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## **Acquisition of Picture Exchange-Based vs. Signed Mands and Implications to Teach Functional Communication Skills to Children with Autism**

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A literature review was conducted to describe important concepts involved in functional analysis of verbal behavior as well as to evaluate empirical research findings on acquisition of picture exchange-based vs. signed mands to suggest instructional implications for teachers and therapists to teach functional communication skills to children with autism. Research findings indicate that children with autism acquire picture exchange responses to mand for reinforcing items more easily and rapidly than signed responses. There is also a strong relation between motor imitation, matching skills and sign language acquisition. It is suggested that both motor imitation and matching skills be examined to teach manual signs to children with autism. Speech is the most common response form, but writing, typing, signs, pictures, gestures, or eye gaze should also be considered for manding. A decision making process is proposed to determine a proper communicative form considering abilities and environmental conditions of a child concerned.

*Keywords:* Verbal Behavior, Mand, Function, Picture Exchange, Signs, Autism

The National Research Council (2001) conducted a comprehensive evaluation on effects of various communication and language interventions for children with autism and recommended functional communication applied across natural settings as a primary focus of early intervention for children with autism. The report indicated intervention programming should be based on the assumption that most children with autism can learn to speak and communicate.

If young children with developmental disabilities do not develop functional communication skills in a timely manner, it has been known that they develop various forms of negative or aberrant behavior (Sigafoos, 2000; Sundberg & Partington, 1998). In fact, a significant number of children with developmental disabilities engage in aberrant behaviors such as aggression, self-injury, stereotyped movements, and extreme tantrums (Downing, 2005; Sigafoos, 2000). In addition,

the level of communicative competence attained by children with autism is an important predictor for their education performance. The presence of functional language use and spontaneous communication before the age of five continues to be a good prognostic indicator of cognitive development, language, social and adaptive skills, and academic achievement (National Research Council, 2001, p. 47).

Therefore, it is important to understand the functional analysis of verbal behavior identified by Skinner (1957) that are critical for the daily use of language in the child's natural environment (Koegel & Koegel, 2006; Sundberg & Partington, 1998). Language programs incorporating Skinner's (1957) analysis of verbal behavior have been successful in improving communication skills of children with autism and other developmental disabilities (Sundberg & Partington, 1998).

The purpose of this paper is twofold. First, it is to describe important concepts involved in functional analysis of verbal behavior. Also, this paper is to evaluate empirical research findings on acquisition of picture exchange-based vs. signed mands to suggest instructional implications for teachers and therapists to teach functional communication skills to children with autism. Research on other important functions of verbal behavior such as tact and intra-verbal are beyond the scope of this paper.

## Methods

To identify appropriate empirical research articles, the first author searched an electronic database, EBSCOhost including PsycInfo, ERIC, and Academic Search Premier. The keywords such as mand, picture exchange, signs, selection-based, topography-based, and children with

autism were used to initially screen potential articles. Then, the author manually searched and identified the empirical studies (N= 5) with a set of criteria: (a) employ an empirical research method; (b) picture exchange-based and manual sign communication training as an independent variable; (c) acquisition of mands as dependent variable; (d) include children with autism as participants, and (e) occur in the US and be published in a peer-reviewed journal. Explanations of main principles and concepts of functional analysis of verbal behavior are based on the books referenced (Cooper, Heron, & Heward, 2007; Downing, 2005; Sundberg & Partington; 1998) as well as from the first author's college teaching experience.

## Verbal Behavior

Skinner (1957) proposed that language is learned behavior, and that the same basic principles of behavior that constitute the foundation of applied behavior analysis apply to verbal behavior. Skinner (1957) stated, "What happens when a man speaks or responds to speech is clearly a question about human behavior" (p. 5). Skinner noted that humans acquire their ability to talk much in the same way that they learn nonverbal behaviors (reaching, grasping, crawling, etc.).

Skinner chose the term "verbal behavior" for his functional analysis of language because he found the term "speech" too limiting, and the term "language" too general (Sundberg, 2014). His usage of this term includes all forms of communication such as sign language, icon exchange (e.g., Picture Exchange Communication System), written language, gestures, or any other form that

communicative responses might take (Sundberg, 2014).

It is noted that verbal behavior is not a synonym of vocal behavior. Saying “water, please” to get water is an example of vocal verbal while pointing to a glass of water to

get water is non-vocal verbal. Both of them are verbal behavior.

### Major Functions of Verbal Behavior

The following table explains major functions of verbal behavior. Each function is explained relating to its controlling environmental variables.

