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An Evaluation of Static versus Dynamic Instructional Stimuli on Generalization of Action Tacts

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An Evaluation of Static versus Dynamic Instructional Stimuli on Generalization of Action Tacts

by

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Abstract

An Evaluation of Static versus Dynamic Instructional Stimuli on Generalization of Action Tacts

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Researchers have noted that children with autism have difficulty generalizing responses to stimuli outside of those used in training. Some studies have analyzed ways to promote generalization such as using concurrent training or using stimuli that would be most similar to those found in the natural environment. Little research, however, has investigated strategies for promoting generalization of action tacts. The current study investigated two different types of stimulus delivery forms: static (i.e., pictures), which are typically used during instruction, and dynamic (i.e., videos), which may provide stimulation closer to that which a child would encounter in a natural setting. Findings suggest videos are a more effective and efficient method for promoting generalization of action tacts to the natural environment. Results may provide practitioners news ways to teach tacting actions for individuals with autism.

Keywords: tacting, generalization, actions, autism, children

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Dedication

This thesis is dedicated in loving memory of my father, Wavie Fentress III. He passed when I was young, but I truly would not have made it this far without him. Every decision I've made and struggle I've pushed through has been for him. He is missed every day.

An Evaluation of Static versus Dynamic Instructional Stimuli on Generalization of Action Tacts

Autism is a neurodevelopmental disorder characterized by behavioral excesses and deficits. Skill deficits are common in the areas of social interaction and communication (American Psychiatric Association, 2013; Horovitz & Matson, 2010). For parents of children with autism, language and communication impairments are often among the first concerns that arise (Austin & Carr, 2000). Therefore, teaching functional communication skills to individuals with autism is critical. A core feature of communication training involves targeting specific verbal skills.

In his landmark 1957 book, Skinner introduced the term "verbal behavior," defining it as behavior that is reinforced through the mediation of another person (pp. 2). This conceptual analysis built upon his previous experimental work on *operant behavior,* defined as a class of responses that have common consequences (pp. 20). In *Verbal Behavior*, Skinner argued that language, like other forms of behavior, is influenced by environmental factors. He introduced a taxonomy for classifying verbal operants, which together form the foundation for complex verbal behavior. These elementary verbal operants include echoic, transcription, mand, tact, intraverbal, and textual behavior (Skinner, 1957; Sundberg & Michael, 2001).

Of interest in this paper is the *tact*, which is a verbal response under the control of an antecedent nonverbal stimulus and consequent generalized conditioned reinforcer (Skinner, 1957, pp. 81). In layman's term, tacting is often referred to as labeling, although the term tact refers to the entire relation of the referent, response and consequence, whereas the term label refers to the response alone (Miguel, 2016). One could tact an object (e.g., rock), a property of an object (e.g., hard), an event (e.g., music festival), a smell (e.g., freshly baked bread), a sensation (e.g., itchy) and so on. According to Skinner, the things we talk about are the stimuli that make up our environment (pp. 81). Tacts are one of the fundamental building blocks necessary for complex verbal interaction. An individual's ability to define and describe the environment provides a foundation for conversation and increases the probability of effective communication. Moreover, a child's tact repertoire is frequently used as an important indicator of language ability. For example, assessments such as the Preschool Language Scales-5 (PLS-5; Zimmerman et al., 2011) and Expressive One-Word Vocabulary Test (EVT; Brownell, 2000) measure the tact repertoire, and are often used to inform placement decisions for individuals with disabilities. It is no surprise then that tact training is a primary focus in early intensive behavioral intervention programs for children with autism (Sundberg & Partington, 1998). In fact, a search within the *Journal of Applied Behavior Analysis* found 558 references related to the tact at the time of this writing.

Tact training: concept formation

Stimulus control. A wide variety of procedures are used to teach tacting to children with autism, such as discrete trial training (Smith, 2001), embedded instruction (Sigafoos, O-Reilly, Hui Ma, Edrisinha, Cannella, & Lancioni, 2006), and Direct Instruction (Engelmann, Becker, Carnine, & Gersten, 1988). Regardless of procedure, all tacts should be taught as *concepts* (Markle, 1990). To teach a concept, an instructor must arrange training that will produce both appropriate *stimulus control* and *generalization* (Barthold & Egel, 2001). Stimulus control is demonstrated when the target behavior is evoked in the presence of a particular stimulus but not in the presence of other stimuli (Skinner, 1957, pp. 59-69). For example, if a child said "milk" upon seeing his baby sister drinking milk but did not say "milk" (or perhaps said something else) in the presence of juice, then we would say that the presence of milk had stimulus control over his utterance "milk." Leaners must demonstrate appropriate discrimination of stimuli when learning new tacts.

Faulty stimulus control. Stimulus control can interfere with learning if the response comes under control of an incorrect stimulus. A related problem occurs when the response is controlled by only one critical feature of the antecedent context, or by a feature that can be present in many types of stimuli. For example, Partington, Sundberg, Newhouse, and Spengler (1994) sought to understand why a six-year-old girl with autism was failing to acquire tacts despite developing repertoires across other verbal operants. The researchers speculated that the girl was only attending to the verbal antecedent stimulus (i.e., “What is that?”) and not the non-verbal stimulus (i.e., the object she was supposed to tact). They initially removed the verbal antecedent and taught her to attend to the non-verbal stimulus. When correct responding increased, they were able to reinstate the original verbal antecedent while maintaining high levels of correct responding. This illustrates how faulty stimulus control can lead to failed acquisition of tacts.

Overselectivity is a specific kind of faulty stimulus control, defined as responding under the control of irrelevant stimuli (Barthold & Egel, 2001; Lovaas, Schreibman, Koegel, & Rehm, 1971). Lovaas and his colleagues suggested that many children with autism characteristically respond to specific features of a stimulus, rather than the stimulus as a whole. This poses potential obstacles for tact training when the object or event includes complex components that require specified attending. The learner might attend to an irrelevant aspect of the stimulus and could appear to successfully acquire the tact, but only be able to emit the trained response in the presence of an identical stimulus. Consequently, the individual could fail to generalize the response to novel stimuli. For example, if a child learns to tact “kick” when he sees a picture of someone wearing white sneakers kicking a ball, the child may subsequently tact “kick” when he sees pictures of people wearing white sneakers, regardless of whether they are engaged in a kicking motion. In addition, he may not tact “kick” when shown a picture of dancers in a kickline who are wearing jazz shoes. In other words, an irrelevant feature (i.e., white sneakers) controls the response “kick”, rather than the action of kicking. When attempting to teach concepts to children with autism, it is critically important to select stimuli that will facilitate development of appropriate stimulus control to avoid the aforementioned pitfalls.

