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Authors
Rieth, Sarah R
Stahmer, Aubyn C
Suhrheinrich, Jessica
et al.

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EXAMINATION OF THE PREVALENCE OF STIMULUS OVERSELECTIVITY IN CHILDREN WITH ASD

SARAH R. RIETH

UNIVERSITY OF CALIFORNIA, SAN DIEGO

AUBYN C. STAHMER

UNIVERSITY OF CALIFORNIA, SAN DIEGO AND RADY CHILDREN'S HOSPITAL, SAN DIEGO

AND

JESSICA SUHRHEINRICH AND LAURA SCHREIBMAN

UNIVERSITY OF CALIFORNIA, SAN DIEGO

Many individuals with autism spectrum disorders (ASD) display stimulus overselectivity, wherein a subset of relevant components in a compound stimulus controls responding, which impairs discrimination learning. The original experimental research on stimulus overselectivity in ASD was conducted several decades ago; however, interventions for children with ASD now typically include programming to target conditional discriminations in ways that might minimize the prevalence of stimulus overselectivity. The present study assessed 42 children who had been diagnosed or educationally identified with ASD using a discrimination learning assessment. Of these 42 children, 19% displayed overselective responding, which is a lower percentage than that seen in early research. Possible explanations for this decreased percentage, implications for intervention, and future directions for research are discussed.

Key words: autism, compound stimulus, conditional discrimination, stimulus overselectivity

Several decades of research have demonstrated that stimulus overselectivity is a problem for individuals with autism spectrum disorders (ASD) as well as other populations (Ploog, 2010). *Stimulus overselectivity* refers to the control of an individual's behavior by a subset of the total stimuli in the environment (Lovaas & Schreibman, 1971; Lovaas, Schreibman, Koegel, & Rehm, 1971; McHugh & Reed, 2007). This abnormality in attention and stimulus control may contribute to the difficulties experienced by individuals with ASD in learning appropriate social communication skills (Schreibman & Lovaas, 1973) and generalizing skills to new environments (Koegel & Rincover, 1974; Schreibman, 1997). For example, a child may learn to recognize someone only by his or her glasses rather than by the plethora of identifying features that are typically used for identification (e.g., facial features, height, body type). Incorporation of conditional discriminations with compound stimuli (i.e., discriminations that require response to two or more elements of a stimulus such as shape and color) into programming has been shown to reduce overselectivity and ameliorate associated learning problems (Burke, 1991; Koegel & Schreibman, 1977; Schreibman, Charlop, & Koegel, 1982).

The original research on stimulus overselectivity in ASD was conducted over 30 years ago and may need to be updated for several reasons. First, there have been several decades of research

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Sarah R. Rieth is now associated with the Department of Child and Family Development at San Diego State University, and Aubyn C. Stahmer is now associated with the Department of Psychiatry and Behavioral Health, MIND Institute, University of California, Davis.

Correspondence concerning this article should be addressed to Sarah R. Rieth, Child and Adolescent Services Research Center, 3020 Children's Way MC 5033, San Diego, California 92123 (e-mail: srieth@mail.sdsu.edu).

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on the phenomenon of overselectivity and on the optimal technology for conditional discrimination training (Barthold & Egel, 2001; Green, 2001; Ploog, 2010). Second, participants in the original studies on overselectivity in ASD may have been more severely impaired than the current population. The participants in the first studies were all severely affected and likely faced permanent hospitalization (Lovaas & Schreibman, 1971; Lovaas et al., 1971), whereas increased awareness, improved interventions, and a broadening of the diagnostic criteria for ASD has resulted in a current population of children with ASD that is less impaired. Shifts in diagnostic criteria have resulted in a broader range of social and communication impairments being identified in children with ASD (Tidmarsh & Volkmar, 2003; Volkmar, Lord, Bailey, Schultz, & Klin, 2004). In fact, the time since the original overselectivity research was conducted has spanned the introduction of the third, fourth, and fifth editions of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*), each of which contains significant alterations to the criteria for ASD (Tidmarsh & Volkmar, 2003). As one example of a changed feature of the population and improved intervention services, original estimates held that over 70% of individuals with ASD would never acquire functional speech, whereas more recent data indicate that the percentage of children with ASD who do not use words to speak is less than 20% (Lord, Risi, & Pickles, 2004). The broadening of the definition of ASD has played a large role in altering the population of children who receive services for the disorder (Fombonne, 2001; Kabot, Masi, & Segal, 2003; Nassar et al., 2009; Steyaert & De la Marche, 2008; Wolff, 2004).

