Generalization of Audience Control over Verbal Repertoires:

A Systematic Replication

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Abstract

Skinner (1957) described audience control as, “the selection of which repertoire to use under the conditional control of the present audience”. Little research has been conducted on audience control in children with developmental disabilities. A systematic replication of Silverman et al. (1986) was conducted with modifications including the use of culturally specific stimuli and training using visual stimuli only. One typical adult and 1 child with autism participated. Visual-visual match-to-sample procedures were used to first establish audience classes and then to establish response repertoires under the control of 1 member of each audience class (the “teacher”). The formation of functional equivalence between audience class members was confirmed before generalization of control from the teacher audience class member to the “prober” audience class member was assessed. The typical adult demonstrated functional equivalence of audience class members and generalized control to the prober audience class members, while the child with autism did not.
Generalization of Audience Control over Verbal Repertoires: A Systematic Replication

Today an estimated 60-75% of the global population speaks more than one language (Global bilingualism. ND). Although the proportion of this group who are parents of children with autism is unknown, it is highly probable that the number is similar to the distribution of those parents in the general population. As a result, it is not unlikely that a child with autism might hear multiple languages spoken at home or school. In such cases, teachers and specialists concentrating in autism have a challenging task; they must teach a child to communicate in more than one language who, by diagnosis, has difficulties learning language.

The behavior analyst is somewhat assisted with this challenge by the body of behavioral research and theory on verbal behavior. Two broad areas of this work, Skinner’s verbal behavior analysis (Skinner, 1957) and Sidman’s analysis of equivalence relations and conditional control (Sidman, 1994), are particularly pertinent to the issue.

*Skinner’s Analysis*

Skinner defined verbal behavior as, “behavior that is reinforced through the mediation of another person’s behavior” (Skinner, 1957, p. 172). In this definition, Skinner treated verbal behavior as an operant, which implies that it is a distinct class of behavior. As such, an individual’s verbal repertoire can be described as a set of verbal operants that may consist of an entire language, scientific language, casual language, or the selected words used in the work or home environment. This description does not limit verbal behavior to the spoken word, but can also include a variety of communication topographies such as asking for items, waving at someone to get attention, or the crying of a baby.

When verbal behavior takes place, a social interaction occurs between a speaker and a listener. In that interaction, the speaker gains reinforcement from the listener; that is, the
speaker’s behavior is reinforced by the listener behavior that it evokes. Three of the most common types of verbal operants are mands, tacts, and intraverbals (Cooper, Heron, & Heward, 2007). Mands occur when individuals request, demand, or state their needs. These operants are under the functional control of motivating operations and specific reinforcement. For example, food deprivation will evoke responses that have produced access to food in the past; such as, a food deprived child might say, “I want cookie”. A tact, on the other hand, occurs when individuals name things and actions that they can sense. These operants are under the control of a nonverbal discriminative stimulus ($S^D$). An object or item becomes an $S^D$ for a tact after being paired with a verbal response that is reinforced with a generalized reinforcer. In comparison, an intraverbal occurs when an individual differentially responds to the verbal behavior of others. In this form of operant, a verbal $S^D$ evokes a verbal response that does not match the $S^D$ (Cooper et al., 2007). For example, when asked the question “what is your favorite animal?” a child says “cat”.

In both typically developing and developmentally delayed children, different teaching strategies are used for developing tact, mand, and intraverbal communication. Arntzen and Almas (2002) investigated the use of tact and mand training procedures in both typically developing preschool aged children and children with autism. In this study, tact training consisted of placing an item in front of the student and stating “this is a _____” followed by “what is this?” If no response occurred, a verbal prompt was given and the question was restated. During mand training trials an object was hidden from the participant. The participants were told to find the object and were expected to use a mand to ask for the object when they could not locate it. If a participant did not independently use a mand, the experimenter gave the verbal prompt “I want ____” and the participant was expected to give an echoic response. During mand
training sessions, mand and tact training trials were alternated. Training trials continued until the participant independently labeled and requested an object for 10 consecutive trials. This study demonstrated that mand-tact training increases both tacting and manding at a more rapid rate then tact training alone in both children with autism and typically developed preschool children. It is possible that this outcome resulted from the combined training procedures during the mixed mand and tact training trials. The combined training procedure produced acquisition of two verbal operants as rapidly as tact training alone produced acquisition of one verbal operant.