Generalization. Even when appropriate stimulus control is demonstrated, a concept is not fully formed in an individual’s repertoire until they can also demonstrate generalization to novel, untaught examples. Many studies assess generalization after demonstrating acquisition of new skills due to the difficulty it poses for children with ASD (Barthold & Egel, 2001; Jones, Lerman, & Lechago, 2014; Salmon, Pear, & Kuhn, 1986; Schroeder, Schuster, & Hemmeter, 1998; Williams et al., 2006). There are two main types of generalization: response generalization and stimulus generalization. Response generalization is said to occur when a stimulus evokes multiple responses within a response class, such as a child seeing a friend and saying “Hey” or “Hello” (Pierce & Cheney, 2013, pp. 403). Stimulus generalization has occurred when stimuli different from those taught evoke the trained response, such as several different types of chairs being tacted as “chair” (Pierce & Cheney, 2013, pp. 234). Stimulus generalization also occurs when a response is emitted in a new context outside of the formal learning environment, such as on the playground, at church, or at a friend’s birthday party.

Researchers and practitioners have attempted to overcome limitations and difficulties that hinder generalization. Stokes and Baer (1977) compiled a literature review examining studies aimed to identify ways researchers have approached generalization. Historically, generalization was considered a passive skill, with limited tactics to promote it as an operant response. Stokes and Baer identified nine strategies for promoting generalization: train and hope, sequential modification, arrange for contact with natural contingencies, train sufficient exemplars, train loosely, use indiscriminable contingencies, program common stimuli, mediate generalization, and train to generalize. Since the publication of this article, many of these tactics have been utilized in skill acquisition programming.

Stimulus form. One feature of instruction that has shown promise in promoting generalization is the form of the instructional stimuli. Salmon et al. (1986) evaluated the effects of teaching object labels with pictures versus three-dimensional objects. All four participants were more successful in generalizing the tacts in the natural environment and to novel examples when they were trained with objects than when they were trained with pictures. Van Laarhoven, Kraus, Karpman, Nizze, & Valentino (2010) compared the effects of video modeling to picture schedules on acquisition of daily living skills among two adolescents with autism. Participants were taught two daily living skills (i.e., preparation of a meal and folding laundry). One skill was taught using pictures while the other was taught using videos, and the instructional method was counterbalanced across the skills.

While both instructional forms were effective, the video prompts were more effective and efficient for both participants. The findings of these studies suggest that learning and generalization could be enhanced if instructional procedures are arranged with the same stimulus form that would be encountered outside of the training environment. This is akin to Stokes and Baer's (1977) suggestion to program common stimuli.

To summarize, tacting is a critical skill for children with autism because it facilitates the ability to talk about the things and events they experience. Tact training requires savvy instructional design procedures to facilitate acquisition of tacts as concepts. When designing and delivering instruction, practitioners must pay particular attention to the formation of proper stimulus control, while also programming for generalization to novel stimuli and environments. Careful selection of instructional stimuli has been found to aid in both these processes (O'Neill, 1990).

Tacting Actions

While tacting *nouns* is an essential skill for talking about people, places or things, the ability to tact *actions* (i.e., verbs) allows an individual to talk about what others are doing. Actions are part of the stimuli comprising the environment, and thus are important to be able to talk about, too. It is important to note, however, that verbs appear later in typical childhood language development than nouns, and are more difficult to learn (Masterson, Druks, & Gallienne, 2008). This suggests that individuals with autism may have difficulty learning to tact actions. Nevertheless, it is an important skill to teach to this population, in part because action tacts are a critical component of being able to report on events that occurred when children were away from their parents, a common concern. To date, there have been few studies that examined procedures for teaching action tacts.

Williams, Carnerero, and Perez-Gonzalez (2006) taught six children with autism to spontaneously tact actions in the absence of a verbal antecedent (e.g., "What is she doing?"). Although parents or other caregivers often evoke reporting on events by asking questions (e.g., "How was your day?), it is also important that children learn to emit spontaneous action tacts. In other words, they should be able to tact an ongoing action without being asked (e.g., "Mom, Kenzie is falling off of her horse!"). Targets were selected for inclusion in the study if the participants were able to accurately tact an action depicted in a picture when asked, "What is she doing?," but not give a correct response when shown the picture in the absence of the verbal antecedent. Probes were conducted across three different conditions: verbal antecedent, no verbal antecedent ("nonverbal"), and mixed (i.e., five nonverbal and five verbal trials). Participants were taught to tact the actions depicted by a live model via discrete trial teaching. No verbal antecedents were presented. The therapist prompted the correct response by giving a verbal model (e.g., "Anna is sleeping."). Correct responses were reinforced with behavior-specific praise and tokens. Once participants reached the specified mastery criterion, the researchers assessed generalization to a novel action that was not trained during teaching. The participants were able to generalize to the other action without the formal antecedent in place. This study demonstrated an effective approach for teaching individuals to spontaneously tact actions.

More research into this topic is certainly warranted as tact training of actions may present some additional challenges to practitioners. This instruction is usually carried out using pictures of people depicting the target actions. Faulty stimulus control can easily develop because the learner may focus on irrelevant features of the picture, such as the color of the hair of the person performing the action. While this pitfall can be avoided by teaching with multiple exemplars, other pitfalls are difficult to avoid. For example, when teaching action tacts such as “shoveling,” “mowing,” or “shaving,” specific items are characteristically paired with their corresponding actions (e.g., shovel, lawnmower, razor). The learner may not understand that the tact “shaving,” for example, refers to the action of moving a razor over one’s skin. Instead, they may come to say “shaving” every time they see a razor, regardless of whether someone is actually doing something with it. This is because the most relevant feature was not accounted for when designing the instruction. That is, an action is not a static or immobile stimulus. Actions are dynamic; they take up time and include a start and finish. A 2D picture cannot convey this most important feature of an action. However, other stimulus forms, such as video, can exemplify the dynamic nature of action targets. A dynamic stimulus can serve to enhance the most salient feature of the target action. For example, a video depicting waving may show an individual with her hand sticking out and moving side to side. The same action shown in a picture could be rather ambiguous. It could be perceived that the individual in the picture is waving hello, hailing a cab, holding their hand out to count to five, waiting for a high-five, or gesturing "stop". This ambiguity may lead to overselectivity. By showing a fluid motion, it is possible that the likelihood of overselectivity may decrease because the most critical feature of the stimulus will be displayed. In addition, it is possible that the enhanced saliency of the relevant features offered by videos could facilitate generalization of the action tacts to more natural settings because the target stimuli are more similar to the stimuli encountered in the natural environment (i.e., dynamic).

