).

Contriving incidental teaching opportunities and capturing communication opportunities during active play is an important program component for children with autism. The effort and equipment needed to communicate with symbol systems (SB) during these activities limit the number and quality of communication responses that can be taught when motivation for verbal behavior may be the strongest.

- Since there is no actual verbal community of SB responders and teachers generally do not use pictures and the spoken word while teaching, there are no models for the learner to benefit from through simultaneous observation of picture communication paired with reinforcement.

- Some verbal responses are learned by hearing the words or seeing the signs of others when paired with reinforcement during enjoyable activities. If a teacher signs while singing a reinforcing song, the signs may begin to acquire some control over the signs of the child when fill-in opportunities are provided.
Functional Communication and Preference for Method


2. In addition it appears that preference assessments demonstrated that most children prefer to use SGDs over PECS.

3. Preference assessments have also demonstrated a strong preference for SGD over MANUAL SIGN LANGUAGE.

4. The learner preferences may be an artifact of the preference assessment procedure and not the actual preference of the individual.

5. Recent reviews of the literature suggested that 10 participants preferred SGDs and PECs compared to only 1 participant choosing sign.
2.9.4. AAC preference assessments

These assessments were undertaken to determine if participants would show a preference for using one of the two AAC options. These assessments occurred after every eighth session (i.e., after four MS and four SGD sessions) on average. This number varied slightly because these assessments had to occur before the first session for the day to prevent sequence effects (selecting the AAC option that was taught last; Sigafos et al., 2005), as well as to ensure that at least two such preference assessments were undertaken during intervention for each participant.

During a preference assessment, the trainer presented the MS option on one side of the table and the SGD option on the other side of the table (alternated across sessions to control for choice being made dependent on location of the AAC option). The trainer asked the participant: Which communication option would you like to use? Sign language on this side (while pointing), or the SGD on this side (while pointing)? The trainer initiated one requesting opportunity with the chosen AAC option before reverting back to initiating requesting opportunities with the AAC device that was being used for that session.

Choice for an AAC option was defined as physically pointing to, touching, or picking up the selected communication option. If the child did not choose an option within 10 s, the device preference assessment was terminated and training continued with the AAC option that was scheduled for use in that session.

Fig. 2. Results from the device preference assessment probes depicting the number of times each communication option (SGD and MS) was chosen and number of times a device was not chosen (no selection) across each phase of the study for each participant.
Comparing Three Augmentative and Alternative Communication Modes for Children with Developmental Disabilities

Larah van der Meer · Robert Didden · Dean Sutherland · Mark F. O’Reilly · Giulio E. Lancioni · Jeff Sigafos

Published online: 8 May 2012
© Springer Science+Business Media, LLC 2012

Abstract We compared acquisition, maintenance, and preference for three AAC modes in four children with developmental disabilities (DD). Children were taught to make general requests for preferred items (snacks or play) using a speech-generating device (SGD), picture-exchange (PE), and manual signs (MS). The effects of intervention were evaluated in a multiple-probe across participants and alternating-treatments design. Preference probes were also conducted to determine if children would choose one AAC mode more frequently than the others. During intervention, all four children learned to request using PE and the SGD, but only two also reached criteria with MS. For the AAC preference assessments, three participants chose the SGD most frequently, while the other participant chose PE most frequently. The results suggest that children’s preference for different AAC modes can be assessed.

AAC Preference Assessments These assessments were undertaken to determine if participants would show a preference for using one of the three AAC options. They were undertaken after every sixth intervention session (i.e., after two sessions for each AAC option). During each preference assessment, the SGD, PE, and MS options were presented (randomly) at different positions on the table. While pointing to each option, the trainer asked the participant: Which communication option would you like to use? The SGD, PE, or MS? The child had 10 s in which to make a choice by touching one of the options. Once a choice was made, the trainer initiated one requesting opportunity with the chosen AAC option before reverting back to initiating requesting opportunities with the AAC device that was scheduled to be used for the session. If the child did not choose an option within 10 s, the device preference assessment was terminated and training continued with the AAC option that was scheduled for use in that session.
How To Teach The Sign Mand

• Get the best quality response with the least amount of prompting.

• Practice teaching mands so that you are skilled in how and when to reinforce, what approximations to accept, what level of prompt to provide, and how to fade the prompts as quickly as possible.

• Consistency in methods across trainers is essential, and numerous trials are necessary to promote generalization.

• An orderly and progressive curriculum must be in place.

• The practical steps to teaching mands, once the MO has been established, include stimulus control transfer procedures. The quick transfer procedure for teaching the mand, as recommended by Sundberg and Partington (1998), includes the following steps:
Stimulus Control Transfer Procedures

- MO
- Physical Prompt
- Gestural Prompt
- Echoic Prompt
- Item
- FADE ALL TO MO + Audience

Teaching a Functional Verbal Repertoire with Sign Manding

Sign Videos---Kyle Case Study Olumide Case Study

Recent Research on SGDs

- Still et al. (2014) conducted a systematic review of the use of “high tech” devices to teach communication skills to children with autism.
- Their review included studies between 1998 – 2013
- The types of devices included were: iPad, BIgMack switch, Cheap Talk 4 in line direct VOCA, Touch Talk Direct VOCA, Cheap Talk VOCA, Blackhawk, Introtalker SGD, Pick a Word, Tech/Talk, 6X8, Vantage, Logan Pox Talker, Talk-Trac Wearable.
- The general finding was that each of these devices can be used by children with autism to increase their mand repertoires.
They selected for discussion only high tech devices because of their concerns with PECs as a selection-based modality.

They identified several problems with PECs that should direct a teacher to using a high tech device instead.

Their criticisms of PECs were:

i. PECs is time and labor intensive

ii. “represents a significant practical challenge for parents and practitioners” p.1185

iii. Device must be available and not forgotten

iv. Preparation includes selection of objects and taking photos

v. Print, laminate, cut and apply velcro

vi. Considerable amount of time to do the above

vii. Young children can’t help with all this do to dangerous materials

viii. “...independence achieved by learning to communicate via the PECs is tempered somewhat by the set up and operation requirements of the system” (p.1185)

ix. Current SGD can be much smaller than a PECS book.

The authors therefore conclude that the recent development of many high tech devices should be considered as a selection-based alternative to PECS.
• These authors also presented several disadvantages of the use of Manual Sign Language and concluded that the advent of smaller and more complex high tech alternatives may be the most effective alternative form of communication.

• The smaller size of the these devices in recent years and the larger storage available have made them a potentially worthwhile communication method for children with autism.

• There were 16 studies in the review and 4 included use of the Ipad.

• There was a total of about 50 subjects between the ages of 4 and 27.

• Three of the studies compared the use of manual sign language to a SGD.

• The general findings were that sign language was acquired along with the SGD.

• The largest number of responses taught in any one study was eight (8) and some only taught one (1) mand.

• The trainers in the studies included parents, teachers, researchers and even typical children who instructed children with autism.

• The instructional methods to teach the skills were not thoroughly described.

• They mostly described the prompt and prompt fade procedures, e.g. least to most or most to least.

• Generally, reinforcers were identified through preference assessments at the start of the treatment session.

