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ORIGINAL PAPER

Insistence on Sameness in Autistic Children: a Stimulus Control Analysis with Implications for Assessment and Support

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Abstract

Objectives A characteristic of some individuals with autism is described as an "insistence on sameness." For these individuals, a violation of sameness may occasion problem behavior. Given this, a more precise understanding of the construct of sameness from a behavioral perspective is desirable for assessment and intervention purposes. In this paper, we first examined the role of an existing behavioral theory, stimulus overselectivity, in relation to this issue. A detailed stimulus control analysis led to the conclusion that this theory does not adequately account for problem behavior occasioned by violations of sameness. Based on this analysis, we developed a conceptual model for assessing and treating problem behavior associated with insistence on sameness.

Methods Three representative cases from our past clinical experience with children with autism were employed to develop the conceptual model: (a) paying attention to too few stimuli, (b) paying to too many stimuli, and (c) paying attention to sequentially presented stimuli. Following a detailed stimulus control analysis of each case, we introduce a competing behavior pathways framework for organizing a functional assessment of child problem behavior occasioned by violations of sameness, and for developing a behavior support plan that emphasizes prevention, teaching, and positive reinforcement. We then apply the framework to the three cases, and illustrate its utility for developing an individualized, multicomponent positive behavior support plan for each of the children.

Conclusions We conclude the paper with considerations for future research to empirically examine the proposed conceptual framework for understanding and treating problem behavior in individuals with autism associated with violations of sameness.

Keywords Stimulus overselectivity · Stimulus control · Autism · Assessment · Problem behavior

Since autism was first described in the scientific literature by Kanner (1943), a common feature of the condition is described as an "insistence on sameness." In his classic case study of 11 children with autistic-like behaviors, Kanner wrote:

> The child's behavior is governed by an *anxiously obsessive desire for the maintenance of sameness* that nobody but the child himself may disrupt on rare occasions. Changes of routine, of furniture arrangement, of a pattern, of the order in which every day acts are carried out can drive him to despair. (p. 245)

Perhaps due to the non-behavioral nature of this description, the field of applied behavior analysis has failed to provide explicit attention to the issue of insistence on sameness and the role of this variable in assessing and intervening on problem behaviors. Indeed, this characteristic of autism may be considered a specific risk factor for problem behavior in this population (Iwata, 2011). This article seeks to provide a behavioral analysis of insistence on sameness and its relationship to problem behaviors, functional assessment, and support for autistic children.

To that end, perhaps the most parsimonious behavior analytic explanation of the insistence on sameness phenomena is from a discriminated operant and stimulus control perspective. Discriminated operant refers to behavior that occurs more frequently under some antecedent conditions

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than others (Cooper et al., 2020). A discriminated operant occurs more frequently in the presence of a given stimulus than in its absence and is thus said to be under stimulus control. For example, the ringing of a telephone is a discriminative stimulus (S^D) for answering the phone. Presumably, the combination of the phone ringing and resulting answering behavior has been reinforced in the past by speaking to a person on the other end. Thus, a ringing phone is said to exert stimulus control over phone answering behavior. Applying an operant behavior perspective, we know that behavior referred to as insistence on sameness has been acquired and maintained by reinforcement and is thus under some type of stimulus control. That is, the individual has learned to make more responses in the presence of the S^D rather than its absence (i.e., stimulus control) because responding in the presence of the S^D is associated with positive or negative reinforcement.

It is also worth noting factors that are known to affect the development of stimulus control (Cooper et al., 2020): pre-attending skills, stimulus salience, and masking and overshadowing. Pre-attending skills refer to a repertoire of skills for orienting the sensory receptors to the appropriate S^D for the development of (presumably appropriate or functional) stimulus control. We know that this may be deficient in children with autism. Stimulus salience refers to the prominence of the stimulus in the individual's environment. Some stimuli may have more salience than others depending on a range of individual variables including the sensory capabilities of the individual, environmental context, and past history of reinforcement. What are considered salient stimuli for autistic children is likely to be different than for typically developing children. Related to stimulus salience are the concepts of masking and overshadowing. Masking refers to a competing stimulus blocking the evocative function of an already established discriminative stimulus. Overshadowing refers to the presence of one stimulus interfering with the acquisition of stimulus control by another stimulus. The principle of stimulus control and factors that are related to the development of stimulus control will be applied in the analysis that follows.