Teaching a child to name an item when it is presented does not necessarily give the child the skill to use the name of the item independently as a mand. Skinner describes this problem as functional independence of vocal responses (Kelly, Shillingsburg, Castro, Addison, & LaRue, 2007). Kelly and colleagues compared generalization following tact training and mand training procedures. In mand training the therapist presented an object, and simultaneously stated “what do you want?” She then immediately named the object. Following three trials with this immediate full verbal prompt, a 3-s delay was added between the question and prompt (delayed prompt). During the tact training, the therapist handed the participant an object and asked “what is this?” then stated the name of the object. Two of the three participants generalized responding from tact training to a mand response when asked, “what do you want?” but did not generalize from mand training to a tact response when asked “what is this?”. The third participant generalized across both training procedures. These results support the use of combination training procedures; that is, alternating between mand and tact training trials within a training session, to ensure that tacts or mands will generalize to environments in which training did not occur.
Once a child can use tacts and mands, the next step is to teach the child to incorporate these skills into intraverbal communication. Ingvarsson, Tiger, Hanley, and Stephenson (2007) compared two training procedures to establish the answers “I don’t know” and “I don’t know please tell me” in children that struggled to answer age appropriate questions. Ingvarsson et al. first identified 4 sets of 8 questions that the participants could not answer, and 2 sets of 5 questions that participants could answer. During “I don’t know” training trials, teachers asked a question and immediately prompted the response “I don’t know”. A 1-s delay was introduced before the prompt and the delay was increased after each session. Following “I don’t know” training, three participants generalized the “I don’t know” response to the previously known sets of questions. In response to this unwanted generalization, a second phase, “I don’t know please tell me,” was added. The same prompt procedure was used to train this response; however, following the correct response teachers gave participants the correct answer to the question then prompted them to repeat the answer. Once this training procedure was implemented, the use of “I don’t know” in response to known questions decreased. Additionally, following the training of “I don’t know please tell me” for one set of unknown questions, the response was generalized to all other unknown questions.

The verbal operants described above all involve a speaker and an audience; that is, a listener. Skinner (1957) described the audience as a discriminative stimulus for verbal behavior in which verbal behavior is reinforced in the presence of the audience but not in its absence. Reinforcement that occurs in the presence of the audience is generally strong, which results in strong stimulus control. Therefore, individuals often engage in specific forms of verbal behavior in the presence of audience members. Skinner goes on to state that the discriminative stimulus, audience, eventually becomes reinforcing as demonstrated by the increase in a specific form of
responding in the presence of the audience. The audience member eventually becomes a
generalized conditioned reinforcer for a particular repertoire of the speaker. Skinner’s notion of
audience may be conceptualized as an example of second-order conditional control (Sidman,
1994), a discussion of which follows.

Second-Order Conditional Control and Stimulus Equivalence

Sidman and colleagues (Sidman, 1994) pioneered research on the stimulus equivalence
paradigm and the related second-order conditional control. This work has far-reaching
implications, particularly for complex human behavior such as language. For example,
cognitive phenomena such as “understanding”, “meaning”, and “reading comprehension” can be
operationalized as relations among equivalent stimuli. Additionally, selection of one language
over another, such as when a multilingual individual speaks in different languages to different
audiences, can be understood in terms of contextual or second-order control. Similarly, in social
interactions, words and symbols can be reacted to as if they are the events and actions they refer
to (Sidman, 1994). For example, burning the American flag in the United States is a symbol of
offense against the country for which offenders can be prosecuted.