• There was no control for the moment to moment changes in MOs throughout the sessions except in a couple of studies in which a grab response for an item alerted the trainer to the MO for a specific item.

• In most cases however, it was impossible to know if an MO for the “requested” item was in place at the time that the response occurred.
Teaching Manding with SGDs

• Teaching the mand relations with a SGD can be a very difficult and a complicated process.

• Issues that require attention are:
  i. Insuring the relevant MO is established.
  ii. prompting and prompt fading,
  iii. Insuring a conditional discrimination which entails number of pictures displayed simultaneously and insuring that the pictures displayed are also those being taught so that each picture acts as both and $S^D$ and S-Delta across trials. (See next slide)
  iv. position of the picture to avoid placement bias
  v. backward chaining of multiple screens with categories

• Here is an example of procedures that are frequently used during the teaching of mands with SGDs.

TEACHING WITHOUT CONDITIONAL DISCRIMINATION

To begin a session, the experimenter placed each of the four objects assigned to a condition (i.e., SPEECH, NO-SPEECH) individually and successively on a table in front of the participant, and said “Let me know if you want [name of object].”

TEACHING WITHOUT MO CHECK

After offering one object item and saying “Let me know if you want ______ [name of object],” the experimenter immediately (0-s delay) prompted a response, consistent with the simultaneous prompting technique (Schuster, Griffen, &

Failure to consider these issues will lead to difficulties in acquiring a mand repertoire although it will appear as though it has been acquired.
What follows is a description of how a mand repertoire was taught using an iPad and Proloquo 2 as a SGD.

My impression is that this is a very common method for teaching manding using SGDs.

The participants were three children with autism, ages 3, 4 and 5 years old. Two of the three had echoic repertoires with one to three word utterances and the third produced only sounds.

Many studies use a modified PECS training protocol developed by Bondy and Frost.
Below is the display of the pictures of the iPad during each phase of the experiment to teaching manding with a SGD.

Table 3
Visual representation of the iPad screen for all phases.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Baseline probes</th>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3a</th>
<th>Phase 3b</th>
<th>Phase 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I want (______)</td>
<td>I want</td>
<td>Blank icon</td>
<td>Blank icon</td>
<td>Small</td>
<td>I want (______)</td>
</tr>
<tr>
<td></td>
<td>Gummy</td>
<td></td>
<td>Playdoh</td>
<td>Blank icon</td>
<td>Sing book</td>
<td>I want</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>Elmo phone</td>
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<td></td>
<td></td>
<td>Camera</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Small</td>
</tr>
<tr>
<td>Book</td>
<td></td>
<td></td>
<td>Cookie</td>
<td>Cat (preferred item)</td>
<td>Noise stick</td>
<td></td>
</tr>
<tr>
<td>Spin toy</td>
<td></td>
<td></td>
<td>Blank icon</td>
<td>Tissue (nonpreferred item)</td>
<td>Slime</td>
<td></td>
</tr>
</tbody>
</table>

NO DISCRIMINATION REQUIRED - 1 ITEM PRESENT
NO CONDITIONAL DISCRIMINATION REQUIRED - NO MO CHECK
NO MO Check
NO MO Check
• Here is what they did and the problems associated with these procedures:
  1. They conducted preference assessments to determine items that might act as reinforcers during the study.
  2. They did a check for MO in phases 1 and 2 but not in phases 3, 3a and 4. The authors rotated the position of the items every 5 trials.
  3. In all phases they displayed the items in their hands or on a table in front of the individual.
  4. In phase 1 they presented preferred items in isolation with blank “buttons” for 3 other items.
  5. In phase 2 they added “traveling” to get the iPad with the same array containing only 1 preferred item.
  6. This arrangement denied the opportunity to develop a conditional discrimination in phases 1 and 2 and therefore it is unclear if the response was under the control of the MO and the sight of that particular picture or merely the presence of a picture that had been correlated with reinforcement for selecting.

  7. In phase 3a they presented a preferred item in one hand and an unpreferred item in the other hand and rotated the hands. The iPad display included the preferred item and the unpreferred item (tissue) and 3 blank buttons and NO MO check was required.
  8. Since the children only had a history of choosing the preferred item it is unclear if the responses to the picture of the preferred item was under the control of the MO and the particular picture or just a default response to previously selected pictures. Moreover, there was no check for an MO.
  9. In phase 3b the children were required to choose among 4 preferred items. Only 2 of the 3 children met mastery criteria.
  10. It is unclear if there was an MO for the item represented by the picture and therefore it is unclear if the response was a mand for the item.
  11. None of the children mastered level 4 which included the use of the “I want” phrase.
• Finally, the reported increase in vocalizations was attributed to the SGD without regard for the more likely controlling variables of the MO and SSP of receipt of preferred item and hearing the name of the item when a reinforcer was delivered. Moreover, the children engaged in echoic responses which probably facilitated the vocal productions.

Teaching SGDs

- MO
- Physical Prompt
- Gestural Prompt
- Echoic Prompt

FADE ALL to MO + Audience

SGD Videos
Protocol # 1
Protocol # 2
DEVELOPMENT OF VOCALIZATIONS

- Vocal verbal behavior is the most desirable form of communication and therefore should be at least one of the goals to be achieved by augmentative communication.

- The research literature suggests that some children with autism may develop vocal verbal behavior with both SB and TB methods. However, manual sign language has shown some superiority over selection based methods. (Tincani, 2004; Anderson, 2002; Curtis, 2012)

- Gevarter et al. (2013) wrote “In support of Tincani’s suggestive finding, that two participants vocalized more often or consistently with sign than with PECS, Curtis (2012) found that while 3 participants had little to no vocalizations, there was preponderant evidence that one participant who mastered both sign and PECS used vocalization more often with sign than PECS”.

- There appear to be both learner characteristics and instructional variables that account for the development of vocal responding in some children with autism.

- The learner characteristics necessary for the development of vocal responding appear to be related to the development of at least a minimal echoic repertoire. Children who do not develop this repertoire are less likely to become vocal regardless of the method of instruction.

- The limited TB-based literature (sign language) shows greater support for the development of vocalizations although SB verbal behavior methods (PECS and SAL) have successfully engendered vocal verbal behavior.

- It appears that regardless of the method, learners with some echoic skill may develop vocalizations if the instruction focuses initially upon intensive mand training, which takes advantage of the effects of strong reinforcement, along with stimulus-stimulus pairing of spoken words with delivery of the reinforcer. When vocal responses are also shaped as they develop, vocalizing is enhanced. These may be the contributing independent variables separate from the SB or TB method.

- TB sign language may have some advantage over SB in developing vocalizations with some children with autism.

- It appears that the different motor movements associated with each sign and the point to point correspondence between the motor movements and the response product (what is seen) for each sign may facilitate both the development of the sign repertoire and the development of vocalizations. The unique motor movement associated with each sign may act as a built in prompt for the vocalization.

- Through sign training, a more sophisticated motor imitative repertoire may be developed and in turn this newly acquired repertoire may facilitate the development of improved vocal imitation.