Using technology in instruction

Technology has increasingly found its way into academic environments for typically developing children as well as children with developmental disabilities (Kagohara et al., 2013). Electronic devices have been used in early intervention programs for children with ASD for a variety of purposes such as a leisure activity, to deliver instruction (Alzrayer, Banda, & Koul, 2014) and as a communication device (Charlop-Christy, Carpenter, Le, LeBlanc, & Keller, 2002). Video modeling has been used frequently for children with ASD for a variety of skills including facial expression recognition and response (Axe & Evans, 2012), math and numeracy skills (Jowett, Moore, & Anderson, 2012), social responses (Jones, Lerman, & Lechago, 2014), reducing problem behavior (Neely, Rispoli, Camargo, Davis, & Boles, 2013), matrix training (Kohler & Mallott, 2014), communication skills (Shukla-Mehta, Miller, & Callahan, 2010), appropriate transitioning (Cihak, Ayres, & Smith, 2010), perspective taking (LeBlanc et al., 2003), reciprocal play (MacDonald, Sacramone, Mansield, Wiltz, & Ahearn, 2009), and daily living skills (Aldi et al., 2016).

Videos have several advantages: they allow for more learning opportunities throughout the day, as instructors can easily access videos and technology devices. They may be more practical because it can be difficult to arrange multiple exemplar training if the instructor requires a variety of live models to perform at specific times. They are also more beneficial for teaching complex skills (Ayres and Langone, 2005). Electronic tablets, such as iPads, can be used to deliver videotaped stimuli, and have already been shown to be effective tools for academics, communication, employment, leisure, and transition for individuals with autism. Researchers have found that technology has had an overall positive effect for individuals with ASD by creating more effective and efficient instruction. In addition, individuals with ASD prefer using an iPad over typical teaching materials or low technological options (Kagohara et al., 2013).

To date, only two studies have examined the use of videos during instruction of action tacts. Nao, Yokoyama, and Yamamoti (2007) taught three

Japanese children with autism to report events to an instructor or caregiver. Participants were instructed to walk a meter away to watch a short video of a cartoon on a monitor. The children then returned to the instructor and were asked, "What did you see over there?" Correct responses included comments such as "penguin eat snacks," "penguin skiing down slope," or "penguin singing." The experimenters implemented a teaching package consisting of constant time delay, praise for correct responses, and error correction. During generalization probes, participants were required to walk longer distances and down hallways or into other rooms. Following training, all the children were able to report previously seen events to instructors or parents, and were able to maintain and generalize the skill with increased distance.

Shepley, Lane, & Shepley (2016) used a multiple probe across participants design to evaluate the effects of videos plus language expansion on acquisition of action tacts among three preschool age children with ASD. The intervention package consisted of presenting videotaped actions as antecedents, a verbal instruction (e.g., "What is he doing?"), prompt and prompt fading using progressive time delay (Walker, 2008), reinforcement thinned to a VR 3 over sessions, and language expansions modeled by the therapist (a form of instructive feedback; (Reichow & Wolery, 2011). The language expansion model involved adding one to two words to the action while delivering the consequence. For example, if the participant tacted the action "petting" correctly, the instructor delivered the reinforcer and then said, “petting dog” or “boy petting dog”**.** Generalization of the four trained actions to pictures and novel videos was assessed through a pretest and posttest. All participants learned the action tacts that were directly trained, but only two of the three demonstrated generalization to novel stimuli. Additionally, the researchers did not evaluate generalization of the learned action performed *in vivo* in natural settings.

Specific Aims

Nao, Yokoyama, and Yamamoti (2007) and Shepley, Lane, and Shepley (2016) demonstrated that videotaped antecedents were a viable instructional strategy to teach action tacts to children with ASD. However, it is unclear whether videos facilitate generalization of action tacts to *in-vivo* situations, and whether dynamic stimuli (i.e., videos) provide any advantage over static stimuli (i.e., pictures). Thus, the purpose of the proposed study is to compare the effects of videotaped actions to actions depicted in a picture on the generalization of tacting actions to *in-vivo* settings among children with ASD.

Method

Participants and Setting

Participants were recruited from a university-based clinic. Specific actions for each participant were selected based on clinical relevance and probes prior to baseline. The current study included three students, who ranged from three to six years old. Sessions were conducted by Registered Behavior Technicians who were trained on the measurement procedure and program protocols to 90% or above accuracy. Sessions took place in a treatment room at an autism treatment center three to five times a week. Generalization probes occurred across multiple settings including classrooms, kitchen, playground, novel rooms, and/or hallways and occurred with novel people. Participants were taught to tact actions using the two instructional methods, videos and pictures.

Mark was a 6-year-old male diagnosed with autism who had been receiving 15-30 hours of behavioral intervention for two years. Although Mark had gained a number of skills (e.g., multi-word tact, mand, and receptive repertoires of over 200 targets each), his team reported that he tends to have difficulty learning new skills due to poor attending. In addition, he does not readily demonstrate stimulus or response generalization. Typically, Mark requires lengthy generalization training across novel environments, therapists, and exemplars.

Owen was a 3-year-old male diagnosed with autism. Owen recently started services and had been receiving 15 hours of behavioral intervention for five months. He typically learns new tacts within an average of nine trials and has gained skills in tact, mand, and receptive domains. Owen's therapists report he has trouble generalizing to novel people. Generalization to novel stimuli is also a main concern.

Christina was a 3-year-old female diagnosed with autism. Christina has been receiving 15-30 hours a behavioral intervention a week for six months.

Christina typically acquires targets on average within 12 trials. Therapists report she has difficulty acquiring targets due to poor attending. Christina also has difficulty generalizing to novel stimuli. Additional training across multiple exemplar and with novel people is typically required during generalization training.