Another important new scientific finding in this area is that typically developing children display some degree of overselectivity until they are 3 years old (Reed, Stahmer, Suhrheinrich, & Schreibman, 2013). Many of the earlier studies of children with autism may have included individuals who functioned at younger than 3 years; thus, earlier findings of overselectivity may have been a developmentally appropriate finding rather than a unique feature of autism. Therefore, it is necessary to reexamine whether overselectivity is present in today's population of children with ASD above this developmental level in order to gain an estimate of stimulus overselectivity that is unique to the current diagnosis of ASD. Early studies consistently indicated that approximately 80% of children with ASD displayed overselectivity (e.g., Gersten, 1983; Koegel & Wilhelm, 1973; Lovaas & Schreibman, 1971; Lovaas et al., 1971), but it is unknown what percentage characterizes today's population.

The characteristics of today's population of individuals with ASD have important clinical implications for intervention delivery. Recent years have seen a tremendous growth in the number of applied behavior-analytic treatments available for individuals with ASD in community settings. The availability of professional licensure for behavior analysts (Behavior Analyst Certification Board, 2014), insurance reform that requires funding for delivery of applied behavior-analytic treatment (Reinke, 2008), and the validation of behavior-analytic treatments for ASD as evidence based (Wong et al., 2014) have all contributed to the growth in service delivery. This increased access to service creates increased responsibility for behavior analysts to examine existing practices and to evaluate their fit to the population served. Interventionists need to know the proportion of children who receive intervention today and have difficulty with overselectivity to design effective curricula. Others have made similar statements about the importance of identifying the presence or absence of restricted stimulus control in individuals with ASD before specific teaching procedures are selected and implemented (Doughty & Hopkins, 2011). Conducting a brief overselectivity assessment before instruction is implemented may increase the efficiency of intervention by improving identification of appropriate prompting and intervention techniques (Kodak et al., 2011). The objective of the current study was to determine the extent to which children who currently receive public intervention services for ASD display overselectivity in a conditional discrimination paradigm.

METHOD

Participants

Forty-two children identified as having ASD, 3 to 10 years old ($M = 5.6$; $SD = 1.8$), were recruited for participation in the current study. The majority of participants were male ($n = 28$; 67%), and the average receptive language age equivalence was 4.4 years ($SD = 1.2$). The inclusion criteria required the child to be currently receiving services under an educational classification of autism and to have a receptive language age equivalence at or above 3 years. This age equivalence was selected based on previous work that demonstrated that typically developing children do not reliably respond correctly to single-feature conditional discriminations until this age, therefore precluding the possibility of separating overselective responding characteristic of ASD from overselective responding due to developmental level for children below this age (Reed et al., 2013).

An educational classification of autism rather than a research or clinical diagnosis was used to obtain a sample of children who are typically served in applied settings, because this population is most directly relevant to behavior analysts in the community. However, Autism Diagnostic Observation Schedule (ADOS; Lord, Rutter, DiLavore, & Risi, 1999) scores were available for 21 participants (50%) from assessments that occurred within 3 months of the current study and were conducted by a reliable assessor. ADOS scores for these participants indicated that 100% exceeded ASD cutoff scores, indicating a high probability of a match between educational classification and ASD diagnoses for these participants. Social Communication Questionnaires, Current Form (SCQ; Rutter, Bailey, & Lord, 2003) completed by the teacher within 3 months of the current study were available for an additional 17 participants (40%). SCQ scores for these participants indicated that 100% exceeded the ASD cutoff scores. These assessments provide a high level of confidence for a match between educational classification and ASD diagnoses for at least 90% of participants.

The majority of participants ($n = 39$; 93%) were recruited through public elementary school and preschool programs. Several local special education teachers with either a history of collaboration or current involvement with the study authors agreed to send home a flyer and descriptive letter explaining the study. Interested parents returned the letter and consented to their child's participation. Three additional potential participants with ASD were contacted through a database of families interested in participating in ASD research. These families were contacted by phone or e-mail, and willing families set an initial appointment with an experimenter for consent and assessment. Subsequent assessment sessions were scheduled as needed.

Procedure

An experimenter conducted a standardized language assessment and the discrimination learning assessment described below with each participant in one or two appointments. Experimenters for this study included the first, second, and third authors and two research assistants, all of whom had extensive experience with children with ASD. Participants were assessed to determine receptive language age equivalence. During initial recruitment, 18 participants received a Mullen Scales of Early Learning (Mullen, 1995). In a second recruitment wave, additional participants received either the Preschool Language Scales IV (PLS; Zimmerman, Steiner, & Pond, 2002) or the Comprehensive Assessment of Spoken Language (Carrow-Woolfolk, 1999), as appropriate for the child's age and developmental level. Age equivalences for receptive language subscales from each assessment were used to compare across assessments. A total of three children completed the discrimination learning task but were unavailable for the standardized language assessment, one because of the end of the school year and two because they failed to respond to scheduling phone calls for a second session. For these children, an estimate of language age equivalence was obtained from the Vineland Adaptive Behavior Scales II (Sparrow, Cicchetti, & Balla, 2005) scores available in their individual education plans. Details of the number of children who received each standardized assessment and receptive language age-equivalence scores are presented in Table 1.