Sign Vocalization Videos  VIDEO
Comparing the Picture Exchange Communication System and Sign Language Training for Children with Autism

Matt Tincani

This study compared the effects of Picture Exchange Communication System (PECS) and sign language training on the acquisition of speech behaviors for children with autism. Participants were two elementary school students with autism enrolled in a suburban public school. Training sessions consisted of paired presentations of preferred items, prompting and prompt fading procedures. PECS was conducted for the generalization of learned words to classroom and home settings, while sign language training focused on independent words. PECS training produced a higher percentage of independent words for the other participant. For both participants, sign language training produced a higher percentage of vocalizations during training. These results suggest that both methods are effective for improving communication skills in children with autism. Further research is needed to determine the optimal procedures for teaching both modalities to students with communication difficulties.

Speech deficits are common in children with autism (American Psychiatric Association, 1994). About 80% of children diagnosed with autism will remain functionally nonverbal as adults (Pierce & Gillberg, 1999). Even with early intensive intervention including speech instruction, some children may fail to acquire useful speech (e.g., Lovaas, 1987). Training in augmentative and alternative communication (AAC) systems, sign language and picture exchange, show promise for teaching communication to nonverbal children.

In sign language training, children may be taught to use gestures or request gestures under the control of various stimulus contingencies (Sundberg & Partington, 1999). Although there has been little recent research on sign language intervention for children with autism, there is evidence that simultaneous communication training to teach nouns and speech produces favorable communicative and other developmental abilities (e.g., Brady & Stein, 1978; Kempermann, 1984; Levy & Baker, 1981). The Picture Exchange Communication System (PECS; Bondy & Frost, 2002), a popular picture exchange system used for children with autism spectrum disorders, taught children to exchange pictures for items, among other functions. Initial studies suggest that most children taught PECS acquire independent use of the system, and many even acquire functional speech (Bondy & Frost, 1994; Garland-Cleary et al., 2003)."Grasping the positive reported outcomes for each modality, choosing between sign language and PECS may be difficult. Although some have argued for the benefits of teaching one AAC system over others (e.g., Sundberg & Partington, 1999), it is unlikely that any single system meets the diverse needs of all children with autism.

Tincani, 2004

![Graph showing percentage of word vocalizations in baseline and training conditions for Carl.](image)

FIGURE 5. Percentage of word vocalizations in baseline and training conditions for Carl.
On the next few slides is a study our clinic published related to speech production and application of manual sign.

In this study the learner was vocal in that she had a strong echoic repertoire but failed to acquire and maintain vocalizations in mainly the tact repertoire.

When sign was added to the her repertoire a substantial improvement in the frequency of vocal productions occurred as displayed on the data sets on the next few slides.

A Comparison of Two Approaches for Teaching VB Functions: Total Communication vs. Vocal-Alone

Vincent J. Carbone, Lisa Lolis, Emily J. Sweeney-Kerwin, Julie Dixon, Rose Louden and Susan Quinn

Abstract

Total communication (TC) involves the use of manual signs with their corresponding spoken words simultaneously; and research indicates that TC facilitates vocal responding by children with autism. However, most of this previous research was conducted 20 years ago and did not consider vocal responding in relation to verbal behavior functions (Skinner, 1957). The present study used an alternating treatment design to compare the effects of TC vs. vocal-alone (VA) training on the vocal tact responses of a child with autism. Results indicated that the child produced nearly four times as many vocal tact responses during TC training than during VA training in less than half the number of teaching trials. The use of manual sign training is considered in relation to its advantages for supporting the production of vocal responses.

Keywords: verbal behavior, sign language, tact, autism, total communication.
**Figure 1.** Cumulative number of vocal tacts acquired in the total communication condition and vocal-alone condition per session.

Carbone, V. J. (2006)

**Figure 2.** The mean number of trials to criterion for vocal tacts in the total communication condition and vocal-alone condition.

Carbone, V. J. et al. (2006)

Sign Vocalization Videos
Brief report: an evaluation of total communication vs vocal alone for teaching tacts

Beverley Ann Jones¹, J. Carl Hughes¹, and Bethan Mair Williams¹, ²
Wales Centre for Behaviour Analysis, School of Psychology, Bangor University, Wales¹
and Betsi Cadwaladr University Health Board²

Total Communication (TC) and Vocal Alone (VA) are two teaching approaches used to facilitate vocal responding with children with language delays and autism. TC involves the simultaneous use of the manual sign and the spoken word. VA involves the use of the spoken word only. This single subject study aimed to compare the two approaches using an alternating treatment design to find which condition produced the most effective acquisition rate of vocal tacts for an echolalic child with autism. We also examined the effect of condition on speech articulation on targeted items and the child’s listener behaviour (selection) following tact only (speaker) training. An in depth phonological assessment was carried out pre test and the subject’s vocal utterances phonetically transcribed over the course of the study by a speech and language therapist (SALT). Results indicated that the TC condition produced six times more vocal tacts than the VA condition; results from the listener behaviour tests showed the subject was able to respond appropriately when given both the vocal and sign, but not with the vocal stimulus alone. The phonetic transcription yielded inconclusive results but indicated ways that such information could be used more effectively in future research.

Keywords: Total Communication, Vocal Alone, tact, autism, articulation, listener behaviour.

Discussion

In the present study, Jim acquired six times more vocal tacts in the TC condition compared to the VA condition. These results support the findings of Carbone et al. (2006) in that TC is a more effective training condition to teach vocal tacts. Although the overall number of acquired targets was relatively low in both conditions, this emphasises the difficulty that some children lacking these repertoires have in acquiring verbal behaviour.
In spite of some of the criticisms of signing and “total communication”, studies comparing the effects of teaching expressive language using speech, signing, or “total communication” report that signing or “total communication” training often results in quicker and more complete learning than speech training alone for many participants (Carbone et al., 2006; Yoder & Layton, 1988). Carbone et al. (2006) compared the effects of “total communication” and speech alone training on labelling responses of a child with autism. Significant differences in terms of the effectiveness of the two training conditions were reported, whereby the child produced over three times as many comments during “total communication” training relative to speech alone training.

References


References


GENERALIZED SELECTION-BASED BEHAVIOR

- It appears that topography based verbal behavior has primacy over selection-based verbal behavior.

- In another section we discussed the role of joint control in the development of generalized selection based responding.

- It is clear however, that TB plays a role in mediating many selection based responses.

- In the Potter et al. (1997) article, the researchers found selection based responses were mediated by TB verbal behavior.

- In fact, persons with limited TB verbal behavior performed less adequately on tests for selection based responding.

- A few studies have demonstrated that after acquiring TB tacts and intraverbals compared to SB responses that persons with developmental disabilities were more likely to correctly select the items when there name was given. (Sundberg, et al. 1996)

  John Luca Video

  Joint Control Activity
• In addition, Potter et al (1997) demonstrated that college students reported using their TB repertoire to more accurately perform a delayed matching response.

• When they were shown arbitrary configurations of dots matched to flag-like figures and then asked later to choose the correct dot array when re-shown the flag-like figures the subjects indicated that they would tact both figures and intraverbally link them.
They then reported when shown the flag-like figure they would tact it as they had before and then tact each of the dot arrays until the intraverbal connection between the two responses evoked the correct selection of the appropriate dot array.