Materials

A room devoid of distractions was used for teaching sessions. Each room included a table, chairs, and session materials. Videos of the target actions assigned to the dynamic stimuli condition were created using the Apple iPad Air Mini. One experimenter, wearing the same clothes and hair style for each target, modeled actions in the video segments. Each video was 6 s long. Targets in the static condition were photographs of the same experimenter, wearing the same clothes and hairstyle, executing the target actions assigned to the static stimuli condition. These still photographs were presented on the same Apple iPad Air Mini as the videos for the dynamic condition. Single exemplars of the targets were used to rule out multiple exemplar training as an explanation for any generalization observed in the course of this study. 215.9 x 279.4 milimeter color cards served as a signal for each of the experimental conditions during sessions. Reinforcers specific to each child were present during the preference assessment and were delivered during sessions. Reinforcers for Mark included Skittles $_{TM}$, Starbursts $_{TM}$, PEZ $_{TM}$, Laffy Taffy $_{TM}$, and Nerds $_{TM}$. Owen had reinforcers of Honey Bun $_{TM}$, Oreos $_{TM}$, Cheese Puffs $_{TM}$, Cheetos $_{TM}$, and Goldfish $_{TM}$. Christina's reinforcers included Oreos $_{TM}$, rice cakes, Pringles TM, marshmallows, and popcorn. A video camera was used to record sessions for the purpose of data collection; paper and pen was used to record data.

Response Measures and Data Collection

The dependent measure was percentage of correct and independent responses in each trial block. The participant needed to independently (i.e., without prompting) and correctly tact the action within 5 s of the verbal antecedent for the trial to be scored as correct. Prompted responses, incorrect tacts or failures to respond were scored as incorrect. Registered Behavior Technicians conducted sessions and collected data. Training on how to correctly conduct a session was done prior to the start of the study. Therapists needed to demonstrate 90% accuracy or above on a checklist of the following behaviors: present the conditions in the prespecified order, present correct color card and require card touch, present stimulus, state verbal antecedent, use correct prompt, run error correction if applicable, and deliver the appropriate consequence.

Interobserver Agreement and Treatment Integrity

Interobserver Agreement (IOA). Six independent observers collected data on the dependent variable for each of the three participants. Data were collected via video recordings or during sessions. Inter-observer agreement was calculated using trial-by-trial agreement. For every trial that was scored as correct or incorrect by both observers, an agreement was scored. A disagreement was scored if one observer scored a correct and the other scored an incorrect response. The number of agreements were divided by the number of agreements plus disagreements and multiplied times 100 to yield the percentage IOA score (Kazdin, 2011, pp. 103). IOA was collected for 48.9% of sessions, with an average of 98.4% reliability. IOA averaged 97.3% (range = 83%-100%) for Mark, 99.7% (range = 92-100%) for Owen, and 98.3% (range = 75-100%) for Christina.

Treatment Integrity. Treatment integrity data were collected by two independent observers across all phases and participants. Sessions were viewed via video recordings. A checklist of the session components was included to score the integrity of session. The components were (a) the correct condition was run, (b) the instructor required attending to the color card, (c) the correct instruction was delivered, (d) the correct prompt was used, and (e) the correct consequence followed the response and (f) error correction was run (if applicable). Treatment integrity data were collected during 35.6% of sessions with an average of 98.9% integrity. Treatment integrity averaged 100%, 99.2%, and 97.6% for Mark, Owen, and Christina, respectively. The range across all three participants was 83% to 100%.

Experimental Design

The current study used an adapted alternating treatments design (AATD; Holcombe, Worley, & Gast, 1994) combined with a nonconcurrent multiple baseline design across participants. An AATD was used due to each treatment containing different targets. Specifically, targets selected for use in the dynamic (i.e., video) condition were different than targets selected for use in the static (i.e., picture) condition. This allowed for comparison of the effects of each treatment on acquisition and generalization of the targets. To decrease the chance of order or sequence effects, the alternating treatments design included rapidly alternating conditions. A nonconcurrent multiple baseline allowed one participant to complete the study before the next participant began. The multiple baseline design also included each subsequent participant having more baseline points than the previous participant. This design allowed for multiple comparisons across participants to rule out time or maturation as an explanation for any observed effects of the intervention. A third set of targets, assigned to the control condition received no treatment. Prior to baseline, in-vivo probes of the target actions were tested for all conditions. Baseline only included the treatment conditions. Control probes were run every third session.

Procedures

Pre-experimental assessment. A variety of actions were assessed to determine targets that would be taught to each participant during the course of the study. To control for possible exposure to the targets outside the study, actions that were unlikely to be encountered by the participants were selected. Probe trials were conducted in the natural setting with live actors, with pictures, and with videos. Actions were selected as targets if the participant made an incorrect response two consecutive times to each of the stimulus conditions. In other words, when asked, “What is she doing?”, the participant must have given an incorrect response or no response two times each for natural setting, picture, and video representations of the action. Correct responses were consequated with praise and incorrect responses were ignored. Trials continued until nine action targets were identified for use in treatment, with three targets assigned to each condition. Targets were assigned by first grouping them according to the number of syllables in each action tact and then randomly assigning the matched targets to conditions using a random number generator. Targets for Mark included typing, folding, and sneezing in the video condition. The picture condition included the targets dancing, mixing, and scratching. Video targets for Owen included clapping, eating, and drawing. Targets in the picture condition included waving, drinking, and jumping. Christina had video targets of spinning, cutting, and waving. Picture targets included clapping, sneezing, and pushing. Targets for the control condition were consistent across all participants and included actions of stretching, screaming, and ripping.

Color Preference Assessment. A multiple stimulus without replacement preference assessment (MSWO) (DeLeon & Iwata, 1996) was conducted prior to baseline to determine color preference for each participant. Six color cards were placed in an array in front of the participant and the verbal antecedent, “Pick one” was delivered. Following selection, the experimenter removed the selected color card from the array. Instruction, selection, and removal continued until all colors were selected. The three least preferred colors were selected for use as signals for each condition, in order to avoid bias toward preferred colors. The color cards also served to enhance the discriminability of each condition.

Preference assessment. An MSWO preference assessment (DeLeon & Iwata, 1996) was conducted prior to each session. An array of preferred items previously identified through parent and/or therapist interview(s) was placed in front of the participant. The assessment was run the same way as the MSWO for color preference until all items had been selected. The two highest preferred items were used as reinforcers for correct responses during teaching sessions.

General Procedures. Each session comprised the two experimental conditions presented in random order to avoid bias and multiple treatment interference. Each condition was assigned a number and a random number generator was used to determine the order of conditions during each session. No more than two consecutive conditions were run each session to ensure an equal number of conditions. Sessions were conducted using discrete trial training (DTT). Each condition included 12 trials, ensuring four trials per target. Control condition targets were probed every third session. Prior to baseline, generalization probes for all three conditions were conducted.