Table 1. Major Functions of Verbal Behavior

Function	Environmental Variables
Mand (request)	Mand is a function of verbal response in which a speaker asks for what he needs or wants. The mand function of response is under the functional control of motivating operations and specific reinforcement. This is the only type of verbal behavior that directly benefits the speaker. Mands are the first verbal function acquired by a human child. For example, saying “water” because you want water.
Tact (expressively label)	Tact is a function of verbal response in which a speaker names or identifies objects, actions, events, etc. For example, saying “water” because you see water. Tact is a type of verbal function in which a speaker names things (nonverbal discriminative stimuli) that the speaker has direct contact with through any of the sense modes.
Intraverbal (Asking/Answering a question)	Intraverbal is a function of verbal response in which a speaker answers questions or has conversations. The speaker’s responses words are controlled by other words. For example, saying “water” when a teacher asks, “what do you want to drink?” The intraverbal is a type of verbal function in which a speaker differentially responds to the verbal behavior of others. All verbal functions except mand produce generalized conditioned reinforcement (e.g., praises, approval).
Echoic	Echoic is a function of verbal response in which a speaker repeats what is heard. For example, saying “water” after someone else says water. The echoic function is controlled by a verbal discriminative stimulus that has point-to-point correspondence and formal similarity (i.e., the same sense mode) with the response.
Textual (reading)	Textual is a function of verbal response in which a child reads written words. For example, saying “water” because a child sees the written word “water.” Textual behavior is reading, without any implications that reader understands what is being read. The textual operant has point-to-point correspondence but not formal similarity, between the stimulus and the response product.
Transcription (dictation)	Transcription is a function of verbal behavior in which a child writes and spells words spoken to him/her. For example, writing “water”

because a child hears “water” spoken. Transcription consists of writing and spelling words that are spoken (taking dictation). Like textual function, there is point-to-point correspondence between the stimulus and the response product, but no formal similarity.

**Functional Analysis of Verbal Behavior**

The function of a verbal response is not classified or defined by its topography or form alone. It is determined based on the relationship between the response and the relevant environmental variables.

The following table shows how each response is analyzed in relation to its environmental variables to determine the function.

Table 2. Functional Analysis of Verbal Behavior

Antecedent	Response	Consequence	Function
Playing for an hour and become thirsty; Seeing the teacher holding a pitcher of water	“water please”	The teacher fills a glass with water and hand it over to the child.	Mand
A child looks out of the window and saw a bird	“look, a bird.”	The teacher says, "Right!"	Tact
Seeing his friend and says	“how are you?”	The friend returns, “good and you.”	Intra-verbal
A teacher says to a child, “apple”	The child repeats “apple”	The teacher says “good.”	Echoic
By seeing, “apple” written,	The child reads “apple”	The teacher says “good.”	Textual

**Decision Making Process for Communication Forms**

Before beginning any communication intervention, the assessment should be conducted and a decision should be made as to what communication form will be used (see Figure 1). There are five general options for selecting a form of communication for a child: (a) speech, (b) writing and typing, (c) sign language, (d) picture pointing or exchange systems, and (e) gestures and eye gaze.

Speech is the most preferred form of communication for a number of reasons. First, speech is the most common form used

by a large speaking community that can easily model, prompt and reinforce vocal words without special training. Second, speech is potable so it does not need additional device or equipment.

While less preferred than speech, writing, spelling out words, or typing would be a choice for a child who can’t imitate sounds or words. There are a number of children with autism who have limited speech, but have demonstrated the ability to write and type to communicate.

For a child who has pretty good literacy skills and fine motor skills, writing, spelling out,

and typing would be an effective communication form.

If a child cannot imitate sounds or words, it will be difficult to immediately teach him vocal language. If a child can imitate some actions, but can't imitate sounds or words, then sign language may be the most appropriate communication form. The use of sign language with children with autism and other developmental disabilities has proven to be an effective way to engage in functional communication. There are some advantages of sign language that need to be considered in the assessment process. Sign language is portable and free from mechanical support. It does not require additional device or equipment like speech. In addition, sign language is a more sophisticated language system as a topography based language. In topography based language there is a different word for each object, action, letter, etc. A topography based language system is contrasted with a stimulus-selection based language system where the response topography is the same

(e.g., a pointing, gazing), but stimulus identified is different as in a picture communication board (Sundberg & Partington, 1998).

If a child cannot imitate any actions due to his severe physical impairments, then a picture exchange system may be most appropriate (Sundberg & Partington, 1998). If a child cannot understand conventional symbols (words, signs, & pictures) but able to move some part of the body, non-symbolic forms of response (gestures, eye gaze) would be appropriate.

Figure 1 summarizes the decision-making process of determining a proper communication form for a child. Whenever possible, the child should be moved to upward in the decision making process. The first author conceptualized "the Decision Making Process" through analyzing and integrating information from the books referenced (Cooper, Heron, & Heward, 2007; Downing, 2005; Sundberg & Partington; 1998).