You can imagine someone saying “That’s the backward flag that goes with “Y”, no wait, it goes with the backward L, that’s it”.

Other responses are possible such as self-echoing the invented name of the item that goes with the invented name of the flag-like figure until the echo and the tact can occur while looking at the same array which would be the moment of “recognition” and then choosing it.
Full Linguistic System

- Sundberg and Michael have suggested that it may not be possible to acquire the tact and intraverbal repertoire with a selection-based response form.

- In fact, it appears that what appears to be a tact is in fact a match-to-sample response.

- And, what appears to be an intraverbal is a listener response by feature, function or class.

- What appears on the next couple of slides are diagrams of the operants that illustrate these points.

- Keep in mind that an operant is defined by the controlling variables and therefore operants with different controlling variables are different operants.
**TACT**

**Controlling Relations for Topography-Based Tact**

A

NV Stimulus ➔ Verbal Response ➔ Social Reinforcer (Vocal or Sign)

**Controlling Relations for a “Selection-Based Tact”**

A

NV Stimulus ➔ Scan ➔ Sight of the Picture

Sight of the Picture ➔ Selection ➔ Social Reinforcer

**Controlling Relation for a MTS Response**

A

NV Stimulus ➔ Scan ➔ Sight of the Picture

Sight of the Picture ➔ Selection ➔ Social Reinforcer

**INTRAVERBAL**

**Controlling Relations for Topography-Based Intraverbal**

A

V Stimulus ➔ Verbal Response ➔ Social Reinforcer (Vocal or Sign)

**Controlling Relations for a “Selection-Based Intraverbal”**

A

V Stimulus ➔ Scan ➔ Sight of the Picture

Sight of the Picture ➔ Selection ➔ Social Reinforcer

**Controlling Relation for a Listener Response**

A

V Stimulus ➔ Scan ➔ Sight of the Picture

Sight of the Picture ➔ Selection ➔ Social Reinforcer
WHY SIGN LANGUAGE TRAINING MAY FAIL

- First signs taught are not mands
- First signs taught are too complex/generic (e.g., please, yes/no, help, toilet, more, thank you)
- First signs may resemble each other too closely (e.g., eat and drink)
- First signs may involve a complex response form
- Not enough training trials are provided
- Training is conducted under multiple sources of control (e.g., motivation, picture/object prompts, vocal prompts, imitative prompts), and prompts are not faded so “spontaneous” responses can occur
- Individual verbal operants are never established (i.e., mands, tacts, intraverbals); responses remain multiply controlled
- Stuck at one level too long, not a progressive curriculum in place
- Single verbal operant focused on almost extensively (e.g., tacts, but limited intraverbal or mand training)
- Failure to establish a signing verbal community
- Failure to require signs outside of the training sessions
- Failure to generalize to novel stimuli, staff, settings, times, etc.

Conclusions

Selecting a Response Form

- Even when echoic responding is weak vocal behavior should be the response form of choice initially.

- If skilled attempts to develop the echoic repertoire and mands and tacts are unsuccessful then an alternative response should be considered.

- If a person has physical or neurological disabilities which makes the differential muscle control necessary for signing impossible a pointing or selection based system should be immediately considered.
• If a student is young without physical conditions which preclude sign then begin an intensive signing program that includes speaking while signing. The teacher, however, should be skilled in prompting and differentially reinforcing vocalizations that may occur.

• With older students who may be involved in frequent community activities and who do not have a strong echoic repertoire or frequent verbalizations, a combination of signing and selection based systems may be best.

• This older person may have a need to immediately verbally interact with persons in the community who do not have specialized sign training and therefore would benefit from the use of a picture selection repertoire. Picture selection will be easier to acquire once sign language has been taught.
Quick Assessment Overview: Spoken Words

- Outlines 6 profiles of learners with moderate-to-severe developmental disabilities based on the extent of their spoken-word repertoires

- Assists educators in determining whether to select “saying words” as the learner’s primary method of speaking or to select an alternate...
Quick Assessment Overview: Alternative Method of Speaking

- An assessment within the EFL
- Focuses on selecting an alternate method of speaking (communicating)
- Selecting of Alternate Method of speaking is based on one or more of the following:
  - the physical skills of the learner (gross and fine motor skills)
  - The size of audience for specific methods (sign vs device)
  - The ease with which specific methods can be implemented by instructors, care providers and parents OR
  - The potential for the teaching of advanced language

Alternative Method of Speaking
Additional Methods to Teach Vocal Verbal Behavior: Increasing Speech Sound Production of Children with Autism

Introduction

• A large number of children with autism fail to develop echoic responses (vocal imitation) to adult sounds and words (Esch, Carr & Michael, 2008).

• The low frequency and variety of sound production by these children provides few responses to be selected and shaped by a verbal community.

• As a result many children with autism do not acquire vocal verbal behavior as their primary form of communication.

• To overcome this deficit the implementation of some behavior analytic procedures have shown promise in supporting the development of vocal verbal behavior.
• The term vocal behavior is used specifically to refer to the production of auditory stimuli resulting from the movements of the muscles of the vocal apparatus, e.g., the sounds one makes.

• In treatment programs for children with autism we are interested in developing not just vocal responses because not all vocal responses constitute verbal behavior. Coughing and yawning produce vocalizations but in most cases they are not considered verbal.

• Vocal verbal behavior is the production of auditory stimuli that effectively control the behavior of a community of listeners resulting in reinforcement for the speaker (Skinner, 1957). Vocal verbal behavior is the production of the sounds and words of a verbal community.

• Non-vocal persons are individuals who fail to emit high rates of vocal verbal behavior.

• In the case of children with autism this issue is represented by individuals who produce very few speech sounds or words that correspond to those produced by other members of their verbal community.

• In more common terms, these are children with articulation problems or speech sound disorders.

• More precisely, for some children with autism the naturally occurring contingencies of reinforcement have failed to effectively control the movements of their vocal musculature.

• This does not mean that non-vocal persons do not emit verbal behavior (VB); they may exhibit other forms of VB (e.g., sign language, exchanging pictures, speech output devices, hitting, screaming, self-injury, etc.)
• The purpose of this talk is to outline the evidence-based methods to increase the speech production of children with autism who emit few vocal verbal responses and who have generally failed to develop functional vocal verbal behavior.

• Be reminded, that many of the children we will be discussing have weak alternative verbal behavior repertoires (language) as well. In other words, their alternative forms of verbal behavior are not extensive across verbal operant categories.

• Teaching vocal verbal behavior to nonvocal learners can be very difficult task. It requires a diverse teacher repertoire and a substantial understanding of the applications of Skinner’s analysis of VB. Procedures that have been shown to have at least some support include:

1. Reinforcing all Vocalizations
2. Stimulus-Stimulus Pairing (Automatic Reinforcement)
3. Echoic Training
6. Shaping Vocal Productions. (Phonetic Transcription)
Non-Behavior Analytic Approaches to Speech Production

- The field of speech language pathology contains several methods that clinicians use to increase speech production of children with autism.

- Two of the most frequently reported are:
  1. Non-Speech Oral Motor Exercises (NSOME)
  2. PROMPT Therapy

- I will only briefly mention these methods because they are frequently recommended as alternatives to behavior analytic approaches.