Baseline. At the start of each condition, the assigned color card was placed in front of the participant and he/she was required to touch the card to confirm attending to the color. Each trial began with the simultaneous presentation of the action stimulus and the verbal antecedent, “What is he/she doing?”. There were no prompts or programmed consequences delivered for correct or incorrect responding during baseline sessions. In order for the participant to move to treatment, responding needed to be stable and not on an increasing trend. In vivo generalization probes were run prior to treatment condition baselines for all three conditions.

Dynamic stimuli. The action antecedent stimuli were delivered by video in this condition; the video was played for a duration of 6 s. This allowed 1 s for the verbal antecedent and the remaining 5 s to emit a response.

Static stimuli. The action antecedent stimuli were depicted in pictures in this condition. The participant was able to view each picture for a duration of 6 s. This was to equate the duration of exposure to the target stimuli in each condition.

Control stimuli. The action antecedent stimuli were modeled in the natural environment. The participant was able to view the modeled action for a duration of 6 s. Control condition probes were conducted identical to generalization probes.

Intervention. Training sessions were conducted identically to baseline with the exception that, following the verbal antecedent, “What is he/she doing?”, the instructor provided a vocal model of the correct response within 0-5 s. For example, following the prompt delay, the instructor would state “running” if running was the action depicted in the video. Systematic fading using progressive time delay was used to fade prompts across sessions (Wolery, Ault, & Doyle, 1992). Prompts were delivered at 0-, 3-, and 5-s delays. For one participant, an additional delay of 2 s was required for successful learning. Responses prompted at a 0-s delay were reinforced with praise and an edible. To avoid prompt dependency, differential reinforcement for independent responding was used when time delay fading began. Mastery criterion was 80% or higher for three consecutive sessions.

Generalization. Following mastery of both conditions, in vivo generalization probes were conducted. Novel people and environments were used to test for generalization of the nine actions in a natural setting. The instructor presented the same verbal antecedent used in baseline and training with simultaneous presentation of a model engaging in the action. Correct responses were consequated with praise and incorrect responses were ignored. For clinical purposes, if a participant did not generalize actions from a treatment condition to the natural environment, actions were directly taught in the natural environment until mastery criteria was met.

Stimulus form preference assessment. Following completion of all sessions, a modified concurrent-chains procedure (Hanley, 1997) was used to determine participant preference for stimulus form. The three color cards correlated with each condition were placed on a table and the participant was verbally reminded which color corresponded to each condition. The instructor provided the verbal statement, “pick one” and then physically prompted the child to touch a color. The participant then completed a 2-min session correlated with the color card that was selected. This was repeated three times for each condition, in random order. Following the training, test trials began. Instead of being prompted to select a color, the participant was allowed to select the color he or she wished. If the participant did not choose a card, the therapist continued to prompt, "pick one" until a selection was made. Upon touching a card, a praise statement was delivered (e.g., "nice job choosing a card") and subsequently completed a 2-min session of the condition. This was repeated until all 10 choice trials were completed.

Results

Figure 1 depicts the percentage of correct and independent responses for action tacts for all three participants. Mark's data are displayed in the top panel; Owen's data are displayed in the middle panel, and Christina's data are displayed in the bottom panel.

Figure 2 displays the percentage of selections based on stimulus form for all three participants. Mark's data are displayed on the left, Owen's data are displayed in the middle, and Christina's data are displayed on the right.

During pre-training generalization probes, Mark responded correctly during 0% of opportunities for all three conditions in the natural environment. Baseline continued with the static and dynamic conditions only and responding remained at 0%. Once treatment began and prompts were faded, adjustments were made to the time delay. Mark consistently erred prior to the 3-s delay, thus we moved to a 2-s delay. Once Mark started responding to the 2-s delay, we moved back up to the 3-s delay and continued with the fading criteria as stated in the protocol. Mastery criteria were met for the dynamic condition in 14 teaching sessions, or 168 trials, for the set of three targets. Training sessions to mastery averaged 56 trials per target within the set. For the static condition, set mastery was met in 18 teaching sessions, or 216 trials, averaging 72 trials per target. Control probes remained at 0% correct responding throughout the study. Generalization probes for targets taught using video were 100%, 91.67%, and 100% for each 12-trial block. Responding during generalization probes for target taught using pictures were 58.33%, 58.33%, and 66.67%. Following generalization probes, the preference for stimulus form was conducted. Of the 10 choice trials, Mark chose videos during 40% of trials, pictures during 30% of trials, and the control condition during 30% of trials. This corresponded to 4 selections, 3 selections, and 3 selections, respectively. It is important to note that for this participant a side bias for selection seemed to occur for nine out of the 10 trials; i.e., Mark consistently chose the color card on the left with the exception of one trial, in which he chose videos. Since Mark did not successfully generalize targets from the picture condition to the natural environment, additional training sessions were conducted to teach the targets in the natural environment to achieve mastery criteria.

Owen responded correctly on 0% of opportunities for pre-training generalization probes across all three conditions. During baseline, responding remained at 0% for correct action tacts for both static and dynamic targets. Following the introduction of teaching, Owen met mastery for dynamic targets in 10 teaching sessions, or 120 trails. Trials to mastery for videos averaged 40 trials per target. Mastery criteria for the set was met for static targets in 6 teaching sessions, or 72 trials. Overall, trials to mastery averaged 24 trials per target. Generalization probes for the dynamic condition were 8%, 0%, and 0% for correct responding for each 12-trial block. During generalization probes for static targets, correct responding occurred on 0% for all three probes. Correct responding for the control condition remained at 0%. Following generalization probes, the preference for stimulus form was conducted. Owen chose pictures for 100% of the 10 trials. Owen failed to generalize targets in both treatment conditions to the natural environment. Additional training sessions were conducted to teach targets from videos and pictures in the natural environment to achieve mastery.

Christina was the final participant run in the study. During her pre-training generalization probes, correct responding occurred 0% for all three conditions. Baseline for static and dynamic stimuli remained at 0% of correct responding. Once treatment was implemented, Christina met mastery criteria for videos in 8 teaching sessions, or 96 trials. On average, each target was mastered in 32 trials. For static stimuli targets, mastery was also met in 8 teaching sessions with 96 trials. Mastery for pictures also averaged 32 trials for target. Generalization probes for pictures were 8%, 0%, and 0% for each 12-trial block. Christina successfully generalized targets from the dynamic condition to the natural environment, responding at 82%, 100%, and 100% for probes during each 12-trial block. Responding during the control condition probes remained at 0%. Christina did not successfully generalize targets from the picture condition, so targets were taught in the natural environment until mastery criterion were achieved. Following generalization probes, the preference for stimulus form was conducted. Christina chose pictures for 50% of trials, videos for 40% of trials and the control condition for 10%. It is important to note that Christina had a right-side bias, with the exception of when the card for the control condition was present on the right, then she would choose the middle card.