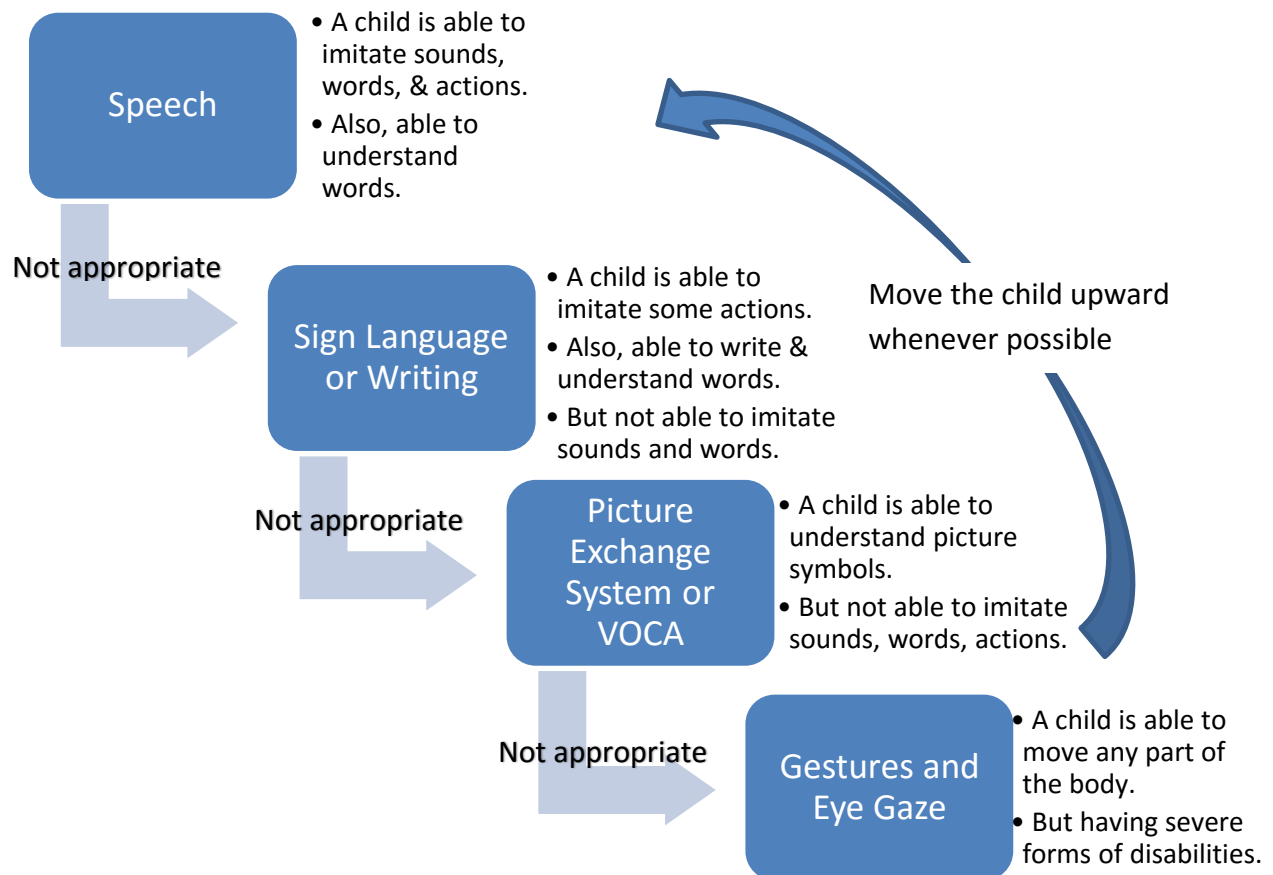


Figure 1. Decision Making Process for Communication forms

### Teaching Mand Function

Mand is a verbal function in which a person is making demand, command, or request (Skinner, 1957). The manding response is usually reinforced by providing whatever is demanded. It is the first type of verbal function to teach children with autism and other developmental disabilities (Sundberg & Partington, 1998; Downing, 2005). This function is taught first because the mand is a unique type of language function that allows the child to understand the link between his verbal action and the delivery of reinforcers that meet his basic desires. There should be numerous opportunities for young children to make requests on a daily basis in all activities so

they can have considerable practice for the mand skills to develop. Without an appropriate mand repertoire, a child is not able to actively obtain reinforcers that meet their basic desires.

There are five major categories of stimuli that meet basic human desires: edible, activity, tangible, sensory, and social (EATSS). Teachers and therapists usually teach mands for a child to obtain those stimuli (positive reinforcement function). However, it is equally important to teach mands to escape, protest, or reject those stimuli when it becomes aversive to him (negative reinforcement function).

Shillingsburg, Powell, and Bowen (2013) successfully taught five children with

autism to mand for the removal of a blocking stimulus. All participants learned to mand for the removal of the stimulus so they can have access to a preferred item or activity.

Teachers need to frequently conduct preference surveys with caretakers and the child to find out the value of reinforcers. The value of reinforcers may change many times throughout the day, week, and month. Each child is differently motivated, so preference or reinforcement assessment should be individually conducted. Authors recommend DeLeon et al's chapter (2014) for more detailed information on preference and reinforcement assessment.

Mands also allow a child to learn a speaker's role of communication, thus giving the child some control of the social environment. If mands fail to develop in a typical manner, negative behaviors such as tantrums, aggression, social withdrawal, or self-injury that serve the mand function commonly emerge (Cooper, Heron, & Heward, 2007).

Vocal words are of course the most common response form, but sign language, pictures, gestures, or eye gaze can also be used for manding. For example, a child can be taught use a symbol (e.g., a manual sign, vocalizing the sound "wa," or pointing to a picture for "want") in combination with the item, person, or activity of their choice (Downing, 2005, p. 148). Authors recommend Downing's book (2005) to learn more about specific the procedures and classroom examples for teaching different language forms to children deficient vocal verbal skills.

A typical child can learn manding for basic desires like edible and tangible reinforcers, then the child learns to mand for

actions (verbs), attention, removal of aversive stimuli, movement to certain locations (prepositions), certain properties of items (adjectives) and actions (adverbs), verbal information (WH- questions), and so on (Cooper, Heron, & Heward, 2007).