The Applied Problem

Many behaviorally oriented clinicians (e.g., Board Certified Behavior Analysts) supporting individuals with autism conduct functional assessments of challenging behaviors. A commonly encountered antecedent condition is change to routines or physical environments, or violations of sameness. For example, a clinician may find him or herself faced with a child who exhibits problem behaviors when the child's carefully arranged toy cars are disrupted in some way. In these situations, we often hear the problem behavior attributed to a desire for sameness. In trying to classify the function of this behavior, we are faced with the options of escape from the aversive change or tangibly motivated behavior directed to restoring sameness. Indeed, Kanner (1943) wrote:

> This insistence on sameness led several children to become greatly disturbed upon the sight of anything broken or incomplete. A great part of the day was spent in demanding not only the sameness of the wording of a request but also the sameness of the sequence of events. … Every other activity had to be completed from beginning to end in the manner in which it had been started originally. (p. 246)

Below are three examples from our clinical experience that cover a range of problems related to children with autism's insistence on sameness. For each example, we offer an analysis from a stimulus control perspective.

> Case 1: Stacey is a school-aged girl with autism. Her educational assistant (EA) wore eyeglasses. Half way through the school year, the EA received laser vision correction and no longer required eyeglasses. When Stacey encountered her EA without eyeglasses, she engaged in problem behavior and insisted he put his glasses on. The EA was not able to be in the same room as Stacey for 2 weeks without problem behaviors present. Eventually, the EA started to wear his old glasses (without lenses) and the problem behaviors immediately stopped. Stacey seemed to require sameness in her EA's physical appearance; she stipulated on his glasses. We consider this an example of paying attention to too few stimuli.
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> Case 2: Andrew is a pre-school aged boy with autism. He is an only child and has many toys at home. He organized his various toys around the living room in long and winding arrangements with several toys stacked one upon the other. Once they were set up, he exhibited problem behaviors if they were changed in any way. As a result, his parents left his things exactly as he liked them in order to avoid triggering problem behaviors. Andrew seemed almost hyper-aware of changes to his toy set arrangements. Even though there were hundreds of individual toy pieces aligned and stacked together, if even one was removed or altered, he was quick to notice it and respond with problem behavior. This pattern of behavior developed very quickly. It only took one exposure to the arrangement of toys to lock in this pattern of behavior and for him to expect sameness; he stipulated on the pattern and arrangement of his toys. We consider this an example of paying attention to too many *simultaneously* presented stimuli.
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> Case 3: Riley is a school-aged boy with autism. When visiting his grandmother, he is used to following a consistent driving route to get to her house. One day, his mother

decided to take a different route. Riley became very upset and engaged in problem behavior. In the future, his mother reverted back to her usual driving route in order to avoid triggering a tantrum. In this way, Riley demanded sameness in the route taken to his grandmother's house and his parents accommodated this in order to avoid problem behavior. That is, he stipulated on the order of turns and route taken. We consider this an example of paying attention to many *sequentially* presented stimuli.

Nature of the Problem

When examining these clinical cases of insistence on sameness from a behavior analytic orientation, we immediately considered the role of stimulus overselectivity. Stimulus overselectivity has been referred to as "tunnel vision in autism" (Edelson, n.d.) in reference to the phenomenon of attending to only one aspect of the environment while ignoring others; thus, over-selecting on one of many possible (relevant or irrelevant) features. Research in stimulus overselectivity originally began as a search for the key cognitive deficit in autism (Gersten, 1980). This occurred during a time when the prevailing view of autism was a psychodynamic one, which saw autism as an emotional disturbance. This view, however, fell from vogue in favour of a behavior analytic model. Thus, our analysis of insistence on sameness led us to begin with the hypothesis of stimulus overselectivity.

Lovaas et al. (1971) coined the term "stimulus overselectivity" in the operant literature. They conducted an experiment in which children with autism primarily responded to only 1 stimuli in a compound stimulus comprised of auditory, visual, and tactile cues. They observed some stimulus overselectivity in a control group of children with mental retardation, for example, attending to 2 of the 3 stimuli in the compound stimulus, while typically developing children tended to respond to all 3 stimuli in the compound stimulus. Furthermore, their data failed to support the premise that there was one preferred sensory modality or one that was impaired. Rather, the stimuli that were over-selected seemed to be arbitrarily selected.