The stimulus equivalence research builds upon the concept of the discriminated operant.
A discriminated operant, or three-term contingency, is defined as, “a response class formed by
reinforcement only in the presence of a specific stimulus” (Catania, 2007, p. 128). For example,
answering the phone is a discriminated operant. An individual answers the phone when the
phone is ringing but never in the absence of the ring (Cooper, et al. 2007). The stimulus
equivalence paradigm expands the three-term contingency concept to include an additional
stimulus that exerts control over the discriminated operant thus establishing a four-term
contingency. This four-term contingency consists of an $S^D$ which is under the control of a
conditional stimulus, a target response following the S^D, and a consequence following the target response. The inclusion of the conditional stimulus allows for contextual control to be added to the three term contingency. Contextual control implies the control the environment has over behavior; for example, a child may embrace or flee from a parent depending on the parent’s tone of voice or the events of the day leading up to the parent’s arrival (Sidman, 1994).

Sidman (1993) explains that in order for a relation to be considered an equivalence relation it must meet three requirements: reflexivity, symmetry, and transitivity. Reflexivity is defined by a conditional relation between a stimulus and itself, for example A is related to A. Reflexivity is demonstrated when a participant can match identical, novel stimuli to one another. Symmetry, on the other hand, refers to the reversibility of relations. For example, if A is related to B then B must be related to A. In the matching-to-sample paradigm, this ensures that the stimuli within the relation can function as both comparison and sample stimuli. In transitivity, the third defining characteristic of equivalence relations, two stimuli are related through an association with a common, third stimulus; thus, if A is related to B, and B is related to C, then a relation of A to C must hold true. In this example, the relation between A and B and between B and C are explicitly taught; however, the relation between A and C must emerge without prior training. If this occurs, then transitivity is conclusively demonstrated (Sidman). Once stimulus equivalence has been established, the participant should be able to match any member of the equivalence class to any other member without further teaching. This outcome, which allows for the establishment of novel relations, has many implications. Not only can it account for much complex human behavior, but it can also inform teaching procedures.

The establishment of stimulus equivalence relations has been used to increase vocabulary, reading skills, and naming of stimuli among other skills in typical individuals as well
as those with developmental disabilities (de Rose, De Souze, & Hanna, 1996; Melchiori, De Souza, & de Rose, 2000). De Rose et al. combined a standard match-to-sample equivalence paradigm with verbal naming of pictures and words to increase reading and writing skills in first grade Brazilian students who had not learned to read and write simple words. In this study, the students were first taught a picture to printed word relation, followed by the printed word to dictated word relation. Before the equivalence test, the students were also taught to name the pictures and printed words. Following the first experiment, all participants demonstrated equivalence classes and were able to name pictures and words. A second experiment was then conducted which employed the same procedures as the first experiment with the exception that participants were required to use individual letters to construct copies of the printed words. Following the second experiment, participants were able to spell both trained and novel words using similar letter combinations. Naming of novel words also increased.

Further research has been conducted on the function of naming in the acquisition of equivalence relations. Randell and Remington (2006) used two sets of arbitrary stimuli, one rhyming and one non-rhyming, to study the function of verbal naming in the establishment of equivalence classes. The participants were typical adults. Although the stimuli were all known, their names were never given or dictated. Equivalence classes, consisting of arbitrary pictures, were established through visual-visual match-to-sample procedures. All participants established both equivalence classes; however, the number of trials to mastery for the rhyming classes was significantly lower than for the non rhyming classes. The number of errors made throughout training and testing were also lower during rhyming class establishment. Results of the study demonstrated the functional use of naming behaviors in the establishment of equivalence relations, even within a visual-visual paradigm.
Both of the studies described above involved conditional discrimination, or four-term contingencies. By adding additional controlling stimuli to the four-term contingency in the basic stimulus equivalence paradigm, contextual control can be evaluated. Sidman (1994) describes this control as second-order conditional control. The fifth term adds variation to the conditional control developed in the four term contingency. That is, if a four term contingency develops a relation that states A is related to B and C is related to D then the fifth term may add the contextual control that states A is related to B and C is related to D in the presence of X, but in the presence of Y, A is related to D and C is related to B.