A number of research have demonstrated that children with autism successfully acquire and generalize more advanced manding skills such as WH-questions. According to Marion et al. (2012), two children with autism learned to mand, "where" and generalized it to other activities and situations. Another study (Lechago, Howell, Caccavale, & Peterson, 2013) also reported that children with autism learned to mand "how" and generalized it across motivating operations and response topographies.

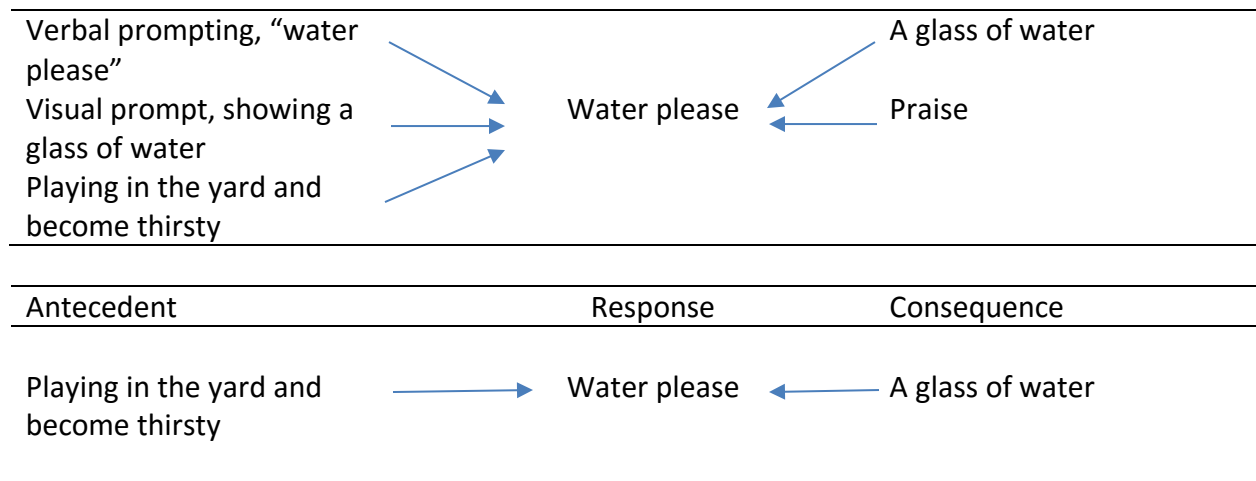
#### **Transfer Procedure**

Individual functions explained above are considered to be functionally independent from each other. However, they are interrelated in real life situations such that verbal behavior can be taught using transfer procedure. In transfer procedure, a verbal response initially is taught using multiple prompts with different types of reinforcers. For example, a child saying "water please" can be initially taught by verbal and visual prompt of water when the child become thirsty. Once the verbal response of "water" is consistently evoked by the multiple prompts and reinforcers, it needs to transfer the control to a pure motivating control free from additional prompts (see Table 3 below). For more detailed information about fading multiple prompts, read the work by Sundberg and Partington (1998).

Table 3. Transfer Procedure from Multiple Control to a Pure Mand

Antecedent	Response	Consequence
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**Picture Exchange-Based vs. Signed Mands**

Special educators frequently use two language forms, picture exchange system and manual signs to teach mand function to children with autism and other developmental disabilities deficient in vocal verbal repertoires. Often decisions to use one system or the other are based on the personal preference of the teacher or trainer, rather than on the child's individual abilities, needs, or on any empirical evidence supporting a specific system (Sundberg & Partington, 1998). This paper highlights significant findings from current empirical research conducted with individuals with autism and developmental disabilities.

Tincani (2004) compared the effects of Picture Exchange Communication System (PECS) and sign language training on the acquisition of mands (requests for preferred items) of children with autism.

For one participant (i.e., Jennifer, 6 year-old), PECS training produced a higher rate of independent mands than sign language training. The study revealed Jennifer's motor imitation skills prior to the intervention was weak. She correctly imitated only 20 percent of the motor movement attempted in the pre-baseline imitation assessment.

However, Carl (5 year-old) emitted independent mands more often during sign language training than with training. Carl's preexisting motor imitation skills were better than Jennifer's. He imitated correctly 43 percent of the attempted motor movements in the pre-baseline imitation assessment.

The results suggest that acquisition of picture exchange and sign language may vary depending on the child's motor imitation skills prior to intervention. It is noted that for learners without hand-motor imitation skills, picture exchange-based system may be more appropriate for initial mand acquisition. For learners who have moderate hand-motor imitation skills, sign language training may be equally appropriate (Tincani, 2004)

The percentage of independent mands by the two children throughout the study is shown in the Figure 2 below.

Gregory, DeLeon, and Richman (2009) conducted a study with six children with autism and intellectual disability to find correspondence between existing skills and acquisition of two forms of communicative responses. Existing matching and motor-imitation skills were assessed before the training to request the preferred items using picture exchange communication system

and manual signs. Three participants displayed both skills and rapidly acquired both communicative response forms. Three others displayed neither skill but one child mastered exchange-based responses but not manual signs, and neither of the other two children easily acquired either response form (see Figure 3 below).

The findings of this study indicate children with autism and developmental

disabilities acquire picture exchange responses to request for reinforcing items more easily and rapidly than signed responses. Also, this study shows the relation between matching skills and sign language acquisition is strong. It is suggested that that both motor imitation and matching skills are prerequisites for acquisition of manual signs.