Discussion

The present study compared the effectiveness of two teaching methods, dynamic versus static stimuli, to promote generalization of action tacts to a natural setting for children with autism. Of the three participants, two were more successful in generalizing action tacts to the natural environment when taught using videos compared to pictures. (The other participant did not generalize the actions from either condition to a natural setting.) These findings suggest videos may be more effective for promoting generalization for some learners, and support previous literature for using videos as a teaching method.

In applied settings, specifically within early intervention programs, tacting is a necessary skill taught. It is crucial to ensure generalization of these tacts beyond a structured treatment environment. While it is important that skills are acquired, treatment loses value if the child cannot use the skills functionally outside of the clinic. Therefore, it is important for practitioners to know which procedures best facilitate generalization outside of the structured teaching environment to more natural settings, with novel people, and/or to novel exemplars.

Why do videos have this effect?

Actions have multiple features including movement, a beginning, middle, and end, and can even include sound. Static images fail to capture the salient features and can lead to ambiguous interpretation of the action being depicted. A video is able to capture those features, creating a clear and realistic exemplar of the action. For example, one of the targets for Mark was dancing. This example was assigned to the static condition. The image depicted a very brief snapshot of the entire dance move that occurred, and can be ambiguous if movement is no shown in the stimulus.

Videos also allow exemplars to depict variability within the action. Returning back to the dancing example, there is not only one type of dance move, thus a video would be able to show many different exemplars and forms of dancing, even in one short video clip. In contrast, a picture will show a brief snippet of only one of those possible exemplars and would require multiple exemplars.

Videos have the ability to represent multiple features of an action including movement, start and finish, and sound. This can also mitigate ambiguity of a static image, such as an individual with pursed lips. In such an image, the individual could be whistling, saying “oo”, or blowing a kiss. A video would not only allow the whole action to occur but also feature a main component of the action (i.e., the whistling sound) to help the learner emit the correct tact. Having the ability to use multiple features and components in one stimulus can help in overcoming overselectivity, which can be a barrier to learning (Lovaas et al., 1971). The use of a stimulus containing multiple key components may decrease the chance of an individual attending to only one component or an irrelevant component of the stimulus, in this case, the action.

Our findings align with suggestions from Salmon, Pear, and Kuhn (1986) and Stokes and Bear (1977) that using training stimuli similar to those in the natural environment (i.e., “programming common stimuli”) aids in promoting generalization. Ideally, these targets would be taught using a live model performing the target action. Consequently, it would be expected that generalization would occur to other settings, exemplars, and novel individuals. However, the use of a live model is not always feasible in treatment settings. Extra staff may be unavailable when two or more people are needed to demonstrate an action (e.g., catching a ball). In addition, it may not be possible to depict some actions with a live model in a structured teaching environment (e.g., skiing, showering). It may be possible to demonstrate some actions, but impractical to do so for enough trials to provide opportunities for fading of prompts (e.g., cracking open an egg). Thus, the use of videos can provide similar stimulation as a live model, while remaining in a controlled environment. This allows instructors and practitioners to utilize available resources while teaching tacts that are still functional to the individual, but may not be commonly taught in the clinical setting.

Effects on Acquisition

While the main focus of the study was to assess generalization, it is notable that one teaching method led to faster acquisition for two participants. Results indicated that rates of acquisition for action tacts were idiosyncratic across participants based on stimulus form. Mark learned faster using videos, while Owen had faster acquisition with the picture targets. (Christina's data were undifferentiated.). Despite attempts to equate the targets across conditions, differences in acquisition may have been due to some targets being more salient to the participant, requiring less time to acquire the action. There is also the possibility that the participant had a preference for the stimuli in one or the other condition. Within-participant replications with additional stimuli may lend clarification. However, the important point to note is that the rate of acquisition was not predictive of ability to generalize skills, suggesting that these may be separate processes.

Generalization across Operants

Findings of the study demonstrated that not only can teaching action tacts through video help promote generalization to novel environments and people, but may facilitate generalization across other operants. For Christina, this transfer across operants occurred. She had a target for “spinning” assigned to the video condition. As she began to master the tact for spinning, she began manding for her therapist to spin her during breaks in study sessions. Her EIBI team reported that she had never emitted that mand before, and she also started manding for spinning during her regular clinical sessions as well. This is particularly noteworthy because honoring her mand required the therapist to pick her up and hold her while spinning, which was topographically dissimilar from the spinning depicted by the actor in the video. It is possible that the transfer across operants occurred due to the salient features of the antecedent stimulus previously discussed.

However desirable transfer across operants is from a clinical standpoint, it may confound the results of the present study. If Christina was manding for spin prior to generalization probes (and that mand was reinforced), she would have had extra practice saying that particular topography, which may have aided her successful generalization. However, it is believed generalization was due to other variables since she successfully generalized all targets.

Limitations

One limitation of the study was the strict participant criteria. Participants needed to have poor generalization skills but overall, have a strong tacting repertoire. It was difficult to find participants who fit all components of the criteria. This may suggest that the combination of failure to generalize with a strong tacting repertoire may not be realistic criteria. Some individuals may have a different combination of these criteria. There is also the possibility that an individual may meet the other criteria but may not imitate 3-syllable signed or spoken responses but may have a strong 2-syllable imitative repertoire. However, difficulty finding participants may have also been due to the specific participant pool.

Another limitation of the study was that the targets taught in this study were age-appropriate actions. It is possible that the participants came into contact with the targets in the natural environment outside of the study. This could weaken internal validity by making it difficult to determine whether true generalization occurred or if it was due to prior exposure. It is unlikely this occurred, though, because the baseline conditions remained at zero for all three participants until the intervention was introduced in a staggered fashion.

A third limitation was how the control condition was implemented. The control condition used a model to perform the actions in the natural environment, but these targets were never placed into treatment. It is possible that exposure to targets in the natural environment for which responses were never prompted or reinforced may have resulted in extinction of that entire operant class in that particular environment. This may account for Owen's failure to generalize responses from either of the experimental conditions to the natural environment. Future studies may want to consider different procedures for the control condition.