Perez-Gonzalez and Serna (2003) studied the transfer of contextual control within different conditional discrimination procedures. A match-to-sample procedure was used to teach conditional discriminations; selection of B1 in the presence of A1 and B2 in the presence of A2. Additional stimuli were added to the match-to-sample procedure to establish contextual control. Then in the presence of X1 selection of B1 given A1, and B2 given A2 were reinforced; while in the presence of X2 selection of B2 given A1, and B1 given A2 were reinforced. Throughout the study new conditional discriminations were established and contextual stimuli were applied. Results demonstrated that contextual control had transferred to new relations when participants selected the same comparison in the presence of X1 as was previously established, and the opposite comparisons in the presence of X2.

Audience Control

Skinner (1957) defined audience control as, the selection of which repertoire to use under the conditional control of the present audience. Audience control is demonstrated when individuals use a different verbal repertoire (or language) based on the audience with whom they are speaking. Expressed differently, the person to whom they are speaking, the audience,
controls the language repertoire selected. For example, teenagers may speak-differently to their friends than they do to their grandmother. Similarly, a scientist may use different language when speaking to colleagues than when speaking to children. Audience control is exerted not only by the people being spoken to, but also by the environment in which the speaker is located. For example, an individual may speak differently when in a church than at a sporting event. In essence, audience control is an example of second-order conditional control, defined by Sidman (1994) as the environmental influence over conditional discriminations. Unfortunately, there is limited behavioral research on second-order conditional control as it relates to development of audience control.

In one of the few studies of its kind in print, Silverman, Anderson, Marshall, and Baer (1986) examined the development and generalization of audience control with individuals who had both mental retardation and typical functioning levels. In the study, 2 two-member audience classes, one comprised of puppets resembling animals and the other of puppets resembling humans, were established. Matching-to-sample training procedures were used to create membership in the two audience classes. One puppet from each class subsequently functioned as a teacher puppet who presented trials during the verbal repertoire training. The other puppets, which were never present during training trials, functioned as prober puppets in the probe trials. During repertoire training, the teacher puppets trained different verbal answers to questions regarding opposites; for example, good and evil. To illustrate, if the teacher puppet from Audience Class 1 asked the question: ‘What is the opposite of good?’ the designated answer was ‘evil’ (repertoire 1). However, if the teacher puppet from Audience Class 2 asked the same question, the designated answer was ‘bad’ (repertoire 2).
Following the establishment of repertoires, Silverman et al. (1986) conducted probe trials in which the prober puppets asked the questions that the teachers from their respective audience classes had presented. Questions and answers were the same within audience classes, thereby allowing generalization of the functional equivalence of previously trained audience classes to be tested. Following probe trials, the trained repertoires were reversed, which placed answers to questions under the control of the opposite audience class. During reversal trials when the teacher puppet from Audience Class 1 asked the question: ‘What is the opposite of good?’ the answer was ‘bad’ and when the teacher puppet from Audience Class 2 asked the answer was ‘evil’. The reversals functioned as an experimental control procedure. Following the reversal training, probe trials were conducted. Results showed that participants responded to prober puppets with the same answers as those trained by teacher puppets within their audience classes; that is, they reversed their answers from the previous probe trials. These results demonstrated that functional equivalence had formed among audience classes and audience class members exerted differential control over response repertoires.

The purpose of the current study was to further evaluate the establishment and generalization of audience control relations in individuals with developmental disabilities. A systematic replication of the Silverman et al. (1986) study was conducted. Adaptations were made to the study in order to develop culture specific audience classes. Rather than puppets, audience class members were photos of individuals wearing culture specific clothing. Further, this study used only visual-visual match-to-sample procedures rather than a combination of auditory-visual, visual-visual match-to-sample procedures, and intraverbal training procedures to establish audience class membership and response repertoires and to assess generalization of audience control from one member of the audience to another.
Method

Participants and Setting

The participants were Sam, an 8 year old boy diagnosed with autism and Becky, a typically developed 25 year old. Sam attended a day school specializing in the application of Applied Behavior Analysis to the education and treatment of children with autism. He was included in the study because his education occurred in two languages, Arabic and English. In addition to previous experience with two languages, both participants had a history with identity- and non-identity matching. Becky’s sessions were conducted in her home, whereas Sam’s sessions were conducted in his classroom cubby. The cubby, which was furnished with a table and two chairs, isolated Sam from the activities of the classroom. Only Sam and the experimenter were present during sessions.