All testing took place in one of two environments, according to the preferences of the child's parents. Most children ($n = 38$) participated during their regular day at school. Arrangements were made with the child's classroom teacher for an experimenter to work independently with the child, either at a small table or an area in the child's regular classroom or in another available room on the school campus. Four children participated during a visit to a university research laboratory with their parents. For these children, testing took place at a table with the experimenter sitting directly across from the child in a small room with a large one-way observation panel on one wall. Parents watched the assessments from an observation room on the other side of the panel.

Each testing session began with a brief period in which the experimenter interacted with the child with several toys. After the experimenter judged the child to be comfortable in the testing situation, she began the assessments. If the child appeared to be bored with testing or attention to the experimenter decreased noticeably even after brief breaks (e.g., repeatedly leaving the testing area, pushing the stimuli off the table, repeatedly making responses with the stimuli unrelated to the task), the session was ended and a second appointment was scheduled. At the conclusion of testing, each child was given a small prize for participating (e.g., stickers, a small toy).

Table 1
Receptive Language Age-Equivalence Scores

Assessment	*n*	*M*	*SD*
MSEL	18	48.8	8
PLS-IV	18	55.3	18
CASL	3	75	35.8
Other (VABS)	3	45.6	2.5

Note. MSEL = Mullen Scales of Early Learning, Receptive Language Subdomain; PLS-IV = Preschool Language Scales IV; CASL = Comprehensive Assessment of Spoken Language; VABS = Vineland Adaptive Behavior Scales II.

Discrimination learning assessment. The discrimination learning assessment was modeled after similar conditional discrimination paradigms designed to assess responding to compound stimuli in young children and individuals with ASD and other developmental disabilities (Eimas, 1969; Koegel & Wilhelm, 1973; Ploog & Kim, 2007; Schover & Newsom, 1976; Schreibman, 1975).

Materials included six wooden blocks (approximately 5 cm by 5 cm). Two blocks were used as training stimuli: a green cube and an orange pyramid. Four additional blocks were included as testing stimuli: a green T, an orange T, a pink cube, and a pink pyramid (see Figure 1). These color and shape features are consistent with those used by Schover and Newsom (1976), except that three-dimensional blocks were used in the present study rather than two-dimensional cards. Three-dimensional shapes were used so that the materials in the assessment would be similar to objects encountered in children's everyday routines (i.e., a colorful set of building blocks). The assessment consisted of repeated presentations of pairs of blocks to the child with instructions to choose one of the blocks. Correct performance rates on the discrimination task were classified into four categories, and performance was compared between participants (see *Analysis of Stimulus Control*). The experimenter conducted a training phase (30 to 80 trials, dependingt on the child's performance) and a testing phase (30 trials) with each participant.

Training phase. The green cube and the orange pyramid were used as training stimuli.

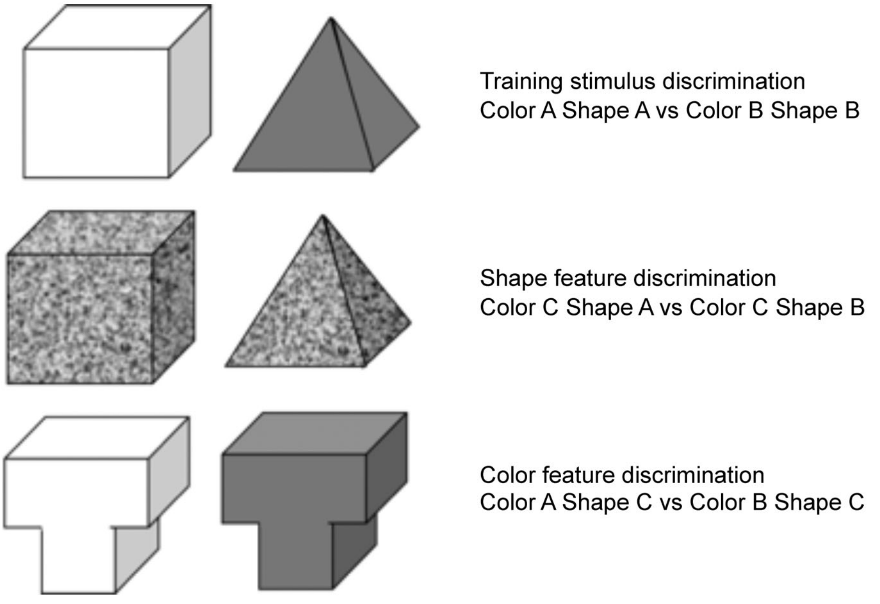

Figure 1. Representation of stimuli. Six colored blocks of the types shown were used for the training and testing phases.