Koegel and Wilhelm (1973) extended the work of Lovaas et al. (1971) by demonstrating stimulus overselectivity in 12 of 15 autistic children to multiple stimuli within the same sensory modality (visual), providing evidence for overselectivity within (i.e., visual) and across (i.e., visual, tactile, auditory) sensory modalities. Furthermore, they were the first to extend their discussion to speculate on the role of stimulus overselectivity and problem behavior. They speculated that stimulus overselectivity may account for changes in the behavior of children with autism (i.e., problem behavior) when seemingly small elements of the environment are altered (violations of sameness). They referred to this as, "peculiar restricted and limited stimulus control" (p. 452). However, subsequent research in this area largely ignored implications for the assessment and treatment of problem behavior.

Schreibman and Lovaas (1973) investigated overselectivity to social stimuli in autistic children. Their thesis focused on the role of overselectivity in learning and social functioning. They were the first behaviorists to use the term "sameness":

> Autistic children are known to show major behavioral disorganization with minor changes in their environment (to insist on "maintaining sameness"). If they do form significant associations to minor aspects of their environment, as the findings on stimulus overselectivity suggest, then one may be in a better position to understand this apparently "psychotic" behavior. (p. 154)

Subsequent research in the area (Bailey, 1981; Koegel & Schreibman, 1977; Lovaas et al., 1979; Rincover & Koegel, 1975; Schreibman et al., 1977; Schrover & Newsome, 1976; Wilhelm & Lovaas, 1976) yielded further discoveries including observations that stimulus overselectivity was not observed in all children with autism and was not, therefore, the "core deficit" in autism. Lovaas et al. (1979) wrote:

> … the term *stimulus overselectivity* does not imply that the children scan their environment and select for relevant cues. Rather, the data suggest that the children respond to only one part of a relevant cue, or even to a minor, often irrelevant feature of the environment, without learning about the other relevant portions of that environment. (p. 1237)

One could argue that this is manifested as the rigid behavior often displayed by children with autism. However, throughout the early literature, issues of sameness, restricted stimulus control, rigidity, and behavioral disruptions were frequently mentioned but were not the primary (or even secondary) foci of stimulus overselectivity research. The context of this early body of research was the role of stimulus overselectivity in discrimination training and learning paradigms (for a detailed review and implications for instruction see Cipani, 2012). Problem behavior was occasionally mentioned as an associated issue but was not investigated more deeply in the early research in this area.

Based on the types of clinical cases described above, it was our original intent to advance an analysis/theory of stimulus overselectivity and its' relationship to problem behavior in autism related to violations of sameness. However, a closer analysis of examples of stimulus overselectivity led us to conclude that this phenomenon does not actually have a role in evoking problem behaviors. Consider the following examples offered by Schreibman (1997) on the role of stimulus overselectivity in autism: A child with autism had no problem recognizing her father. One day, however, her father removed his eyeglasses and "the child responded to him as just another object in the environment" (p. 204). This appears to be a true case of stimulus overselectivity. Let us apply a behavioral stimulus control analysis to this scenario. Consider Dad as stimulus one (S1). Stimulus control should be exerted by any one of several concurrently available stimuli (glasses, hair length and color, height, angle of nose, etc.). However, the child stipulates or overselects on just one stimulus, the eyeglasses. For the purpose of our analysis, we will assign an arbitrary value to eyeglasses. Consider glasses as stimulus "D." Once the glasses are removed, stimulus control is lost and the child does not recognize her father. Dad should be discriminated through any combination of relevant stimuli (stimuli A-through-G, for example). In the absence of stimulus overselectivity, Dad may be discriminated by any one, all, or some combination of stimuli A-through-G, including his eyeglasses (stimulus "D"). However, given the child's stimulus overselectivity, only his eyeglasses (stimulus "D") exert stimulus control over the child recognizing her father. When the eyeglasses are removed or absent, stimulus control is lost. This scenario is depicted in Table 1.

In another example, a behavior therapist works with a little girl 6 days a week all summer long and is considered well known to the little girl. Near the end of summer, the therapist changes her hairstyle, and as a result, the little girl no longer recognizes her. This is similar to the case above and represents stimulus overselectivity. The therapist in this case is stimulus one (S1), and stimulus control should be exerted by any one of several concurrently available stimuli (hair length and color, voice, height, angle of nose, etc.). However, the little girl stipulates or overselects on just one stimulus, which we will arbitrarily call stimulus "B" (hair style). This scenario is depicted in Table 2.