Materials

For both participants, stimuli were presented using a PowerPoint presentation on either a laptop or desktop computer. Stimuli representing audience class members were photos of men and women wearing culture-specific clothing. All audience class member photos were 4cm by 6cm. Sample stimuli were 4cm by 4cm black and white line drawings of a tree and a car. Comparison stimuli were 4cm by 4cm pictures of a Mercedes, Ford, palm tree, and pine tree.

Reinforcement

For both participants, reinforcement was given on a continuous schedule during training trials and on a variable ratio (VR) 2 schedule during mastery trials for all phases. Reinforcers for Sam were identified during a preference assessment conducted prior to this study. He selected Hazelnut chocolate in 100% of opportunities therefore it was used as the reinforcer throughout this study. Becky’s reinforcer was identified via a verbal questionnaire. Becky selected M&M chocolate candy exclusively and therefore it was used as her reinforcer.
Dependent Variable, Measurement, and IOA

The primary dependent variable was the number of correct responses made during probe trials. A correct response was defined as selection of the experimenter-designated correct choice stimulus, when presented with a sample stimulus and four comparison stimuli. Selection was defined as pointing with an isolated finger to the correct stimulus.

The percent of correct responses per session was calculated according to data collected on a previously created data sheet. Data sheets indicated the audience class member, sample stimulus, and comparison stimuli that were to be presented for each trial. Data recorded consisted of “+P” for prompted correct response, “+” for an independent correct response, or “-” for an incorrect response. During sessions in which intermittent reinforcement was used, trials to be reinforced were also indicated on the data sheet.

Interobserver agreement (IOA) data were collected in 100% of sessions with Becky and 36% of sessions with Sam. The experimenter functioned as the primary observer for all sessions. The second observer was previously trained on the procedure, target response, and operational definitions. Sessions were video recorded and IOA data were collected from the videos. Interobserver agreement was scored by dividing the total number of agreements per session by the number of trials within the session and then calculating the average percent agreement across all sessions. The mean IOA scores were 100% and 99% (range, 93% to 100%) for Becky and Sam respectively.

Procedure

In Phase 1, two-member functionally equivalent audience classes, one Arabic and the other English, were developed through a computerized match-to sample procedure. Members of the Arabic audience class were a woman and man wearing Middle Eastern clothing. The
woman, who wore an abaya, served as the “teacher” and the man, who wore a kandora, was the “prober”. The English audience class members wore Western dress. The man, who wore a shirt and tie, served as the teacher, and the woman, who wore a skirt suit, was the prober. A trial began with the presentation of an audience class member in the top center of the computer screen. After the participant pointed to the audience class member, the comparison stimuli appeared on the bottom left and right corners of the screen. Comparison stimuli were two people, one dressed in Western and the other in Middle Eastern clothing, the S+, was the person dressed in cultural attire similar to the sample; for example, the man in the kandora was the + when the woman in the abaya was the sample. Each stimulus was presented as the sample four times and comparison stimuli were counter balanced on the right and left.

The experimenter controlled the presentation of stimuli. If the correct response occurred, the experimenter clicked the forward arrow key which advanced the presentation to a blank screen. While the blank screen was present, reinforcement was delivered; the experimenter advanced to the next trial when the participant was attending to the screen. If an incorrect response occurred, the experimenter clicked the back arrow key which returned the presentation to a blank screen. The trial was then repeated with full manual guidance.

A delayed physical guidance prompting procedure was used to teach the relationship between the sample and the correct comparison. Prompting began with immediate full manual guidance of both the observing response and comparison selection. After three sessions, the prompt was delayed by 2 s. Following another three sessions, the delay was increased to 4 s, if needed. If participants responded independently within the delay period, an independent response was recorded and post tests were given to determine if mastery had been achieved.
Phase 1a consisted of 16 trials with a mixture of Arabic and English audience class members. Once the participant reached criteria for mastery, 90% independent correct responses in three consecutive sessions, the number of trials was increased to 32 trials per session (Phase 1b). Three sessions were then conducted which included 32 trials per session; all correct responses were reinforced (FR1). Following Phase 1b, a variable ratio two (VR2) reinforcement schedule was introduced (Phase 1c). Phase 1c consisted of 3 sessions of 32 trials each. The criterion to proceed to Phase 2 was 90% independent correct responses in three consecutive sessions in Phase 1c.