To begin the assessment, the experimenter held up one of these two blocks and said, "[Child's name], this is the correct block," and handed it to the child for a few seconds. She then took both blocks, removed them from the child's view briefly, presented the blocks by setting them on the table approximately 30 cm in front of the child, and gave the cue, "Give me the correct block," followed by a pause for the child to respond. If the child indicated the appropriate block (either by taking and extending the block towards the experimenter, pushing the block across the table, or touching the block and making eye contact), the experimenter provided praise using phrases such as "That's the correct block! You got it!" The experimenter never named either of the blocks' features of interest (color or shape). If the child did something with the blocks that was unrelated to the assessment (e.g., stacked the blocks on top of one another; pushed one or both blocks off the table), the experimenter removed both blocks from the child's view and then re-presented the blocks and the instruction. If the child failed to respond within 60 s or began to respond incorrectly, the experimenter prompted the correct answer at the necessary level of support to ensure a correct response for the first trial. The experimenter continued immediate prompting when necessary until the child independently responded correctly in two consecutive trials. After the child met this performance criterion, the experimenter utilized a no-no-prompt strategy following incorrect responses (i.e., she responded with "no" for two consecutive trials to which the child responded incorrectly, then removed the blocks and presented the next trial; if the child moved to respond incorrectly for a third consecutive trial, the experimenter immediately prompted the correct response; e.g., Leaf, Sheldon, & Sherman, 2010). Prompting was continued and then faded until the child responded correctly and independently in two consecutive trials. The block designated as correct was randomized across participants, as was the left–right position of the correct block on each trial. Correct responses were continuously followed with praise (e.g., "You go it!" "Way to go!" "Good job!") and preferred tangible items (e.g., a spinning top, a ball, small snacks) individually identified by a parent questionnaire.

After one set of 10 trials at 80% correct or better, the experimenter shifted to a variable-ratio (VR) 3 schedule of praise and tangible items to reduce discrimination between the training and testing phases (e.g., Dube & McIlvane, 1999; Koegel & Wilhelm, 1973; Schover & Newsom, 1976). On trials without praise or tangible items, the experimenter responded to correct responses by saying "thank you" or "okay" in a neutral tone of voice. Training trials continued until the child achieved at least 80% correct responding across two sets of 10 trials on the VR 3 schedule.

After the child reached the mastery criterion, the testing phase began. For children who began the testing phase on a different day than the day on which they reached mastery in the training phase, 10 training trials were conducted at the start of the session to ensure that the child could still respond at the mastery level. If the child did not respond at this level, the experimenter began the training phase a second time. If the child responded at 80% correct or better, the testing phase began.

Testing phase. The testing phase involved three pairs of blocks: a green cube and an orange pyramid (training stimuli), a green T and an orange T (color feature stimuli), and a pink cube and a pink pyramid (shape feature stimuli). To determine which features (color, shape, or both) controlled the child's responses, the experimenter randomly interspersed trials of the color feature stimuli (green T and orange T) as well as the shape feature stimuli (pink cube and pink pyramid) with the compound stimuli used in the training phase (green cube and orange pyramid). The testing phase consisted of 10 trials of each of the three types of discrimination (i.e., compound, color, and shape) to determine whether the child accurately identified both the color and shape features of the training stimulus in a separate discrimination. Order of presentation of each type of trial was randomized within and across participants. The testing phase was conducted in the same manner as the training phase except for the identity of the stimuli presented and the schedule of praise and tangible items delivered. During testing, praise and tangible items were provided for correct responses to the interspersed training stimuli trials, and a neutral response occurred for all testing stimuli trials. Praise and tangible items were provided periodically for compliance and attending behaviors.

In an assessment session, testing was discontinued if the child failed to respond within 1 min of stimulus presentation to each of the 30 testing trials or if the child could not be redirected from attempts to leave the testing area. For these participants, a second and final session of testing was conducted at an additional appointment. If the participant was unable to sustain attention to the task for a period of 30 min on the 2nd day, testing was discontinued and data for that participant were considered incomplete.

Fidelity of implementation. A measure of fidelity of implementation of the assessment procedure was collected for 13 of the assessments (31%). A second experimenter was in the room and scored a 15-item procedural integrity checklist that consisted of yes–no responses to items such as "Experimenter does not name color or shape throughout the assessment" and "Removes both blocks from view between trials." For items that referred to individual trials (e.g., removes both blocks), data were collected on each trial. The experimenter was required to complete the step accurately in 80% or more of the trials to be marked "yes" overall for that item. The fidelity score for each assessment was the percentage of items out of 15 marked "yes." Across all assessments scored, the average fidelity score was 97% (range, 87% to 100%). (The procedural integrity checklist is available from the authors.)