- Notwithstanding the popularity of these methods there are no adequately controlled studies that suggest their benefit for children with autism.

**NSOME**

- NSOME are based upon the assumption that the limited speech production of some children with autism is the result of weak articulatory muscles and therefore oral motor exercises will overcome the problem.

- Carole Bowen describes these exercises this way:
  “Exercises for the mouth, or what some Speech Language Pathologists (Speech and Language Therapists) call "oral motor exercises", "oral motor therapy", "oral placement therapy" or "oro-motor work", are, in some clinical settings, a prominent component of intervention for children with speech sound disorders. The activities may include sucking thickened drinks through straws; blowing cotton balls, horns, whistles and windmills; chewing and mouthing plastic and rubber objects; licking peanut butter and other foods from around the mouth; and playing with "oral motor tools and toys!" (Carole Bowen, 2005) [http://speech-language-therapy.com/oralmotortherapy.htm](http://speech-language-therapy.com/oralmotortherapy.htm)

- In a special issue of the journal *Speech and Language Seminars* Gregory Lof (2008) reported:
  “Many SLPs believe that children with speech sound disorders need to strengthen their articulatory muscles, which research has refuted. In fact, Sudbury et al. found that children with speech sound disorders actually had stronger tongues than did children without speech problems. In Clark’s article, she elaborates on the role of strengthening exercises, also pointing out how targeting increased strength in therapy probably is not beneficial for improving speech accuracy.”(p. 254)
Lof went on to say:

“Research studies have been conducted on the efficacy of nonspeech tasks, and these studies do not support the use of NSOMEs to change speech sound productions. Forrest and Lucini report on findings from their study, one that compares a traditional production treatment approach to NSOMEs for nine children with speech disorders. Their findings are consistent with prior research that shows the benefits of production training and the lack of benefits of NSOMEs.” (p.254)
PROMPT Therapy

- PROMPT therapy has become a popular method designed to increase the vocal production of children with autism.

- One proponent of this method describes it this way: “PROMPT stands for “Prompts for Restructuring Oral and Muscular Phonetic Targets.” It is used to restructure the speech production capabilities of children with a variety of speech disorders, including apraxia. PROMPT utilizes specific techniques based on touch pressure, proprioceptive (the body’s sense of itself) and kinesthetic (tactile) cues to help reshape the way the brain and mouth work together to articulate words. This is a very hands-on approach which will require the involvement of a speech language pathologist to administer treatments.

For example, one PROMPT technique involves manipulating the external muscles of the face to help the child understand the movement required to produce a specific sound. Because each individual’s needs are different, the types of techniques will vary. The PROMPT technique often is not used by itself to treat apraxia, but is used in conjunction with other tools.” (Karen George http://www.chicagospeechtherapy.com/how-can-the-prompt-speech-therapy-technique-help-children-with-apraxia/)
Below are illustrations of therapists conducting PROMPT therapy sessions.

• Despite the popularity of this method there are no controlled studies to support the effectiveness of this method with children with autism.

• To learn more about this method visit the prompt institute website of and read comments by the developer of the method Deborah Hayden. http://www.promptinstitute.com/
REINFORCING ALL VOCALIZATIONS IN FREE AND RESTRICTED OPERANT CONDITIONS

• Reinforcement was delivered for any and all vocalizations that were produced during 3 hour sessions.
• Activities are scheduled that lead to increased vocalizations (e.g. jumping, singing, tickling).
• On the next slides is a data recording sheet for recording any and all sounds and graphs documenting the increase in vocalizations that correlated with the implementation of this procedure.
The Role of Automatic Reinforcement in Speech Sound Production

- Automatic reinforcement describes circumstances in which reinforcement of behavior occurs when it is not directly socially mediated but is, instead, the product of a response. (Michael & Vaughan, 1980)

- Skinner referred to this type of overlooked source of reinforcement many times in his writings.

- He claimed that a substantial portion of behavior that appears to produce limited social reinforcement might well be controlled by automatic reinforcement.

- In fact, he claims that much of the behavior of infants might well be under the control of automatic reinforcement.

- For example, he suggests that an infant’s movements that effectively change the environment, such as swatting a mobile hung above the crib or the first steps might be automatically reinforced by the control over the non-verbal environment.

- Indeed, problem solving behavior might well be strengthened by those, “I did it,” moments.
• As Palmer (1996) points out, children become effective listeners before they become effective speakers.

• Parents frequently talk in positive terms to their children as they are providing early survival tasks, e.g. feeding, bathing, removing unpleasant stimuli, etc.

• As such, the parent’s sounds and words that have been paired with the reinforcing activities noted above might well become conditioned reinforcers.

• The same sounds when produced by the child during babbling might well strengthen the muscle movements necessary to produce them.

• Consequently infants may babble more frequently the sounds that have been paired with socially mediated reinforcement.

• The data on children’s development of sounds shows the pattern of producing the sounds that have been heard during parent care-giving activities. (Schlinger, 1995)

• This process of automatic reinforcement seems to strengthen the vocal repertoire and increase the variety of sounds produced overall and prepare the young child to speak in words and sentences.

• All of this is to say that the foundation for speaking intelligibly in young children might well be the outcome of automatic reinforcement upon the vocal attempts.

• Several researchers have extended this analysis to the application of a procedure called stimulus-stimulus pairing (SSP) and the concept of automatic reinforcement to the development of vocalizations in children who fail to develop them typically.

• Petursdottir, Carp, Mathhies, & Esch (2011) describe this procedure “This procedure involves an adult’s repeated presentations of a specific phoneme or syllable, each immediately followed by the presentation of a preferred item or activity, without any response requirement by the child” (p.45)

• Since phonemes and syllable units are the building blocks of vocal verbal behavior, any attempts to increase their frequency and variety in young children who do not develop them typically might lead to a greater likelihood of developing vocal behavior.

• Sundberg et al. (1996) were the first to make use of the concept of automatic reinforcement to develop vocal responding in language delayed children.
• All children developed novel vocalizations without direct reinforcement after stimulus-stimulus pairing procedures were implemented.

• A series of studies have been conducted since 1996 with children with developmental disabilities and with low rate speech sound production and virtually absent vocal verbal behavior.

• Overall the results of these studies indicate that for some children this method is effective in increasing vocal productions but not for all children.

• The most recent study published related to the topic of SSP by Pettursdottir, et al. (2011), investigated the variables that might account for the successes and failures of the procedure in clinical applications.

• As an alternative to SSP Esch, Esch & Love (2009) demonstrated some preliminary benefit to a direct reinforcement procedure using lag schedules of reinforcement that support speech variability.

• Despite the mixed results to date, a recent replication and extension of the methods currently “in press” with the Journal of Applied Behavior Analysis by Miliotis, Sidener, Reeve, Carbone, Radar, Sidener & Delmolino, demonstrated a treatment effect with children with autism.

• For a current review of the literature on the SSP method see the Pettursdottir, et al. (2011) in The Analysis of Verbal Behavior.

• On the next slide is a description of the stimulus-stimulus pairing account of increased vocal production.