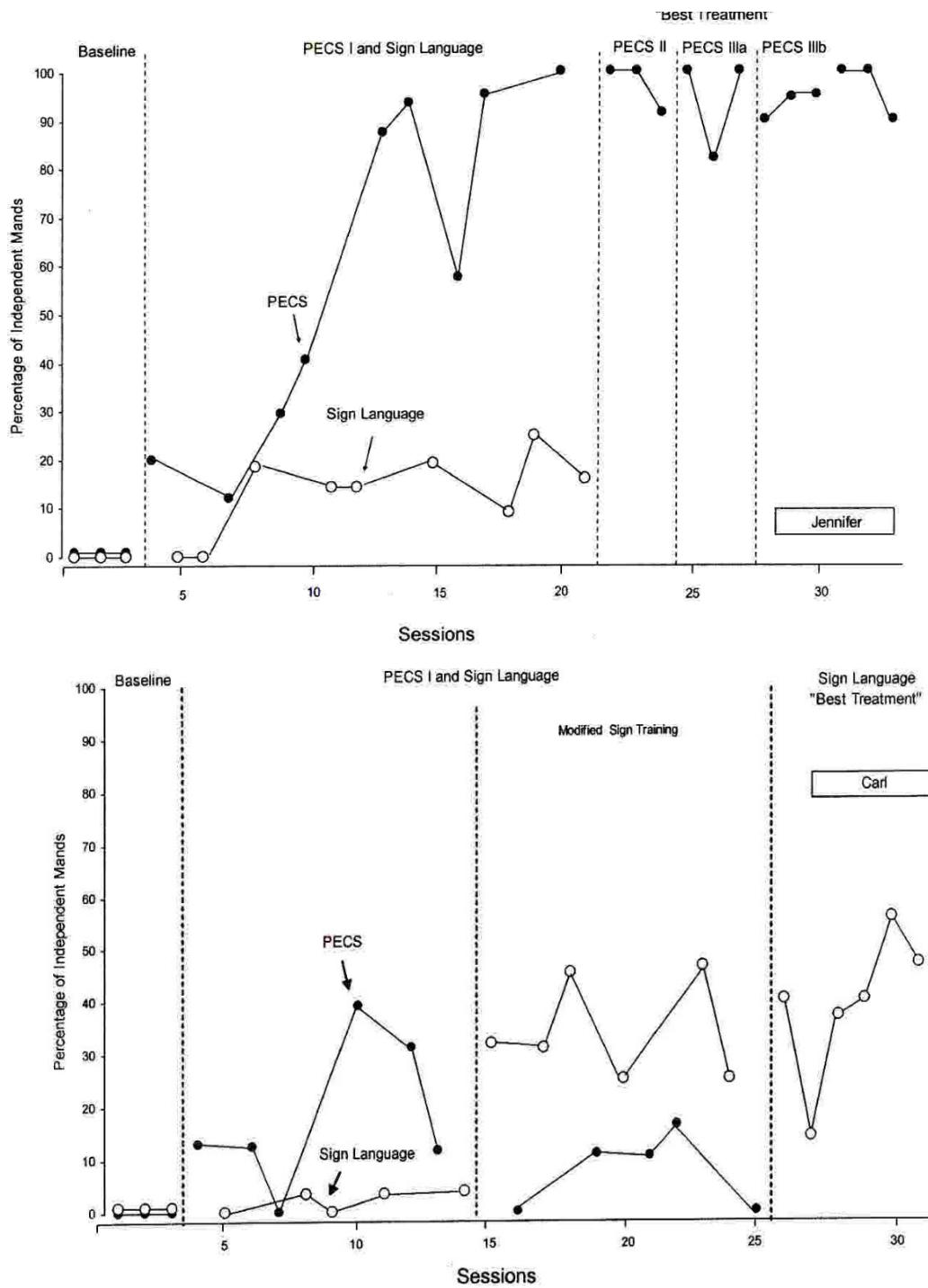


Figure 2. Percentage of Independent Mands during Sign Language and PECS Training, and Best Treatment.

From. Tincani, M. (2004). Comparing the picture exchange communication system and sign language training for children with autism. *Focus on Autism and other Developmental Disabilities, 19*, p. 160.