In Phase 2, different matching performances (repertoires) were established in the presence of the English and Arabic audience class teachers. At the beginning of each trial, one of the two audience class teachers was presented at the top of the screen. After the participant made an observing response to the audience class teacher (touching the stimulus), a sample stimulus, either a car or tree, was added to the middle of the screen. An observing response to the sample produced the four comparison stimuli at the bottom of the screen. Reinforcement followed selection of the experimenter-defined correct stimulus. If the participant selected an incorrect stimulus a blank screen appeared and the trial was presented again with a full manual guidance prompt. A brief intertrial interval, approximately 3 s, preceded the presentation of the next trial.

The Arabic response repertoires consisted of selecting the Mercedes in the presence of the car sample and the palm tree in the presence of the tree sample when the Arabic audience class member was present. The English repertoire consisted of selecting the Ford in the presence of the car sample and the pine tree in the presence of the tree sample when the English audience class member was present. Table 1 depicts the audience, conditional stimulus, discriminative
Audience control

stimuli, and correct comparisons for each repertoire. The same prompting procedure and criteria to mastery were used for Phases 1 and 2. Training trials were presented in 16-trial blocks and followed the same procedure for increasing number of trials per session and introducing intermittent reinforcement as Phase 1.

In Phase 3 probe trials were conducted to assess the functional equivalence of the previously established audience class members; that is, generalization of audience control from the teacher to the prober member of each audience class was tested. Probe trials consisted of the presentation of stimuli from Phase 2 in the presence of the prober audience class members (see Table 1). Sessions consisted of 16 probe trials and 16 maintenance trials. Maintenance trials were trials previously mastered from Phases 1 and 2 and were interspersed with probe trials throughout the session. Probe trials followed the same sequence as Phase 2 repertoire training trials, except that the audience class teacher was replaced by the prober from the same audience class. Correct and incorrect responses during probe trials had no consequence. Correct responses during maintenance trials were reinforced and incorrect responses had no consequence.

Following Phase 3, reversal training was conducted. Phase 4 consisted of reversals of relations established in Phase 2. The same procedure was used as Phase 2 however, when presented with the car sample in the presence of the Arabic audience member selection of the Ford was now the correct response and in the presence of the English audience member selection of the Mercedes was now the correct response. When presented with the tree sample in the presence of the Arabic audience member selection of the pine tree was now the correct response and in the presence of the English audience member selection of the palm tree was now the correct response. Phase 5 probe trials were conducted once mastery criterion was reached in
Phase 4. Phase 5 procedures were the same as Phase 3. In this phase, however, the correct responses were those corresponding to the Phase 4 reversal training.

Results

Data were analyzed to evaluate the establishment of audience classes and to determine if responses under the control of the teacher audience class members generalized to the prober audience class members. Figures 1 and 2 show results of Phases 1 through 5 for Becky and Sam, respectively.

Establishing Audience Classes

In Phase 1 English and Arabic audience classes were established. Becky, who completed this phase in seven sessions, received physical guidance in one session and made no errors throughout the phase. Sam, who completed this phase in 11 sessions, required two sessions of immediate physical guidance before responding independently. During Phase 1, he made only one error.

Establishing Repertoires

Phase 2 established different repertoires of responses to the same $S^D$ under the control of different audiences. Becky completed this phase in seven sessions and required only one session of immediate physical guidance before responding independently with 100% accuracy until criterion for mastery was reached. Sam required 12 sessions before reaching mastery of Phase 2. Sam required three sessions of immediate physical guidance before responding independently. Sam responded with an average of 97% accuracy throughout all independent sessions.