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**Stimulus-Stimulus Pairing**

The two-step process is as follows:

• **STEP 1.** The speech sounds and words heard by young children are frequently conditioned as reinforcers by correlation with parents’ positive reinforcers (e.g., food, caresses, smiles).

  - **STIMULUS** (speech sound) Paired **STIMULUS** (reinforcer)

• **STEP 2.** Subsequent production of these sounds by the child is strengthened by the product of his or her verbal behavior in the form of auditory stimuli. The closer the sound production is to matching the sounds that have been conditioned as reinforcers the greater the reinforcement (Schlinger, 1995; Sundberg, Michael, Partington, & Sundberg, 1996).

  - **SPEECH SOUND** PRODUCED → **WHAT IS HEARD** ACTS AS A **REINFORCER**
Stimulus-Stimulus Pairing of Vocalizations: A Systematic Replication

Lisa Rader · Tina M. Sidener · Kenneth K Reeve · David W. Sidener · Lara Delmolino · Adriane Millotis · Vincent Carbune

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Abstract  The current study replicated an enhanced stimulus-stimulus pairing (SSP) procedure used by Esch et al. (Journal of Applied Behavior Analysis 42: 423-225, 2009) for increasing vocalizations in children with autism. The enhanced SSP procedure consisted of pairing target vocalizations with high-preference items, interposed target and nontarget trials, an observing response, and the presentation of the vocalizations in “motherese” speech. Results showed substantial increases in target vocalizations above baseline levels and above nontarget vocalizations for two of three participants.

Keywords  Stimulus-stimulus pairing · Autism · Speech · Vocalizations

Introduction  For children with developmental disabilities who emit a variety of vocalizations, an array of instructional methodologies exists to promote the development of language (e.g., Lovass 2002). However, few interventions have been evaluated for children who do not exhibit vocal play and vocal imitation. Recently, a stimulus-
Figure 1. Within-session data on rate of target and non-target vocalizations for Mary (top panel), Paul (middle panel), and Aaron (bottom panel).

Figure 2. Target and non-target vocalizations during pre- and post-sessions for Mary (top panel), Paul (middle panel), and Aaron (bottom panel).
Figure 1. Within-session data on rate of target and non-target vocalizations for Mary (top panel) and Nik (bottom panel) during the experiment.
Teaching Procedures

The following are procedures to follow when attempting to take advantage of automatic reinforcement generated by stimulus-stimulus pairing:

1. Choose sounds that have the highest frequency in the repertoire of the child or words that may be particularly easy for the learner. Initial position consonant-vowel combinations that are associated with the names of items that act as reinforcers may be useful. For example “buh” for a child who is reinforced by bubbles. Transfer to the mand may be facilitated when targets are chosen this way.

2. Present a sound three times with about a 1-second delay between presentations. If you hear any approximation or any sound after any of the presentations, deliver the reinforcer immediately. If there is no sound or approximation, then deliver the reinforcer after the third presentation anyway.

   “buh” – 1 sec – “buh” – 1 sec – “buh” – 1 sec   REINFORCER
   *If “buh” is emitted at any point, deliver the reinforcer immediately*

   NOTE: According to recent research results (Miliotis et al., 2012), it would be recommended to reinforce after every single presentation.

   “buh” – 1 sec ----> REINFORCER

3. Graph results.
   - Percentage of ARP trials where target echoic was emitted
   - Another type of data is sound inventory
     - To track total frequency and variety of speech sounds made pre- and post-pairing
     - To track frequency of target ARP sound emitted during free operant conditions (i.e., at all times outside of the ARP sessions) pre- and post-pairing

James Video
Emily with Vince
Houston
Automatic Reinforcement Procedure

Child: A, B  Target:  Date:  Time: 2-31-43

1. Present target sound 3 times or greater with a 1 sec. delay between each presentation.
2. If the child releases the sound during any one of the presentations, remove and do so immediately.
3. If the child releases the sound during any one of the presentations, remove and do so immediately.
4. If the child makes any other sound during your presentation of the target sound, continue with presenting the target sound until you get to the final presentation, again removing any sound as soon as you would FTS even the target sound.
5. Take trial by trial on what the child will if anything is the same as the target answer.

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Percentage of Trials where Target Echoic was reached using ARP

Criteria: 80% of trials where the target sound was omitted

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<th>Date</th>
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The Catheron Clinic, Howard J. Catheron, BSMD and Associates
REFERENCES

STIMULUS – STIMULUS PAIRING PROCEDURE


Echoic Training

- Vocal imitation is an important skill in the development of vocal verbal behavior. Consequently, procedures have been developed to teach this skill. Using the parlance of Skinner’s analysis this method is called echoic training.

- Echoic training methods are designed to increase the number and intelligibility of vocal responses.

- Echoic targets can be selected from the high frequency sounds the learner produces during free operant procedures.

Selecting targets for echoic training:
1. Developmentally easy sounds
2. High frequency sounds the learner produces during free operant procedures
3. Sounds and words associated with reinforcers and for reinforcers for which the child mands
Echoic Teaching Procedure

1. Once echoic targets are selected, list on the probe data sheet echoic responses that will be taught first.

2. Begin the teaching procedure by having strong reinforcement available and visible to the learner to establish motivation for correct responding.

3. Present the echoic.

4. If the learner reaches parity, reinforce immediately.

5. If the learner does not reach parity, re-present the word 2-3 more times (based upon the learner).

6. At any point the learner reaches parity or a better response occurs, reinforce.

7. If the learner does not reach parity or give a better response following 2-3 echoic trials, drop to an easier echoic or motor imitation response and differentially reinforce.

Mattie Echoics
Rurai

ECHOIC DATA SHEET

<table>
<thead>
<tr>
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REFERENCES

Research Studies that Support the Teaching of the Echoic Response to Increase Overall Vocal Responding


Additional Procedures to Increase Vocal Productions

• Some learners do not produce vocalizations during sign mand training as has been reported in the previous review of the literature.

• Additional procedures may need to be added when teaching manual sign language manding.

EARLY SIGNS - NO VOCALIZATIONS
PROCEDURES TO ADD TO SIGN LANGUAGE TRAINING TO INCREASE VOCAL VERBAL BEHAVIOR

• The literature indicates that there are other procedures that may be used alone or along with alternative communication to increase vocal production:
  • Carbone, et al.,(2010) specifically demonstrated that sign mand training along with time delay and echoic prompting procedures increased vocal production and led to some adult form mand responses.
  • The echoic prompting procedure used by Carbone, et al., was similar to the method implemented by Drash, High & Tudor (1999) to increase echoic responses within the context of vocal mand training.
  • Gevarter, et al. (2016) found very similar results with speech generating devices.

Prompt Delay and Echoic Prompting Procedures

MO--------Sign Response--------Reinforce

ONCE RESPONSE IS STRONG
DO THE FOLLOWING

MO--------Sign Response ----(5 sec Delay)--- Vocalization---Reinforce

OR

MO--------Sign Response ----(5 Sec Delay)---NR--(Echoic Prompt)--- Vocalization--Reinforce

OR

MO--Sign Response ----(5 Sec Delay)--- NR-- (Echoic Prompt)----NR-----Small Reinforcer
The purpose of this study was to determine the effect of manual sign mand training combined with prompt delay and vocal prompting on the production of vocal responses in nonvocal children with developmental disabilities. A multiple baseline design across participants verified the effectiveness of this intervention. All participants showed increases in vocal responses following the implementation of the independent variables.