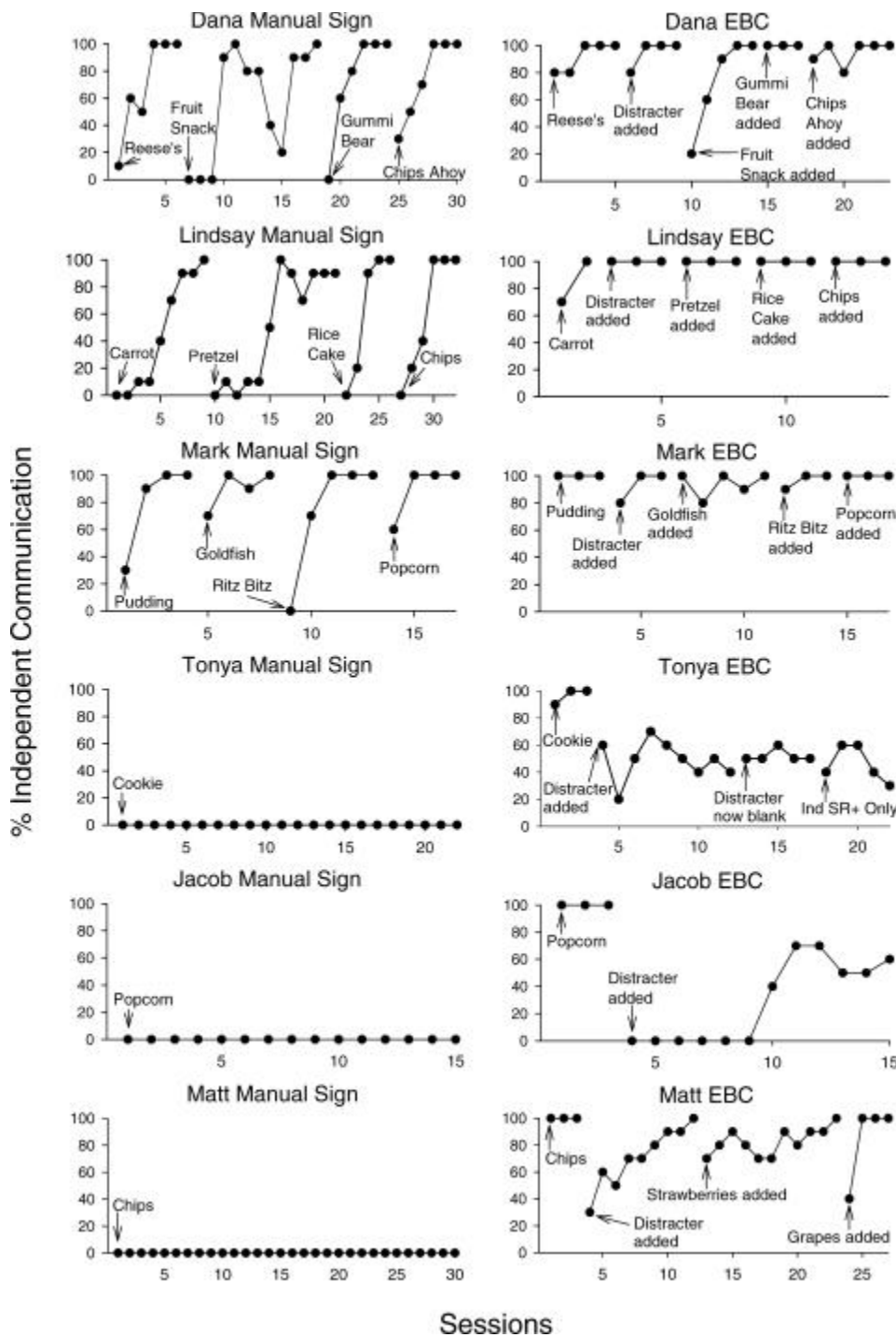
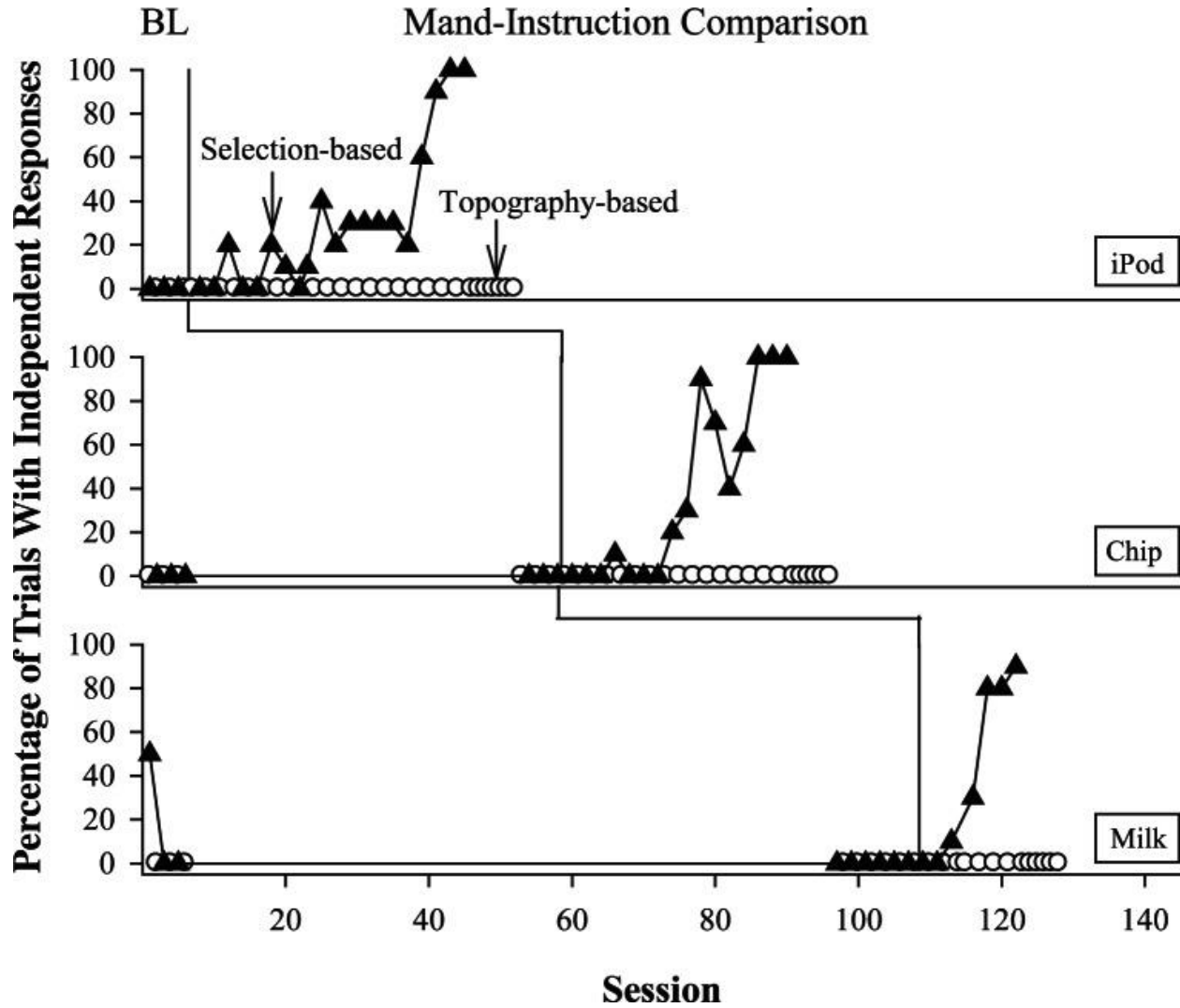