In both of these examples of stimulus overselectivity, stimulus control is lost when the stipulated or over-selected stimulus is removed (glasses) or changed (hair style). However, problem behavior does not occur as a result of either. If problem behavior occurs, we must assume that there is more than one stimulus controlling behavior. In other words, the child does not lose stimulus control and fail to recognize the person. Rather, she/he does recognize the person but engages in problem behavior and insists that the stimuli she/he is treating as relevant be restored to its previous state. Therefore, our initial conceptual analysis was constrained by a focus on stimulus overselectivity alone. Stimulus overselectivity appears to be just one type of faulty stimulus control demonstrated by some individuals with autism and, upon closer analysis, appears unrelated to the issue of sameness and problem behavior. Also, the theory of stimulus overselectivity cannot be applied to explain behaviors like those previously described in Cases 2 (Andrew and his toy arrangements) and 3 (Riley and his route to Grandma's house) above, in which the children insisted that a variety of stimuli (i.e., many more than a single stimulus) remain consistent and the same. As a result, we cast our conceptual net more broadly and expanded our focus to problems of stimulus control in children with autism and how they relate to the functional assessment and treatment of problem behaviors, particularly situations involving the concept of sameness.

Within the conceptual logic of stimulus control, stimulus overselectivity represents a problem of restricted stimulus control. Restricted stimulus control (RSC) refers to situations in which the number of controlling stimuli is limited in an atypical way (Litrownik et al., 1978). Stimulus overselectivity is one example of this and occurs when an individual has stipulated on only one of several simultaneously available stimuli in a compound stimulus (e.g., Stacey and her educational assistant's eye glasses). However, as we have already articulated, the theory of stimulus overselectivity does not account for the presence of problem behavior. Rather, it accounts for error patterns in skill acquisition (Cipani, 2012).

We also see examples of faulty stimulus control in the other direction: when the number of controlling stimuli is broad in an atypical way. There is not, however, a commonly accepted technical term in the behavioral literature for this phenomena. The closest we can find is conjunctive stimulus control (Bellamy et al., 1979) in reference to how two

Table 1 Loss of stimulus control: child stipulates or overselects on stimulus *D* (Father's eyeglasses)

- S1 = combination of stimuli ABCDEFG
- Absence of overselectivity: S1 = A = B = C = D = E = F = G (any one, all, or some combination exert stimulus control for discrimination of S1)
- Presence of overselectivity: S1 = D only (and when D is removed, stimulus control is lost)

Table 2 Loss of stimulus control: child stipulates or overselects on stimulus B (therapist's hairstyle)

- S1 = combination of stimuli ABCDEFG
- Absence of overselectivity: S1 = A = B = C = D = E = F = G (any one, all, or some combination exert stimulus control for discrimination of S1)
- Presence of overselectivity: S1 = B only (and when B is removed, stimulus control is lost)

or more stimuli combined occasion a response. This may be appropriate as the dictionary definition of conjunctive means "two or more." However, conjunctive stimulus control is not inherently problematic (while restricted stimulus control is). In fact, many appropriate and functional discriminations require conjunctive stimulus control. For example, finding a specific person in a large crowd requires attending to and discriminating a variety of concurrent stimuli. Thus, we do not believe that conjunctive stimulus control is the appropriate term to use. Therefore, we still require a term that conveys a problem with stimulus control in which the number of controlling stimuli is atypically large. For the purpose of this paper, we will use unrestricted stimulus control (uRSC), meaning an individual has attended to or stipulated on many or all of the available stimuli either simultaneously (all at once) or sequentially (stipulated on the order of events/stimuli).

Finally, related to uRSC is the concept of relevant and irrelevant stimuli. When an individual is attending to a large number of stimuli simultaneously or sequentially, some of those stimuli may be considered relevant and some may be considered irrelevant to a particular discrimination. For example, attending to an individual's height and facial features would be considered relevant, fixed, or static stimuli for being able to discriminate that person from all other known people. Attending to his or her shoe color and length of shirt sleeves, however, would be considered irrelevant stimuli since they are not fixed or static and are thus likely to change frequently.