Key words: autism, mand, manual sign language, prompt delay, vocal responding.
### Prompt Delay and Echoic Prompting to Improve Vocal Production

**NICK**

<table>
<thead>
<tr>
<th>Reinforcer</th>
<th>Nick, Mattie &amp; Peter</th>
</tr>
</thead>
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<tr>
<td><strong>1. Ball</strong></td>
<td>______NR → Prompt Delay → ih</td>
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<tr>
<td><strong>2. Puzzle</strong></td>
<td>______NR → Prompt Delay → e</td>
</tr>
<tr>
<td><strong>3. Puzzle</strong></td>
<td>Yuu</td>
</tr>
<tr>
<td><strong>4. Ball</strong></td>
<td>______NR → Prompt delay → ___NR → Echoic Prompt → uh</td>
</tr>
</tbody>
</table>

**MATTIE**

| **5. Marble** | mmm → Prompt Delay → arpwuh |

**PETER**

| **6. Cracker** | ___NR → Prompt Delay → guh → PROMPT → guhkuh |

### Time Delay, Echoic Prompting and Differential Reinforcement of Vocalizations

**Bobby w/ Christy**

<table>
<thead>
<tr>
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<tr>
<td><strong>1. Music</strong></td>
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<tr>
<td><strong>2. Key</strong></td>
<td>ke</td>
</tr>
<tr>
<td><strong>3. Ball</strong></td>
<td>buh → TIME DELAY → buu → PROMPT → baw</td>
</tr>
<tr>
<td><strong>4. Ball</strong></td>
<td>bo → TIME DELAY → ___ → PROMPT → bo → PROMPT → baw</td>
</tr>
<tr>
<td><strong>5. Potty</strong></td>
<td>che → TIME DELAY → pohdeh</td>
</tr>
<tr>
<td><strong>6. Cereal</strong></td>
<td>shoh → TIME DELAY → ___ → PROMPT → shoh → PROMPT → shoh</td>
</tr>
<tr>
<td><strong>7. Key</strong></td>
<td>che → TIME DELAY → ke</td>
</tr>
<tr>
<td><strong>8. Jump</strong></td>
<td>bohguhmp → TIME DELAY → ___ → PROMPT → duhmp → PROMPT → duhmp → PROMPT → juhm</td>
</tr>
<tr>
<td><strong>9. Jump</strong></td>
<td>juhmp</td>
</tr>
<tr>
<td><strong>10. Cereal</strong></td>
<td>che → TIME DELAY → kyuu → TIME DELAY → ke → PROMPT → shoh → PROMPT → shieyoh</td>
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</table>
EFFECTS OF TIME DELAY AND ECHOIC

Treatment Procedure

VARIETY OF WORD APPROXIMATIONS

Variety of Word Approximations
Tony Word Approximations

“wahwah” for water,

“buu” for book,

“reahl” and “eahl” for cereal,

“ve” and “oove” for movie,

“puh” & “buhbul” for puzzle,

“cahn” & “ahnd” for candy

Ralph Word Approximations

“puh” for puzzle

“boh” and “bloh” for block

“ta” and “ain” for train

“pa” for turn page

“eht” for pretzel”
References


Shaping Vocal Productions

- When manual sign language and or time delay, differential reinforcement and echoic method produce increased vocal production it may still be necessary to shape the response to more closely approximate the adult form of the word.

- Cooper, Heron, & Heward (2007) describe a teaching procedure called shaping, which can be used to teach novel behaviors. Shaping involves differentially reinforcing successive approximations to a terminal behavior. This means that the practitioner must deliver reinforcement for all responses that share predetermined dimensions of the terminal behavior (i.e., are closer approximations to the terminal behavior) while withholding reinforcement for all responses that do not contain those dimensions.

- A study by Bourett, Vollmer and Rapp, (2004) demonstrated the use of a shaping procedure to increase vocal production.

- A more recent report by Newman, Reinecke & Ramos, (2009) demonstrated that a shaping procedure can be an effective method to improve vocal productions of children with autism.

Phonetic Transcription

- Transcription of the vocal productions during the shaping process can provide a standard on which to determine the sequence of successive approximations toward the adult form.

- Much of the theory about, rationale for, and procedures for transcription can be found in the linguistic literature related to the teaching of individuals with language disorders (e.g., apraxia) or individuals learning a second language.

- A transcript is defined as “an intentional representation of data translated from one medium to another as a necessary and convenient analytic strategy” (Müller & Damic, 2002, p. 301).

- The process of transcription involves 2 main components:
  - A listener who can accurately hear what is spoken
  - A notation system by which to record that which is heard (e.g., The International Phonetic Alphabet (IPA)}
• There are also various reasons within the behavior analytic literature to consider using transcription when teaching language.

  • Direct and repeated measures of behavior or the product of behavior serve as the data for analyzing the relationship between independent and dependent variables (Skinner, 1938, 1953). In this case, the vocal productions and their transcriptions provide a way to objectively measure the vocal product of the learner’s verbal behavior.

  • Second, a precise record of speech productions can serve as a method for determining incremental response requirements toward the adult form of the word during the shaping process.

• By identifying the adult form of the word as the terminal behavior and various combinations of speech sounds as successive approximations to that terminal behavior, the process of shaping can be applied to the development of vocal productions.

• Transcription of vocal productions allows the clinician to assess successive approximations to the adult form of the word. This permits the clinician to determine the next step, or the next successive approximation, that will be reinforced as a part of the shaping process.

• Visual display and analysis of data related to improvements of vocal productions based on transcriptive measurements provide a guide for making data-based decisions throughout the shaping process (Fuchs, Deno, & Mirkin, 1982).
Based on the reasons identified in both the linguistic and behavior analytic research, we have selected transcription of vocal productions as the dependent measure for vocal shaping procedures.

What follows are examples of the phonetic transcriptive alphabet we have designed, as well as a system for classifying vocal productions along a continuum from speech sounds to the adult form of the word.

### Modified Phonetic Transcription

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<thead>
<tr>
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Data Sheets

Developed by T. Kasper & V. Carbone
### Transcribing Vocalizations During Sign Manding

**Differential Reinforcement of Vocalizations During Sign Manding**

<table>
<thead>
<tr>
<th>Reinforcer</th>
<th>Prompt Level</th>
<th>Vocal response during initial attempt</th>
<th>Vocal response after Time Delay</th>
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**Sign Manding with Time Delay, Echoc Prompting and Differential Reinforcement of Vocalizations**

<table>
<thead>
<tr>
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<th>Date:</th>
<th>Session Time:</th>
<th>Instrcutor:</th>
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Developed by the staff of the Children's Clinic. May be copied and distributed with proper attribution.
<table>
<thead>
<tr>
<th>No.</th>
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<th>Vocal Response during initial attempt</th>
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Vocal Production Classification System

To determine progress toward production of the adult form of the word we have developed a classification procedure based upon the transcriptive record from each mand session.