Probes and Reversals

In Phase 3 previously mastered -and probe trials were presented. Both participants made no errors on the previously mastered relationships. Becky responded to probe trials with 100%
accuracy throughout all three sessions. Sam responded with 0%, 15%, and 13% accuracy in the presence of prober audience class members across the three probe sessions. Error analysis suggested that Sam’s behavior in this phase may have been controlled by gender rather than audience classes established in Phase 1. When the Arabic prober class member, a female, was presented Sam selected the same comparison as was previously trained by the English female teacher class member. When the English prober class member, a male, was presented Sam selected the same comparison as was trained with the male English teacher class member.

Phase 4 established the reversals of the initial response repertoires. Becky completed Phase 4 in seven sessions. Becky responded independently with 100% accuracy following one session of immediate physical guidance. Sam completed Phase 4 in twelve sessions. Three sessions of immediate physical guidance were required before Sam responded independently with 99.6% accuracy for the remainder of sessions. Consistent with the results from Phase 2, both participants maintained accurate responding throughout the increase in trials per session and reinforcement schedule thinning.

Phase 5 consisted of probe trials combined with previously mastered trials following the reversal training. Both participants responded to previously mastered trials with 100% accuracy through all three sessions. Becky responded to all probe trials with 100% accuracy. Sam responded to probe trials with 25%, 13%, and 31% accuracy across the three sessions. Sam continued to respond on the basis of gender rather than audience class membership.

Following the completion of Phase 5 an error analysis was conducted to evaluate whether Sam’s responding was under the control of gender or the trained audience classes. This analysis consisted of dividing the number of errors made by the total number of trials for the experimenter-defined correct response based on audience class membership, and comparing this
to the number of errors made by the total number of trials if gender had been the basis for correct responses. Results of the error analysis can be seen in Figure 3. Across the six probe sessions, in Phases 3 and 5 the average percent of correct responding under the control of audience class members was 22.8%. Across the same sessions the average percent of correct responding under the control of gender was 77.2%. All of Sam’s errors during probe trials were consistent with responding under the control of gender rather than audience class membership.

Discussion

Becky, a typically functioning adult, responded to probe trials under the control of audience classes trained in Phase 1, while Sam, an 8 year old boy with autism, did not. Both participants responded independently and accurately on training trials during audience class establishment and repertoire establishment. These responses were maintained when presented in mixed blocks during probe trials. An error analysis of Sam’s data indicates that his responding was under the control of the audience class member’s gender rather than the experimenter-defined audience classes.

The current study was a systematic replication of the Silverman et al. (1986) study. Silverman et al. used auditory-to-visual, in addition to visual-to-visual, match-to-sample procedures to establish audience classes in Phase 1, while the current study did not include auditory stimuli. Silverman et al. taught intraverbal responses during repertoire development; however, the current study used only visual-visual match-to-sample procedures to establish all relations. Results of the Silverman et al. study indicate that functional equivalences were formed during audience class member training and response repertoires came under the differential control of audience class membership. In the presence of prober puppets, participants responded by selecting the same stimuli as trained by teacher puppets within the corresponding audience
class during repertoire establishment. In the current study, one participant responded similarly to participants in the Silverman et al. study. Becky responded the same to prober audience class members as she was trained to respond to teacher audience class members, demonstrating generalization of audience control from the teacher to the prober. However, Sam’s responding did not show generalization from the teacher- to the prober audience class members. Results of the current study indicate that Becky formed functional equivalences during audience class establishment and that response repertoires were under the differential control of audience class members. Results of the study and error analysis indicate that Sam formed functional equivalences during audience class establishment, but response repertoires were under the control of gender rather than audience class membership of the probers.

The learning history of participants in this study may have produced the differences seen in generalization of control by audience class membership. Becky, the typically functioning adult, may have previously established “English” and “Arabic” classes before the Phase 1 training. Therefore, the training in Phase 1 of the study may not have been responsible for audience class development. Phases 2 and 4 may have brought the experimenter-defined correct selection responses under the control of existing audience classes. Based on Phase 1 training data, Sam did not appear to have learned English and Arabic classes prior to the study. Understanding the significance of Becky’s and Sam’s prior histories to the outcome of the present study requires further research.