A final limitation of the study is the overall use of technology. While technology is frequently used as a tool for instruction, it is still not accessible to everyone. Technology can be expensive and not all organizations can afford iPads or other technology that may aid in treatment. There is also the possibility that technology cannot be used by some individuals. Some children may have medical issues that do not allow them to look at movement on a screen or an individual's parent(s) may not prefer the use of video as a teaching method. Of course, there is always the possibility that if the teaching method relies on technology and devices break or are damaged, there would be no alternative source for treatment. Consequently, the methods used in this study may not be applicable to all.

Implications

The results of the current study suggest an effective way to promote generalization for a commonly taught program in early intensive behavioral intervention. The study addressed difficulties with generalization and findings provide considerations for practitioners. The current study analyzed views on generalization identified by Stokes and Bear (1977) and how generalization typically has been seen as a passive skill. Findings suggest a way to proactively promote generalization. Generalization, in this study, was not considered simply an additional skill gained from a specific teaching method, but rather the goal of the teaching method. Using videos to teach tacting actions can aid in promoting generalization but also remain practical for use during discrete trial instruction.

This not only aids in acquisition of skills in a controlled environment while requiring few resources but it also saves time for teaching if generalization training is typically required. There are multiple benefits to using videos as a teaching method. Using videos conserves resources; videos can be recorded on an iPad, rather than constructing multiple pictures that must be printed, cut, and stored. Practitioners could create actions and store the videos to be shared across multiple clients. With the use of technology, it is also possible that if a clinician cannot film the action, there are many outlets online in which a video of the action being performed is likely to be found. One argument that could be made is to simply teach action tacts using a live model. However, this may not be possible based on resources required such as models, setting, and tools required to complete the action. Using a video may allow access to actions that would not be possible in the immediate environment such as teaching sledding to an individual who lives in Florida. It also allows quick access from a stored file rather than taking the time to find a model or for the clinician to perform the action. This not only saves resources but saves time. Using technology may also increase attending.

Anecdotally, the case manager for Mark and Christina reported that both children have difficulty attending to teaching stimuli, which impedes their acquisition. This is also assumed to be a potential issue for generalization due to difficulty with initial acquisition of a target. However, when using the iPad to teach, little if any prompts to attend to the stimulus were required. During Mark's regular EIBI sessions, he typically would look at other items around the room or would “zone-out” at the end of a trial. However, during the study, following the delivery of an edible or praise he immediately would look back at the instructor ready for the next trial. Christina would typically attend to toys in the room sing songs. However, during the study she frequently would try to look around the side of the iPad to see the next stimulus that would be presented while she was consuming her edible. This suggests that for some individuals, using technology may increase attending. If an individual requires less time to prompt attending to the stimulus, this suggests that incorporating technology can be an efficient teaching method (Ayres and Langone, 2005). This may occur due to histories children have with technology which have made iPads a very powerful generalized conditioned reinforcer. Children can access an iPad during leisure time to play games or watch tv. Even in clinics, iPads have been delivered as reinforcement during trials or during leisure time. In contrast, picture cards are typically used for teaching and are associated with demands. Based on the long history, it is possible that pictures in general may have become aversive. So, using a powerful reinforcer embedded as a part of the teaching method may lead to increased attending to help aid in acquisition. Furthermore, if there are fewer problems during acquisition, it may help increase successful generalization.

Alternatively, if an individual does not have a long history with learning from picture cards and receiving an iPad as reinforcement, responding may differ.

Owen is new to early intervention and only has a brief history of learning with pictures, in contrast with Mark and Christina who have longer learning histories with pictures. His learning history compared to the other two participants may imply that pictures are not or have not become aversive. Additionally, Owen typically does not work for an iPad for reinforcement. He prefers balloons, praise, or therapist attention and interaction. This means his history of using an iPad as reinforcement is not as long and is overall fairly infrequent. Whereas, Mark and Christina typically only work for the iPad as reinforcement. Owen not only learned faster with pictures, but his preference assessment revealed that he preferred the picture condition. His results suggest that his learning history of having less time with pictures as the main treatment contacted as well as having a very short and infrequent history with an iPad can influence preference. This supports the argument that a longer history of learning with pictures and receiving an iPad for reinforcement may lead to pictures becoming aversive while making an iPad a strong generalized condition reinforcer. It should be noted that the study used the iPad for both pictures and videos to remain consistent across stimulus forms so a comparison to a picture card was not conducted. Thus, for Owen's case, the argument is made with the use of a static image as compared to a video or dynamic stimulus. The study expands on existing research to build a child's tact repertoire as well as skills for generalization.

The study also ran an overall preference for stimulus form across the participants. Results were also idiosyncratic. Findings did not align with the suggestions of Kagohara et al. (2013) that videos are a more preferred teaching method. The results of the current study may not be representative of true preference based on specific participant responses. Two of the three participants demonstrated a side-bias during the assessment. These two participants were also the individuals who typically have poor attending skills, which may have decreased the chance of the color card gaining stimulus relations with its corresponding condition. For Owen, he chose pictures for 100% of his choice trials. Results indicate that he preferred the picture condition which may, in fact, be true. Conversely, further information was gathered about Owen's preferences following the study. Anecdotally, therapists report that Owen's favorite color is blue. However, during initial preference assessments for color, blue was one of the last colors selected, leading to its assignment to a condition. It is possible that his responding to the initial preference assessment was faulty. The purpose of the color preference assessment was to assign non- or less-preferred color cards to conditions to avoid bias of a condition based solely on color preference. Future studies may want to consider ways to make stimuli paired with each condition more salient as well as determining and assessing additional methods for determining preference for condition.

Based on the limitations of this study and other considerations, future research may want to further assess the effects of teaching with videos to extend the findings of the current study. One consideration could be to conduct a parametric analysis on the length of the video clips. The parametric analysis could compare which length of video (e.g., 3 s, 6 s, 10 s) would be the most effective parameter for teaching and successful generalization. The current study used a 6 s video clip and picture display time. However, less or more time may be required to have the same or more successful effects. Based on the limitation of the study dealing with exposure, probes of the actions in a natural setting could be conducted throughout the entirety of training to test for any acquisition or generalization that may occur. By conducting probes in-vivo throughout training, it is possible that generalization may occur prior to an individual meeting mastery of the teaching stimuli. Although, this may be a threat to internal validity. Alternatively, if generalization probes remain at low levels of correct responding throughout the study until mastery of teaching targets has been met, internal validity would be upheld. Another consideration for future research aligns with the next limitation of the study based on participant criteria.