1. Transcribe vocal responding using the phonetic transcriptive alphabet during mand training.

2. Classify transcriptions of vocal responses according to the following categories:

   – **Speech Sounds** ➔ Any vocal production that contains at least one phoneme or any combination of phonemes (not found in the adult form of the word) independent of the relevant controlling variables. (may include one sound contained in the adult form of the word)

   EXAMPLE: saying “buh” when manding for music or saying “moo” when manding for music.
• Word Approximations \(\rightarrow\) Any vocal production with at least 2 phonemes included in an adult form of an American English word and emitted more than once throughout the session under the control of relevant variables
EXAMPLE- saying “muhehk” when manding for music

• Intelligible Word \(\rightarrow\) Any word that effectively controls the behavior of an unfamiliar listener without contextual cues but does not include all phonemes of adult form under the controls of relevant variables
EXAMPLE- saying “muusehk” when manding for music.

• Adult Form \(\rightarrow\) Any word that contains all the phonemes of the adult form under the control of relevant variable
EXAMPLE- saying “muusihk” when manding for music.

(developed by V. Carbone, T. Kasper, L. O’Brien, M. Janecky, & G. Zecchin)
Figure 1. The average percentage of initial vocal responses emitted as a speech sound, word approximations, intelligible words, and adult word forms per month for Billy.

Figure 2. The average percentage of vocal productions that improved after time delay and echoic prompting for Billy. TD = Time Delay, EP for ST = Echoic Prompting for Specific Targets, PB = Phonological Breakdowns, TD & EP = Time Delay & Echoic Prompting.
**Figure 3.** Average percentage of initial vocal responses emitted as a speech sound, word approximations, intelligible words, and adult word forms per month for Howard.

**Figure 4.** Average percentage of vocal productions that improved after time delay and echoic prompting per month for Howard.
Teaching Procedures

1. The teacher has identified the baseline vocal production of all mands that may be emitted during that session.

2. A variety of reinforcers were made available but out of sight; approximately 5 reinforcers were presented at a time, clearly spread out around the instructor where Matthew could see them.

3. The instructor waited for Matthew to declare motivation for an item (e.g., looking at or reaching for an item).

4. Diagram on the following slide describes the steps of the shaping procedure.

5. On Slide # 111 is a narrative description on the procedure.

---

Successive Approximations

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<th>April 11</th>
<th>April 23</th>
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<td>buhboo - bubuh - buhbuul</td>
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### REVIEW OF TEACHING PROCEDURES TO IMPROVE SPEECH INTELLIGIBILITY

<table>
<thead>
<tr>
<th>PROCEDURE</th>
<th>TACTICS</th>
<th>DATA RECORDING</th>
<th>GRAPHING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Manding Manual Sign Language</td>
<td>CANDIDATE: ALL LEARNERS</td>
<td>• What the learner says</td>
<td>• Rate of spontaneous vs. prompted</td>
</tr>
<tr>
<td>(When Appropriate)</td>
<td>1. Run many trials per day across many reinfores and MO's with sign language and vocals</td>
<td>• Prompt level needed to evoke each mand</td>
<td>• Prompt level needed per reinforcer</td>
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<tr>
<td></td>
<td></td>
<td>• Transcription of sounds</td>
<td>• Classification of sounds</td>
</tr>
<tr>
<td>2. Time Delay &amp; Echoic Prompting</td>
<td>CANDIDATE: POOR INTELLIGIBILITY</td>
<td>• Vocal approximations when manding on first attempt</td>
<td>• % of clear vocal approximations on 1st mand attempt</td>
</tr>
<tr>
<td>and Differential Reinforcement</td>
<td>1. Reinforce clear articulation of first mand attempt</td>
<td>• Vocal approximations that improve when running echoic procedure</td>
<td>• % of vocal approximations that improve during time delay &amp; echoic trials</td>
</tr>
<tr>
<td>During Manding</td>
<td>2. Delay reinforcement and provide up 3-5 echoic prompts for better articulation</td>
<td>• Transcription of sounds</td>
<td>• Classification of sounds</td>
</tr>
<tr>
<td>3. Automatic Reinforcement</td>
<td>CANDIDATE: FEW SPEECH SOUNDS PRODUCED</td>
<td>• All sounds or words said during each trial</td>
<td>• % of trials in which the target sound occurs</td>
</tr>
<tr>
<td>Procedure</td>
<td>1. Conduct sound inventory</td>
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<td></td>
<td>2. Select a target sound from:</td>
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<td></td>
<td>• Most often sound heard during sound inventory</td>
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<td>• Developmentally appropriate sound</td>
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<td>3. Pair the sound with reinforcement:</td>
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<td>• Present target 3 times then provide reinforcement</td>
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<td>4. Differentially reinforce if the sound is produced</td>
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<tr>
<td>4. Reinforcing all Vocalizations</td>
<td>CANDIDATE: FEW SPEECH SOUNDS PRODUCED</td>
<td>• Transcription of speech sounds</td>
<td>• Frequency of vocalizations</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td>• Variety of vocalizations</td>
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<tr>
<td></td>
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<td>• Classification of sounds</td>
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</table>
# TEACHING PROCEDURES TO IMPROVE SPEECH INTELLIGIBILITY

<table>
<thead>
<tr>
<th>PROCEDURE</th>
<th>TACTICS</th>
<th>DATA RECORDING</th>
<th>GRAPHING</th>
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<tr>
<td>5. Echoic Procedure</td>
<td><strong>CANDIDATE: MANY SPEECH SOUNDS; POOR ARTICULATION</strong>&lt;br&gt;1. Select targets from mands, sound inventory, and ARP produced sounds&lt;br&gt;2. Show &quot;promise&quot; reinforcer&lt;br&gt;3. Possible alternative procedures&lt;br&gt;   a. Present the word 3-5 times&lt;br&gt;   b. Present easy motor movements prior to target&lt;br&gt;   c. Present easy words within the same syllable form prior to target&lt;br&gt;   d. Breakdown words using a backward chain</td>
<td>• &quot;Yes/No&quot; cold probe on the adult form&lt;br&gt;• Mark on the card the highest level of the shell</td>
<td>• Weekly cumulative number of adult forms that have met criteria</td>
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<tr>
<td>6. Kaufman Procedure</td>
<td><strong>CANDIDATE: MANY SPEECH SOUNDS; POOR ARTICULATION</strong>&lt;br&gt;1. Conduct Kaufman assessment and select appropriate targets&lt;br&gt;2. Begin teaching session:&lt;br&gt;   a. Show a &quot;promise&quot; reinforcer&lt;br&gt;   b. Present the word approximation at the level where parity was last achieved&lt;br&gt;   c. Run up and the down the shells&lt;br&gt;   d. Differentially reinforce&lt;br&gt;   e. Other procedures:&lt;br&gt;   • Present easy motor movements prior to target&lt;br&gt;   • Present easy words within the same syllable form prior to target</td>
<td>• &quot;Yes/No&quot; cold probe on the adult form&lt;br&gt;• Mark on the card the highest level of the shell</td>
<td>• Weekly cumulative number of adult forms that have met criteria</td>
</tr>
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**General References**