Rather than proposing a revision in terminology so that the definition of stimulus overselectivity is changed to include both too many and too few, we proceed in our analysis of the three clinical cases above using the non-technical terms of attending to either too few or too many stimuli (RSC or uRSC).

The issue of responding (negatively) to violations of sameness is represented by at least three variations as depicted in Table 3. First, an individual stipulates on a single stimulus and when that stimulus is changed/absent, problem behavior is evoked. This is described in Case 1 with Stacey. Her EA could change any part of his appearance without evoking problem behavior except his glasses, as was demonstrated over time by his ability to wear a variety of different clothing, different hair styles, etc., all without evoking problem behavior. The second variation involves an individual stipulating on or attending to too many stimuli at once and any variation in any one of those stimuli evokes problem behavior. This is described in Case 2 with Andrew and his arrangement of toys. The third variation involves an individual stipulating on sequentially presented stimuli as described in Case 3 with Riley. He was attending to the route (i.e., sequence of turns and scenery along the way) used to travel to his grandmother's house. These three cases and their types of potentially defective stimulus control are displayed in Table 3.

If an individual has stipulated on and is under the restricted stimulus control of a single stimulus, then the consistent presence of that stimulus is critical as a signal that reinforcement is available. When the one critical stimulus (i.e., the one that has become discriminative for reinforcement) is missing, the child may not be able to continue to engage in behavior associated with that stimulus (e.g., cooperatively working with her EA for Stacey, sitting calmly and looking out the car window for Riley, etc.). From the person's perspective, all the S^D properties have to be arranged for typical behavior to occur and thus access reinforcement. This is what makes the missing S^D property aversive. All stimulus control and, by association, appropriate behavior, is tied to that one stimulus. Any change in or absence of the single stipulated stimulus results in problem behavior. Thus, we can logically infer that the change or absence of the stipulated stimulus is aversive to the person with autism.

We reasonably infer that the individual with autism may have a history of problem behavior that has functioned to access reinforcement or to escape from aversive stimuli. It stands to reason that this repertoire would be at strength in the presence of the absent or changed stimulus (which is aversive). Problem behavior has likely been a very effective means of obtaining reinforcement (either positive or negative) in the past, and problem behavior that has restored the single, multiple, or sequentially stipulated stimuli in the past would be maintained by negative reinforcement.

It may be helpful at this juncture to apply a more detailed analysis as to how this faulty stimulus control may have originally developed. Stimulus control, by definition, implies that responding in the presence of the stimulus produces reinforcement more often than responding in the absence of the stimulus. As noted above, the roles of pre-attending skills, stimulus salience, and masking and over-shadowing likely play a role in the development of over-selective (single stimulus stipulation) stimulus control in a person with autism. During initial learning, the person with autism may stipulate on a single stimulus for a variety of reasons related to pre-attending skills, which are presumably weak in the person with autism (i.e., knowing which S^Ds are appropriate to attend

Table 3 Types of potentially defective stimulus control

Paying attention to too few stimuli	Paying attention to too many stimuli	Paying attention to a sequence of stimuli
Case 1: Stacey and her EA's glasses (focus on individual's characteristic(s)	Case 2: Andrew and his toys (simultaneously presented stimuli)	Case 3: Riley's car ride (sequentially presented stimuli)

to). The role of stimulus salience is closely related to pre-attending skills. The salient stimuli for any individual will be influenced by their own sensory capabilities, past history of reinforcement, and the context of the environment. Given what we know about people with autism, they are likely to experience the world differently from a sensory perspective and they are likely to have an atypical reinforcement history due to characteristics of their autism (Boutot & Smith Myles, 2011). This may be further complicated by the role of overshadowing in which the presence of one (irrelevant) stimulus interferes with the acquisition of stimulus control by another stimulus or set of (relevant) stimuli. Given the complexity and dynamic nature of these variables, it is nearly impossible to identify when, how, or why an individual with autism stipulates on a particular stimulus (as in the case of RSC, paying attention to too few stimuli) or a set of stimuli (as in the case of uRSC, paying attention to too many stimuli). What is relevant and important, however, is that the person with autism has developed faulty stimulus control and their entire reinforcement history then has been predicated on that type of stimulus control. A change to a discriminative stimulus or absence of a discriminative stimulus then results in a lack of discrimination for reinforcement (i.e., a loss of stimulus control). We posit that this loss of discrimination for reinforcement is an aversive event and that the restoration of the critical (but restricted or irrelevant) stimuli for discrimination is reinforcing. The problem behavior may be evoked by the loss and negatively reinforced by its restoration. This type of conceptual stimulus control analysis is congruent with the early literature (e.g., Kanner, 1943) which refers to insistence on sameness regarding the initial presentation of a stimulus. This implies the faulty development of stimulus control, which then must remain unchanged ("insistence on sameness"). Given this stimulus control analysis of insistence on sameness, we now return to the three clinical cases presented above, and apply this conceptual analysis to each case.