A limitation of the study is the use of previously established audience classes. For the child with autism the audience classes seemed arbitrary; however, the typical adult may have had a previously established learning history with these classes. This may account for the differences in responding between the participants. Upon further analysis, audience class members, people,
do not appear to be arbitrary for Sam. Sam responded to prober audience class members based on the gender of the teacher audience class members. Control by this feature of the complex stimulus, “audience class member”, maintained even after the reversal of repertoires was established. In the Silverman et al. (1986) study, puppets were used as audience class members while photos of people were used in the current study. In addition to using puppets, Silverman et al. combined both animal and human puppets in each audience class. Audience members were combined into classes arbitrarily and had no previous connection with one another.

The training procedures used is a second limitation of the present study and presents additional differences between it and Silverman et al. (1986). This study only used visual-visual match-to-sample training procedures to establish both audience classes and response repertoires. The Silverman et al. study combined these procedures with auditory-visual match-to-sample procedures to establish the same relations among their audience class members. Using two training modes, visual and auditory, may have been more effective than using just one. While the relations seemed to have been established in the current study, functional equivalence of audience class members may not have been formed for Sam. Comparatively, all participants in the Silverman et al. study formed functional equivalence within audience classes.

The limitations described above suggest additional research. Firstly, future research could use novel stimuli as the audience class members; that is, stimuli with which the participants have no prior history. Skinner (1957) specifically notes that “audience” is not limited to people, but may also include places, objects, and other environmental stimuli. Audience class members could be represented by shapes, animals, figures, and so forth. The use of novel stimuli as audience class members may reduce the confounding effects that the participants’ learning history may have had on the results of the study. Secondly, replications of
the current study with more participants may help to analyze what part of the training procedures proved ineffective for Sam.

The current study evaluated the formation and generalization of audience control relations in individuals with developmental disabilities. Visual-visual match-to-sample procedures were used to establish audience classes and response repertoires under the control of teacher audience class members. Probe trials were used to evaluate the formation of functional equivalence and generalization of control of response repertoires among audience class members. The initial participant, a typical adult, successfully formed these relations and generalized control from teacher audience class members to prober audience class members. However, the second participant, an 8 year old boy with autism, did not show generalization of audience control relations from the teacher to the prober audience class members. Future research should focus on ways to increase the formation of functional equivalences among audience class members while working with individuals with developmental disabilities.
References


Table 1

Trial configurations for training and probe trials for English- and Arabic- audience classes in Phases 2 and 3.

<table>
<thead>
<tr>
<th>Audience</th>
<th>Conditional Stimulus</th>
<th>Discriminative Stimuli</th>
<th>Experimenter-Defined Correct Comparison</th>
</tr>
</thead>
<tbody>
<tr>
<td>English teacher</td>
<td>Car</td>
<td>Ford, Pine, Mercedes, Palm</td>
<td>Ford</td>
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<tr>
<td></td>
<td>Tree</td>
<td>Ford, Pine, Mercedes, Palm</td>
<td>Pine</td>
</tr>
<tr>
<td>Arabic teacher</td>
<td>Car</td>
<td>Ford, Pine, Mercedes, Palm</td>
<td>Mercedes</td>
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<td>Tree</td>
<td>Ford, Pine, Mercedes, Palm</td>
<td>Palm</td>
</tr>
<tr>
<td>English prober</td>
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<td>Ford, Pine, Mercedes, Palm</td>
<td>Ford</td>
</tr>
<tr>
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<tr>
<td>Arabic prober</td>
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<td>Palm</td>
</tr>
</tbody>
</table>
Figure Captions

*Figure 1.* Percent correct and percent error for participant 1 in Phases 1 through 5.

*Figure 2.* Percent correct and percent error for participant 1 in Phases 1 through 5.

*Figure 3.* Comparison of percentage of correct responses during probe trials, if correct responding was based on audience class versus if correct responding was based on gender of audience class members presented at the beginning of the trial, for Sam.
Figure 1
Figure 3