While this study aimed to assess a method for teaching individuals with deficits in generalization, future research may want to consider using children with different skill levels to see if videos are a more effective teaching tool for kids across multiple skills levels, including individuals who may have other means of communication, such as assisted communication. Another potential future direction is to conduct within-subject replications for further confirmation of the results (i.e., generalization is more successful when taught using video). Not only would the participants learn more targets, but the results may also aid in further analysis of generalization to determine if failure to generalize was due to a specific target or if it was due to the stimulus form.

Overall, the current study provides considerations for teaching strategies for individuals with autism. Findings add to the literature on the use of video instruction and furthermore, add to instructional methods to promote generalization. Practitioners may want to consider using videos for teaching action tacts to individuals with autism to lead to successful generalization of tacting actions in the natural environment without excessive generalization training.

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Figures

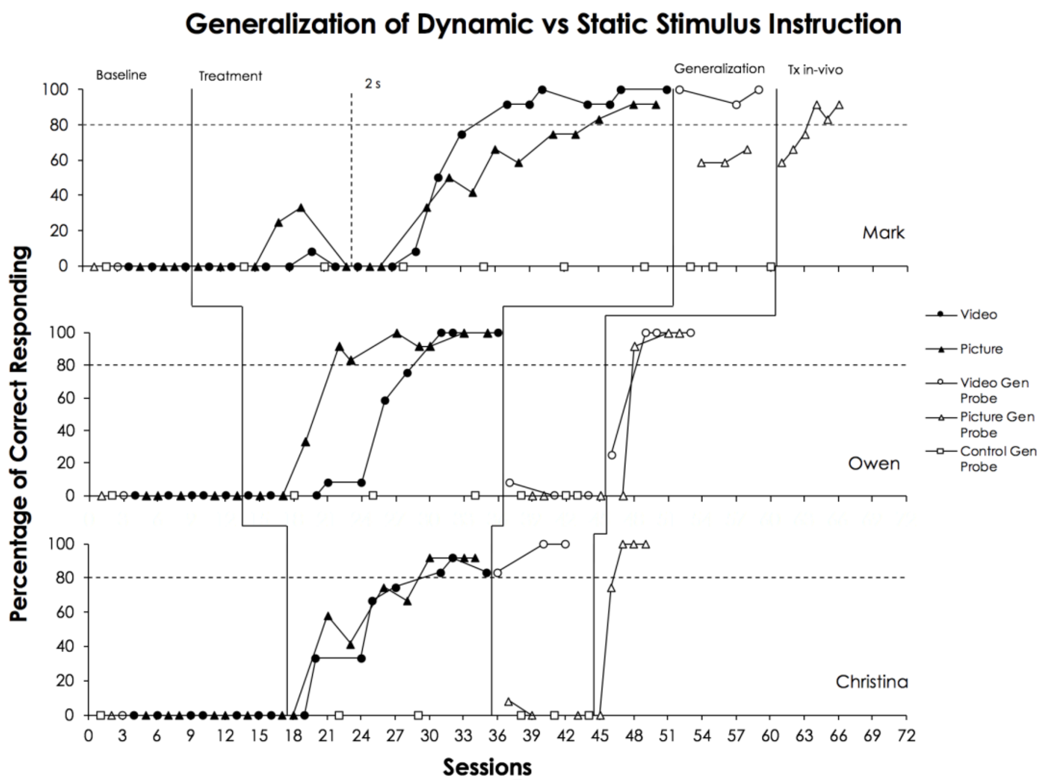

Figure 1. The above graph depicts percentage of correct responding across sessions for all three participants. The black circles represent actions represented using video. The black triangles represent actions using pictures. Open circles represent actions from the videos performed in the natural environment. Open triangles represent actions from the pictures performed in the natural environment. Open squares represent the control condition.

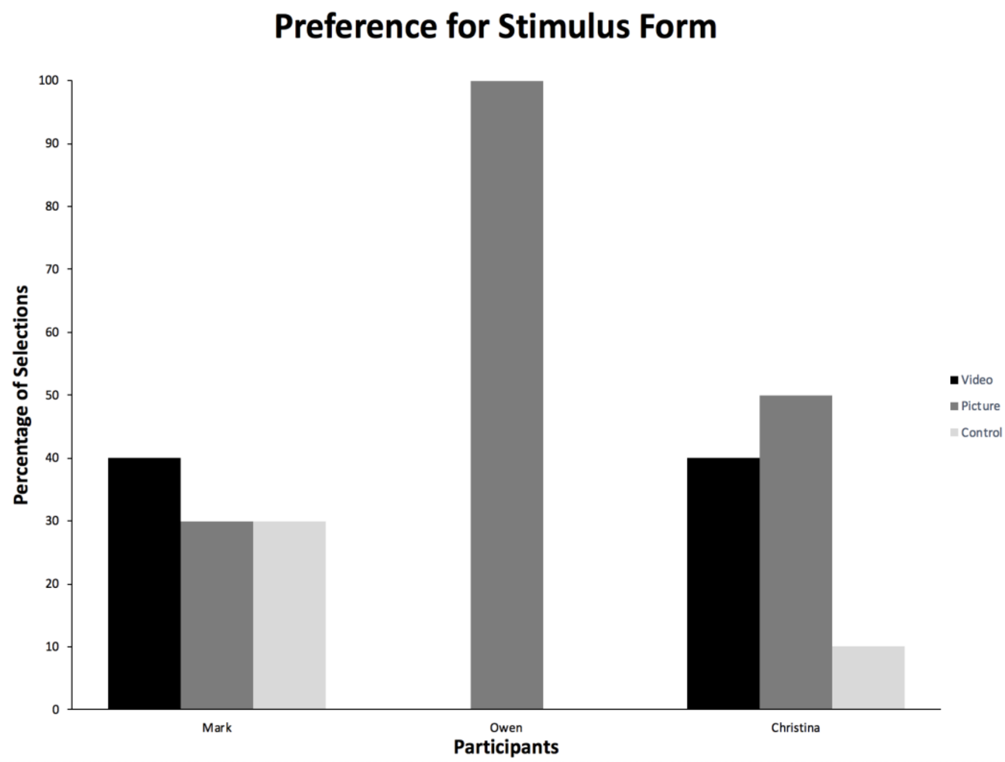

Figure 2. The above graph depicts percentage of selections based on stimulus form for all three participants. The black bars represent the video condition. The dark grey bars represent the picture condition. The light grey bars represent the control condition.