Figure 3. Results of manual sign training (left) and exchange-based communication training (right) for all participants.

From Gregory, M. K, DeLeon, I. G, & Richman, D. M. (2009). The influence of matching and motor-imitation abilities on rapid acquisition of manual signs and exchange-based communicative responses. *Journal of Applied Behavior Analysis*. 42, 399-404.

Barlow et al. (2013) conducted a similar study to compare acquisition of picture exchange-based and signed mands with three children with autism. All three children produced no intelligible vocal-verbal behavior and had limited exposure to sign language or PECS.

The study found that all three children acquired the picture-exchange responses but none of them developed signed mands (see Figure 4 below). The authors explained the three children failed to acquire signed mands because they did not have imitative motor repertoire (Barlow et al., 2013).



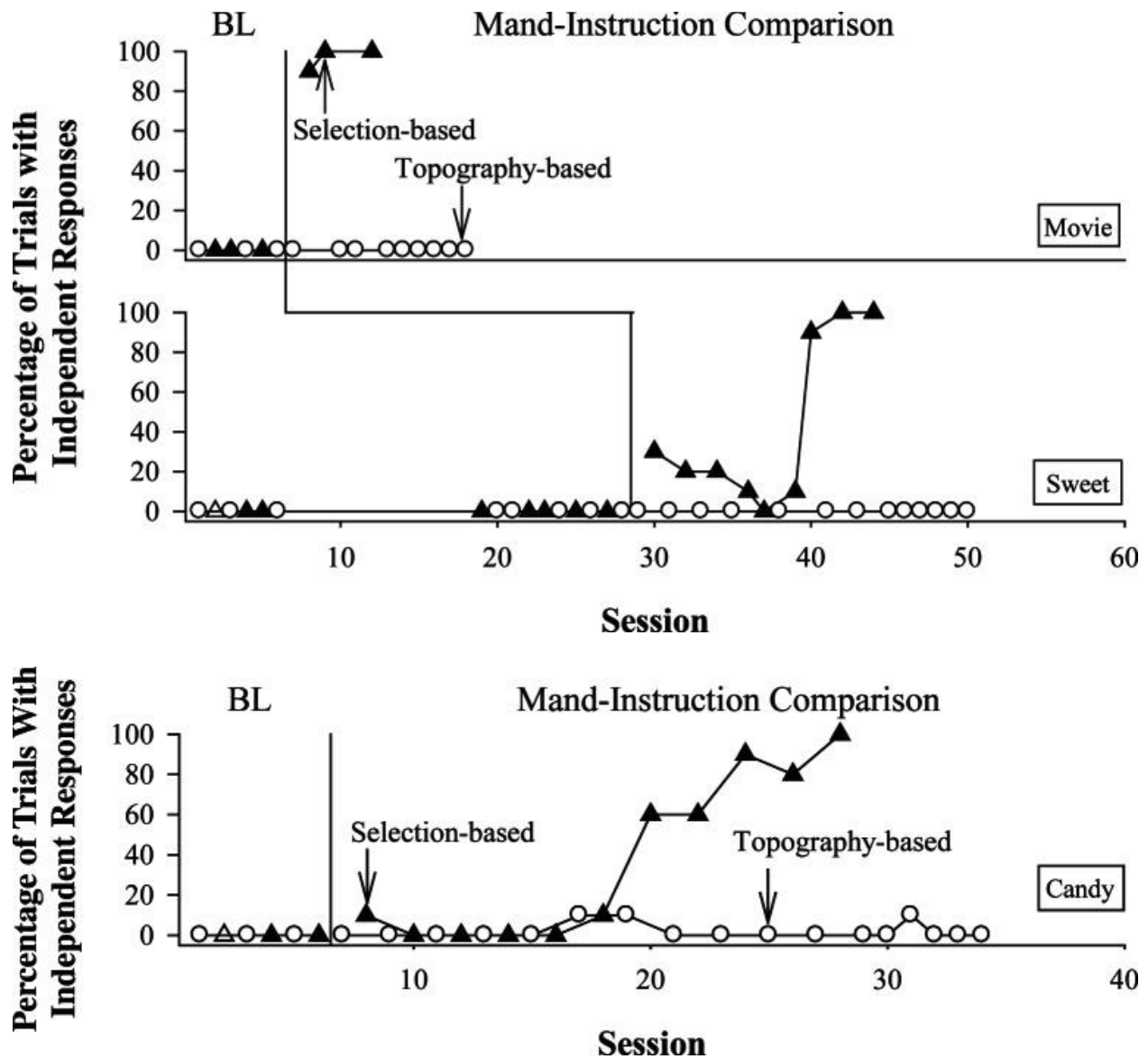


Figure 4. The percentage of trials Joey, Sam Wyatt engaged in independent selection-based (SB) and topography-based (TB) mands.  
 From Barlow, K. E., Tiger, J. H., Slocum, S. K., & Miller, S. J. (2013). Comparing Acquisition of Exchange-Based and Signed Mands with Children with Autism. *The Analysis of Verbal Behavior*, 29(1), 59–69.

Similar findings were also reported with adults with severe developmental disabilities. Adults with severe developmental disabilities more rapidly acquire and likely to use PECS to request for reinforcing items than using manual signs (Chambers & Rehfeldt, 2003; Ziomek & Rehfeldt, 2008).

Moreover, requesting responses established using PECS were generalized across settings and communicative partners (Ziomek & Rehfeldt, 2008).

Despite positive research findings on selection based systems including PECS, Michael (1985) suggested that individuals

with intellectual disabilities may acquire topography based systems including manual signs more readily. Specifically, he noted that selection based systems require a developed scanning, discrimination, and selection repertoires, which are frequently absent among individuals with intellectual disabilities. However, these prerequisites are not required for effective use of manual signs.

Teachers must consider advantages and disadvantages of each communication system suggested by Sundberg and Sundberg (1990).

- Picture exchange-based systems require the use of equipment (e.g., a micro-switch or a card book), which is not physically available at all times, whereas sign systems require no additional equipment.
- Some words (e.g., verbs) are difficult to depict through symbols or pictures, but American Sign Language (ASL) provides a standard gesture for nearly all English-language words.
- The listener must remain close to the speaker in order to see and respond to picture exchange systems. By contrast, signing can be performed and recognized from a distance.

### **Conclusions and Recommendations**

One of the most significant characteristics of children with autism and developmental disabilities is delayed or impaired communication development, that has been suggested to be associated with emergence of aberrant behaviors such as aggression, self-injury, stereotyped movements, and extreme tantrums. Intervention programs incorporating functional analysis of verbal behavior have been successful in improving communication skills and reducing aberrant behaviors of children with