Case 1*:* Stacey's appropriate behavior appears to be under the stimulus control of a single stipulated stimulus, her educational assistant's (EA's) eyeglasses. In the formula below, the S^D is her EA who signals that a variety of responses ($R_{1,2,3,4,5,i}$) are likely to lead to a variety of reinforcers ($S^R_{1,2,3,4,5,i}$). For example, asking for a drink and receiving it, doing her math worksheet and earning a sticker, etc. However, unbeknownst to her EA, Stacey's behavior has come under restricted stimulus control; that is, she has stipulated on a particular stimulus (eyeglasses) as indicated by the bolded "B" ($S^D_{A+\mathbf{B}+C+D+E+i}$). Due to the fact that she is under the restricted stimulus control of S^D_B (i.e., eye glasses), instead of a broader and more functional arrangement of stimuli (e.g., $S^D_{A+B+C+D+E+i}$), and those glasses are now absent, her EA is no longer discriminative for reinforcement (even though the availability of reinforcement is actually unchanged). This can be expressed in the following formulas:

$S^D_{A+\mathbf{B}+C+D+E+i} \rightarrow R_{1,2,3,4,5,i} \rightarrow S^R_{1,2,3,4,5,i} =$ appropriate behavior due to history of reinforcement;

and.

$S^D_{A+\_+C+D+E+i} \neq R_{1,2,3,4,5,i} \neq S^R_{1,2,3,4,5,i} =$ loss of discrimination for reinforcement which is experienced as an aversive situation evoking problem behavior that is negatively reinforced by restoring "sameness," as illustrated here:

$$R_{PB} \rightarrow S^R \rightarrow S^D_{A+\mathbf{B}+C+D+E+i}$$

Case 2: Andrew's appropriate behavior appears to be associated with many concurrently available stimuli. In the formula below, the S^D is the arrangement of his toys which signals that a variety of responses ($R_{1,2,3,4,5,i}$) are likely to lead to a variety of reinforcers ($S^R_{1,2,3,4,5,i}$), for example, playing a game with his sibling, looking at the arrangement of toys, or eating a snack. However, he is under unrestricted stimulus control and has stipulated on a large number of concurrently available stimuli as indicated by the subscripts with a superscripted 1 ($S^D_{A^1+B^1+C^1+D^1+E^1+i^1}$), where the ^{1} denotes that each stimulus is equally valuable in terms of stimulus control. Due to the fact that he is under the unrestricted stimulus control of $S^D_{A^1+B^1+C^1+D^1+E^1+i^1}$ instead of a more functional arrangement of (fewer or more relevant) stimuli (e.g., $S^D_{A+B+C+D+E+i}$), and one or more of his stipulated items is missing or out-of-place, the environment is no longer discriminative for reinforcement (even though the availability of reinforcement is actually unchanged). This can be expressed in the following formulas:

$S^D_{A^1+B^1+C^1+D^1+E^1+i^1} \rightarrow R_{1,2,3,4,5,i} \rightarrow S^R_{1,2,3,4,5,i} =$ appropriate behavior due to history of reinforcement; and

$S^D_{\not{A}^1+B^1+C^1+D^1+E^1+I^1} \neq R_{1,2,3,4,5,i} \neq S^R_{1,2,3,4,5,i}$ or;

$S^D_{A^1+\not{B}^1+C^1+D^1+E^1+I^1} \neq R_{1,2,3,4,5,i} \neq S^R_{1,2,3,4,5,i}$ or;

$S^D_{A^1+B^1+\not{C}^1+D^1+E^1+I^1} \neq R_{1,2,3,4,5,i} \neq S^R_{1,2,3,4,5,i}$