Interobserver agreement. Interobserver agreement for child responses was collected for 11 (26%) of the assessments. A second experimenter was in the room and scored the child's response on each trial simultaneously with the experimenter (e.g., correct, incorrect, prompted, no response). Interobserver agreement was calculated by dividing the number of agreements by the total number of trials and converting the result to a percentage. Across all assessments, the average interobserver agreement was 95% (range, 85% to 100%).

RESULTS

Training

Nearly all participants (98%; $n = 41$) met the mastery criterion for the training phase. The majority (88%; $n = 37$) did so by responding at 80% correct or better across two blocks of 10 trials each. Four participants met mastery criterion for the training phase by verbally explaining their selection in each of 10 trials, and further trials were deemed not necessary to demonstrate learning. The number of trials required to meet the mastery criterion ranged from 30 to 80 ($M = 39.07$, $SD = 13.99$). There was a significant correlation between participants' language age-equivalence score and the number of trials they required to meet mastery, $r(39) = .61$, $p < .01$. One participant was unable to complete the training phase, as determined by failure to respond to at least 10 trials (either correctly or incorrectly) in a period of 30 min on each of 2 days; therefore data for this participant were not included in the analysis.

Testing

Analysis of stimulus control. After completion of the assessment, participants' performances on the discrimination task were classified into four categories based on the proportion of stimulus features to which the participant responded: normal simultaneous responding, overselective responding, failure to acquire, or other. Operational definitions based on this assessment for each of these performance categories are identical to previous research and are provided in Table 2 (Bailey, 1981; Koegel & Wilhelm, 1973; Schreibman, Koegel, & Craig, 1977).

Maintenance of compound discrimination during the testing phase. Figure 2 shows the association between participants' performances on the 10 trials with the training stimuli that were interspersed during the testing phase and their receptive language age-equivalence scores. Participants who responded at 80% correct or better to these trials were considered to have maintained the training discrimination required for the assessment. Of the 41 participants who successfully completed the training phase, five failed to maintain the training discrimination during the testing phase. These participants represented a range of chronological ages and language age equivalences, neither of which was significantly

Table 2
Discrimination Learning Assessment Performance Classifications

Category	Performance definition
Normal simultaneous responding	Child correctly responded to both color and shape stimuli at 80% correct or better. Child maintained at least 80% correct responding to the training stimulus during testing phase.
Overselective responding	Child correctly responded to the training stimulus and one stimulus (shape or color) at least 80% of the time while responding to the other stimulus feature at chance (25% to 75%).
Failure to acquire	Child did not maintain at least 80% correct responding to the training stimulus discrimination during the testing phase. Therefore, all responses were considered random, and results were not considered further.
Other (unclear)	Child responded at chance levels to both feature stimuli or at chance to one feature stimulus and below chance to the other feature stimulus.

Note. A value of 80% correct was selected for above chance based on the 95% critical value for a binomial distribution as well as previous research.

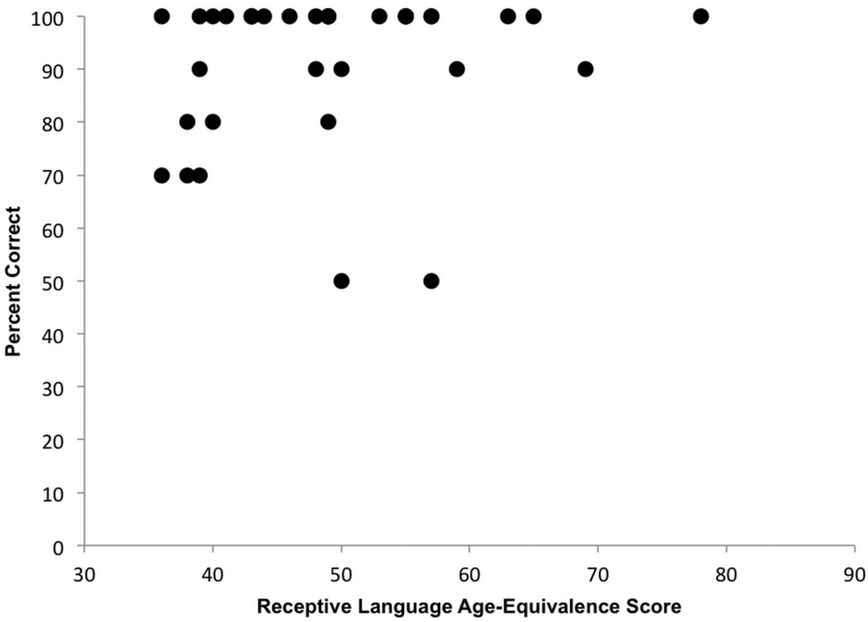

Figure 2. Performance on the training discrimination (green cube vs. orange pyramid) during test trials for participants who completed the assessment.