developmental disabilities (Durand & Carr, 1991).

Mand function is the first type of communication function to teach a child with autism because it delivers reinforcers that meet basic human needs. Children with autism need to be taught to obtain desirable stimuli. They also need to be taught to escape, protest, or reject aversive stimuli common in their natural environments. If mands are properly taught, negative behaviors such as tantrums, self-injury, aggression, and other challenging behaviors that serve the communicative function can be avoided (Durand & Carr, 1991).

Research findings indicate that children with autism and developmental disabilities acquire picture exchange responses to mand for reinforcing items more easily and rapidly than signed responses. Also, there is a strong relation between matching skills and sign language acquisition. Perspective special education teachers commonly ask a question like "which alternative communication system is the best for non-verbal children- PECS or sign language?" A feature-matching process is needed to further define this kind of question. The process involves matching the skills of a child with the features of a given alternative communication system in consideration of environmental demands. Individuals involved in the process should be familiar with the advantages and disadvantages of two alternative communication systems. For instance, one advantage of sign language is its portability and the size of vocabulary is potentially unlimited. However, a child with poor fine motor skills and weak memory may have difficulty with learning and using manual signs. In addition, if the child relies solely on sign language, his communication partners are limited to those people who are familiar with sign language.

Many children with autism and other developmental disabilities can imitate some of the fine or gross motor movements of others. These abilities can be used as a communication form to teach mand function. Motor imitation might be easier to teach because teachers can use physical prompting and fading procedures. Teachers can guide the child's hands physically to the appropriate position and then fade out their physical prompts.

Speech is of course the most common response form, but writing, typing, signs, pictures, gestures, or eye gaze should also be considered for manding. For non-verbal children, it is recommended to consider more sophisticated symbolic communication forms such as writing, typing, and signs first before choosing non-symbolic forms. If symbolic forms are not possible, then non-symbolic forms of communication such as gestures and eye gaze should be considered. The decision making process (Figure 1) discussed in this paper can be used to determine which communication form will be used before beginning any communication intervention. Each child is different in terms of his abilities (cognitive, visual, and motor), communicative forms, and environmental conditions. Therefore, individualized assessment and evaluation of those variables are essential to teach functional communication skills to children with autism and other developmental disabilities. We acknowledge that the findings of the review regarding "acquisition of picture exchange-based vs. signed mand" were based on a limited number of research studies (N= 5) and call for more empirical research on the topic.

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