(etc.) = loss of discrimination for reinforcement, which is experienced as an aversive situation evoking problem behavior that is negatively reinforced by restoring "sameness", as illustrated here:

$$R_{PB} \rightarrow S^{R-} \rightarrow S^D_{A^1+B^1+C^1+D^1+E^1+i^1}$$

Case 3: Riley's appropriate behavior appears to be under the control of sequentially presented stimuli. He has stipulated on a specific route that must be taken and problem behavior is evoked if his desired route is not taken. This can be expressed in the following formulas:

$S^D_{T^1+T^2+T^3+T^4+T^5+T^6} \rightarrow R_{1,2,3,4,5,i} \rightarrow S^R_{1,2,3,4,5,i} =$ appropriate behavior due to history of reinforcement, since each turn ($_T$) follows the expected order (e.g., 1–6); and

$S^D_{T^1+T^2+T^5+T^6+T^7+T^8} \neq R_{1,2,3,4,5,i} \neq S^R_{1,2,3,4,5,i}$ (etc.) = loss of discrimination for reinforcement, since the sequence of turns did not follow the expected order, which is experienced as an aversive situation evoking problem behavior that is negatively reinforced by restoring "sameness", as illustrated here:

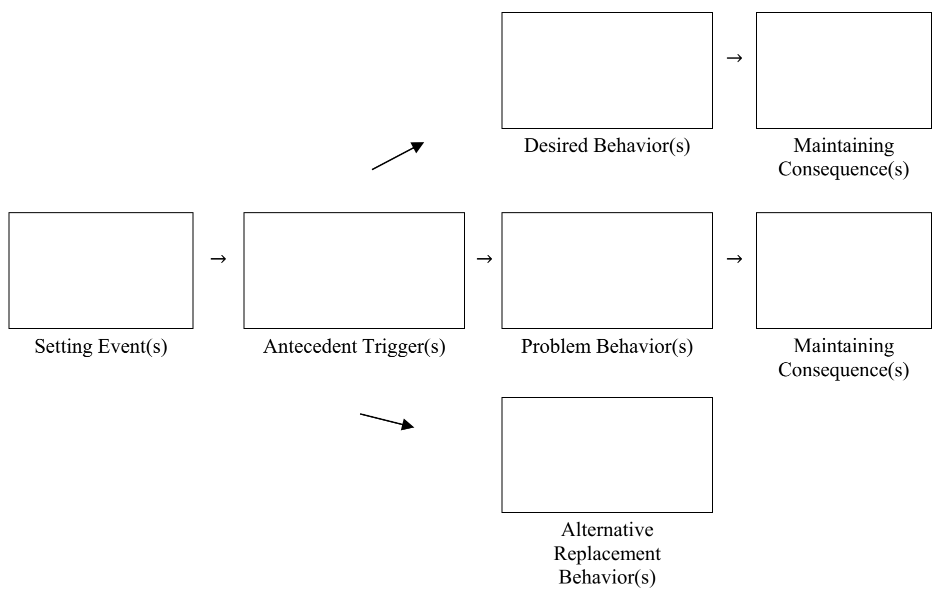
$R_{PB} \rightarrow S^{R-} \rightarrow S^D_{T^1+T^2+T^3+T^4+T^5+T^6+T^i}$

With this understanding of stimulus control, we can now more precisely conduct functional assessments and design positive behavior support (PBS) plans for children displaying problem behavior related to insistence on sameness. Likely the most significant clinical implication is to demonstrate to the child that even if the stipulated stimulus is absent/missing/changed, reinforcement is still available. In order to accomplish this, we need to re-establish stimulus control by pairing the new environment with reinforcement. Given the laws of behavior that govern the establishment of stimulus control, the delivery of reinforcement following the new (latent) stimuli should lead to the re-establishment of stimulus control in the presence of the new stimuli and the concomitant cessation of problem behavior associated with an insistence on sameness.

Competing Behavior Pathways Diagram and Multicomponent Treatment Plan

O'Neill et al. (2015) proposed a model of functional behavior assessment (FBA) and behavior support plan design based on an expanded four-part contingency comprised of setting events, antecedent stimuli, problem behavior, and maintaining consequences and their function. In addition, they incorporated a competing behaviors framework into the model in order to reflect the complex ways in which available response options compete for ascendency in the context of different antecedent stimuli and consequent events (Martens & Witt, 1988). The Competing Behavior Pathways Diagram (CBPD) is presented in Fig. 1.