different from the participants who did maintain the discrimination: chronological ages: $t(39) = –1.07, p > .05$; language age equivalences: $t(39) = –2.16, p > .05$); see Table 2. Responses to the separate stimulus features were not considered further for those who were unable to maintain the training discrimination, and their performance was considered "failure to acquire." Four participants verbally labeled the correct answer to the discriminations during the testing phase by naming both features of interest (e.g., "It's the green cube."). These detailed verbal responses were considered to indicate maintenance of the compound stimulus discrimination during the testing phase. These are the same four participants who explained their selections verbally during the training phase. These children are not represented in Figure 2. The remaining 32 participants successfully responded to the training stimulus discrimination at 80% or above during testing trials, indicating maintenance of the training stimulus discrimination learned during the training phase and valid comparison of separated stimulus features to determine overselectivity. There was no significant correlation between participants' receptive language age-equivalence scores and their percentage correct on the training discrimination during the testing phase, $r(35) = .18, p > .05$.

Response to test trials. Participants' individual performances on feature discrimination trials of the testing phase are shown in Figure 3. Eight participants (19%) displayed overselective responding, with chance responding to one feature stimulus and above 80% correct responding to the other (Participants C, H, I, M, Z, AA, AB, and AF). Of those eight participants, six (75%) had a research-quality diagnosis of ASD and two (25%) had an educational classification of ASD. When considering the 21 participants with a research-quality diagnosis exclusively, the percentage of participants who displayed overselective responding was 29%. No one feature was preferred: Four children overselected by color

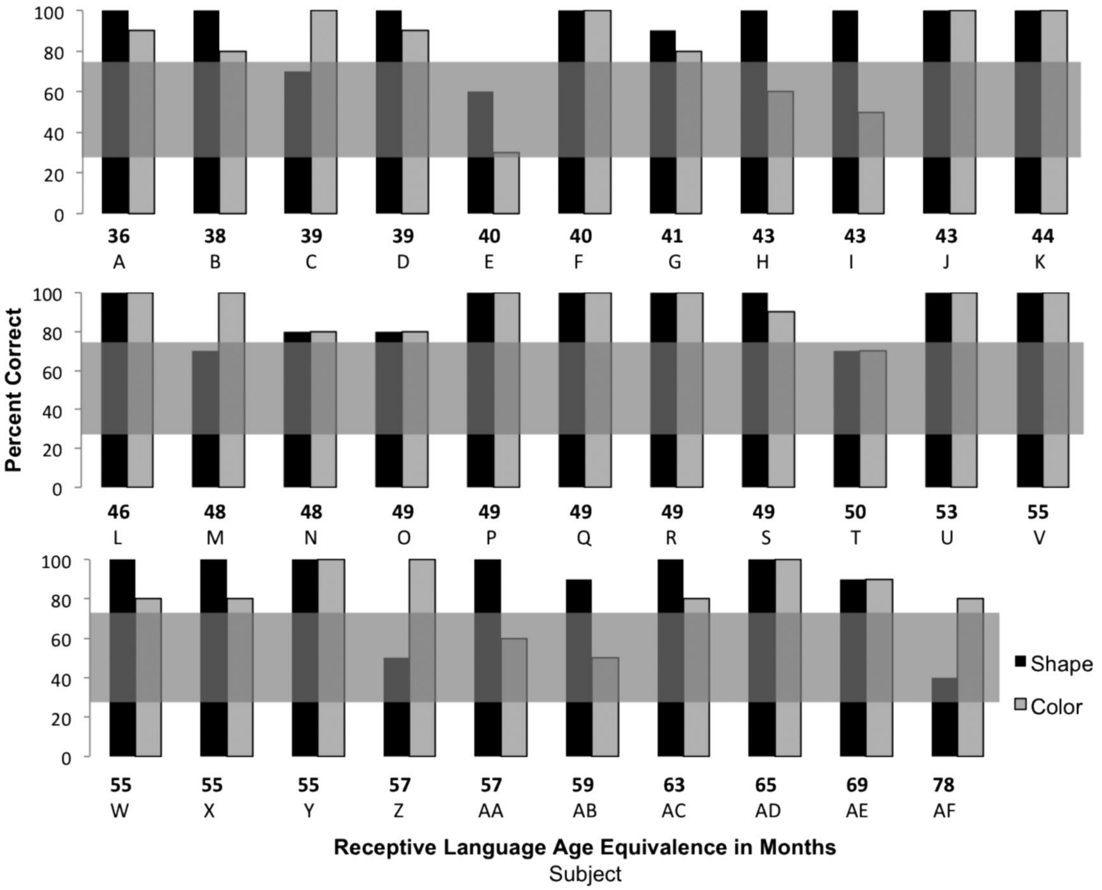

Figure 3. Percentage correct on shape and color feature discriminations during the testing phase. Overselective responding is indicated by one feature performance being within the shaded region (chance, 25% to 75% correct), and the other feature performance being above the shaded region. Participants C, H, I, M, Z, AA, AB, and AF displayed overselective responding.

and four by shape. Two participants (5%) displayed chance responding to both feature stimuli, despite maintenance of the original discrimination (Participants E and T). A total of 26 (63%) participants displayed normal responding with no evidence of overselectivity. Twenty-two did so by correctly responding to both the original discrimination and both feature stimulus discriminations at 80% correct or better. Four additional participants displayed normal simultaneous responding by verbally explaining their selection of the block in each of the feature discriminations across the first three to five test trials of the testing stimuli, indicating explicit awareness of both features of the compound stimulus (e.g., "It's the green T because it is green like the cube."). These four children were the same as those for whom the training trials were discontinued based on verbal explanations. Based on their responses, these participants were considered to display normal responding, and the assessment was discontinued at that point. Their data are not represented in Figure 3.

Table 3 summarizes the number, mean age, and mean receptive language age-equivalence score of participants in each category of

Table 3
Participants' Performances on Discrimination Learning Assessments

Performance type	Source	Number of participants (% of sample)	Mean age in years (*SD*)	Mean receptive language age equivalence in years (*SD*)[a]
Normal simultaneous responding	Testing	22 (52)	5.45 (1.8)	4.13 (.73)
	Verbal explanation	4 (10)	8.70 (1.68)	7.54 (1.36)
Overselective responding	Testing	8 (20)	6.6 (1.74)	4.42 (1.1)
Failure to acquire	Testing	5 (12)	4.88 (1.63)	3.66 (.76)
Other (unclear)	Testing	2 (5)	5.61 (1.88)	3.75 (.60)

[a]Receptive language age equivalences were drawn from the MSEL, PLS, CASL, or VABS based on which assessment the child received.

performance. A between-subjects analysis of variance that examined both the chronological age and receptive language age-equivalence scores across performance types revealed that children who verbally explained their stimuli selection were significantly older and had higher receptive language age equivalence than all other groups: chronological age: $t(39) = 3.91$, $p < .05$; receptive language age equivalence: $t(39) = 4.96$, $p < .05$. There were no other significant differences on chronological or receptive language age-equivalence scores across performance types.

DISCUSSION

Results of this study demonstrate that the majority of children with ASD who were assessed did not display difficulty with stimulus overselectivity in a conditional discrimination paradigm using compound stimuli. These results stand in contrast to original studies of overselectivity in ASD that used similar paradigms and found that higher percentages of individuals with ASD displayed overselectivity on these tasks. The present data suggest that the population of children with ASD who receive intervention services has potentially changed over time. Although there are many possible reasons for the differences, these data imply that we need to take a closer look at current intervention practices to ensure that these practices offer maximum efficiency, effectiveness, and appropriateness for this population. Therefore, modifications to clinical intervention programs may be advisable. The brief task used in the current study could possibly be used as a quick assessment for the presence or absence of overselectivity for individuals with ASD. Performance on the assessment could inform teaching strategies by suggesting whether incorporation of conditional discriminations with compound stimuli into teaching is necessary for that individual. This may be particularly relevant for interventions that include the use of conditional discriminations as a component of the overall protocol, such as pivotal response training (Koegel et al., 1989) and other behavior-analytic approaches that are currently in widespread use.

There are several possible explanations for the shift in percentage of children with ASD who displayed overselectivity on conditional discriminations in this investigation and in previous studies. First, the population tested in the current study included only children with a receptive language age-equivalence score of 36 months or above. Due to this criterion, the participants tested were probably higher functioning and more advanced developmentally than participants in the earlier studies. The fact that a few participants could tact the multiple features of the stimuli in complete, grammatically correct sentences suggests that they were more advanced in their language skills than the participants in the earlier studies. However, because it has been demonstrated that typically developing children under 3 years old are regularly overselective (Reed et al., 2013), the inclusion criteria in this study allow an estimate of individuals with ASD who are overselective independent of their developmental level. This is an important update to the early research on overselectivity and ASD that takes functioning level into account and estimates the presence of overselectivity that is likely unique to ASD rather than the result of cognitive or language functioning. An informal comparison between the group tested in the current study and a sample of typically developing children who participated in a similar assessment (reported in Reed et al., 2013) indicates that the percentage of children with ASD who responded overselectively is above that of typically developing children (19% of children with ASD vs. 6% of typically developing children). However, intentional comparison between ASD and typically developing samples matched specifically on cognitive functioning would further inform the question of overselectivity that is unique to ASD.

Another possibility for the shift is the broadened range of impairments seen in children with ASD based on changes to the *DSM* criteria across the last three decades (Tidmarsh & Volkmar, 2003). As the heterogeneity and subtleties of ASD have become more fully understood, the diagnosis has grown to include individuals not only with classic signs of autism but also children with similar but less severe clinical symptoms (Fombonne, 2001). In addition, in the current study participants were recruited based on an educational classification of autism, which is broader than the *DSM* criteria. When the 50% of participants for whom ADOS scores were available were considered, six displayed overselective responding (29%), one responded at chance levels to both features (5%), and 14 displayed normal simultaneous responding (67%). This is highly similar to the distribution of response types seen in the wider sample. It is possible that the 20% of all participants who displayed overselective responding in the current study represent a subset of the population that is most similar to individuals in previous studies. However, we do have some evidence that children who displayed difficulty in this study were not simply the most severely affected among those tested. Available ADOS scores (available for 75% of those who displayed overselective responding and 53% of those who displayed normal simultaneous responding) did not reveal any significant patterns for those who displayed overselective or normal simultaneous responding, although a previous study found that participants with higher ADOS scores were more likely to be overselective (Dickson, Wang, Lombard, & Dube, 2006). Because these data were not collected systematically as part of the current study, future research should continue to explore the potential relation between ASD severity and stimulus overselectivity.

Another explanation for the contrasting results found here might be the type, quality, and timing of intervention available to children with ASD today. Many early intensive behavioral intervention programs include curricular targets such as conditional discriminations and responses to multiple exemplars (Lord & McGee, 2001). These strategies may be sufficient to increase responding to multiple features of stimuli in the environment, therefore minimizing faulty stimulus control and overselectivity as children develop (Ploog, 2010). In addition, children are diagnosed and receive treatment services at increasingly younger ages (Corsello, 2005; Lord et al., 2006; Stone et al., 1999). It is possible that earlier intervention with optimally designed conditional discrimination training procedures (see Green, 2001) may prevent or ameliorate some degree of overselectivity. Unfortunately, data were not available regarding early intervention experiences for the children in the study. However, all were over 3 years old and lived in an area where typical intervention programs likely included components that addressed stimulus overselectivity. Even if overselectivity is less common, an assessment that identifies overselectivity when it exists would be beneficial. Clearly not all forms of stimulus overselectivity can be captured through a brief discrimination learning assessment with familiar objects. These data provide preliminary evidence that the basic deficit may be different or ameliorated in the current ASD population who receive community services.

Although these results suggest that fewer children with ASD with language skills above 3 years old may have difficulty with overselectivity than previously demonstrated, further research is needed. One limitation to the current study is that the conditional discrimination task used was the simplest possible type (two-feature compound stimulus, two-item array, familiar materials). Perhaps a higher percentage of children with ASD would show overselectivity with a more difficult task. Earlier research has demonstrated increased overselective responding with an increased number of stimulus components in a compound (Burke & Cerniglia, 1990; Lovaas et al., 1971; Lovaas & Schreibman, 1971) and with various types of stimuli (Dickson et al., 2006), such as tactile stimuli (Ploog & Kim, 2007). Tactile simultaneous conditional discrimination is likely a more unfamiliar task and more difficult than the visual task used here. Future research should seek to examine more complex types of compound stimuli and to clarify their role in teaching strategies for this population.

The lack of information about history and functioning of the sample is also a limitation to the study. Full details about early intervention history, level of cognitive functioning, and clinical diagnoses were not gathered in the current study. The absence of this information prevents a conclusive and detailed comparison to participants in previous studies. The lack of information about the learning history for each participant means that we cannot determine the degree to which effective instructional procedures in conditional discrimination training may have been included in prior programming. We are also unable to determine exactly how this sample of children compares to the general population of children with ASD in terms of intervention received. Future research projects that characterize early intervention and examine responsivity to simultaneous multiple cues are needed to better understand the development of this skill in the current population of children with ASD. Furthermore, because children were recruited from the classrooms of teachers who had a history of previous collaboration with the study authors, it is possible that these teachers were in some way more experienced or effective than those teachers who had not participated in research. Therefore, students in their classrooms may have received a qualitatively different education experience than a different sample of the population. However, at the time the assessments were conducted, only 14% of the teachers from whom students were recruited had received any training from the study authors. Still, replication of these findings in additional populations is necessary.

The current study indicates that a smaller percentage of children who receive services for ASD may have difficulty with stimulus overselectivity that is unique to ASD than previously thought. These results suggest that discrimination training that targets overselectivity may only need to be incorporated on an individual basis for children with this specific difficulty. The testing procedure described in the current study could be used as a quick assessment to individualize treatment. Overall, this study represents the importance of returning to basic research to inform optimal clinical practice.

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