Competing Behavior Pathways Diagram:



Positive Behavior Support Plan:

Setting Event Strategies	Preventive Strategies	Teaching Strategies	Consequence Strategies

Fig. 1 Competing behavior pathways diagram and positive behavior support plan

Given the competing behaviors model's close approximation to the complex nature of behavior occurring in natural contexts, we propose the use of this model to assess and design interventions for children with ASD who engage in problem behavior due to an insistence on sameness. The CBPD frames the problem visually by describing, as yielded in the FBA process, the relevant setting events, antecedent triggers, problem behavior(s), and maintaining consequences for problem behavior(s). As such, the CBPD defines the entire four-part contingency operating within natural contexts. In addition, the CBPD provides an understanding of the structure not only of the problem but also of possible solutions. The CBPD contributes to intervention planning by identifying: (a) the desired behavior that is appropriate for the setting and that would typically be engaged in by the focus person, (b) the consequences that can be programmed to reinforce and maintain the desired behavior, and (c) the alternative replacement behavior (ARB) that is functionally equivalent to problem behavior and thus can replace problem behavior as a means to achieve one's purpose. For example, in an academic demand situation, the desired behavior is for the child to remain on task and complete the assigned work. The maintaining consequence for on-task behavior may be teacher praise and tokens that can be used to receive back-up tangible reinforcers. The problem behavior may be, for example, elopement, which is maintained by escape from the academic demand situation. The ARB could be an appropriate request for a "break" (i.e., mand; Skinner, 1957) or for "help".

O'Neill et al. (2015) described four steps in the process of using a CBPD to design a multicomponent behavior support plan.

1. Diagram the functional behavior assessment results by filling in the boxes on the CBPD for the setting event(s), antecedent(s), problem behavior(s), and maintaining consequences
2. Determine the long-term, desired behavior, and the reinforcing consequences that will be used to increase and maintain this behavior, and fill in the corresponding boxes
3. Determine the ARB that will effectively and efficiently receive the same functional consequence as problem behavior, and fill in the corresponding boxes;
4. Select intervention procedures for each of the four categories of intervention that (a) are consistent with the logic of intervention design for each section of the four-part contingency and (b) will render problem behavior irrelevant, ineffective, and/or inefficient at achieving its function.

To facilitate the completion of this final step, a rubric comprised of a four-column table of intervention strategies that corresponds to the CBPD is used to generate the component strategies of a behavior support plan (see Fig. 1 above). For example, setting event strategies are selected to eliminate or neutralize identified setting events, antecedent strategies are selected to replace antecedent triggers for problem behavior, and consequence strategies are selected that will serve to increase reinforcement for positive behavior and remove reinforcement for problem behavior. O'Neill et al. (2015) described four benefits to using this expanded behavioral framework to assess problem behavior and design behavior support plans. The framework:

1. strengthens the link between FBA results and intervention strategies;
2. contributes to contextual fit between the values, skills, resources and routines of plan implementers and the strategies that will be employed;
3. increases the logical coherence between different strategies that are used in a multicomponent support plan; and
4. contributes to the fidelity of plan implementation.

Given these reasons, we employed the competing behavior model to assess the problem behavior of the three children discussed above who experienced different types of defective stimulus control, and to design multicomponent behavior support plans that would directly address these defects and thus potentially ameliorate problem behavior.

Implications for Assessment and Treatment

In the following section, we apply the stimulus control analysis described above to our previously presented case studies: (a) Stacey, whose problem behavior was associated with attending to too few stimuli; (b) Andrew, whose problem behavior was associated with attending to too many stimuli; and (c) Riley, whose problem behavior was associated with attending to a sequence of stimuli.

Stacey and Her EA Without Glasses

Figure 2 depicts Stacey's CBPD for problem behaviors related to her EA's missing glasses. A logically appropriate alternative replacement behavior (i.e., functionally equivalent behavior) would be for Stacey to simply ask the EA to put his glasses back on. If Stacey were willing and able to do so this, it would efficiently achieve the same function as the problem behavior (i.e., restore sameness; negative reinforcement). However, although conceptually logical, this would not be an acceptable alternative response. We can assume that the EA had laser eye

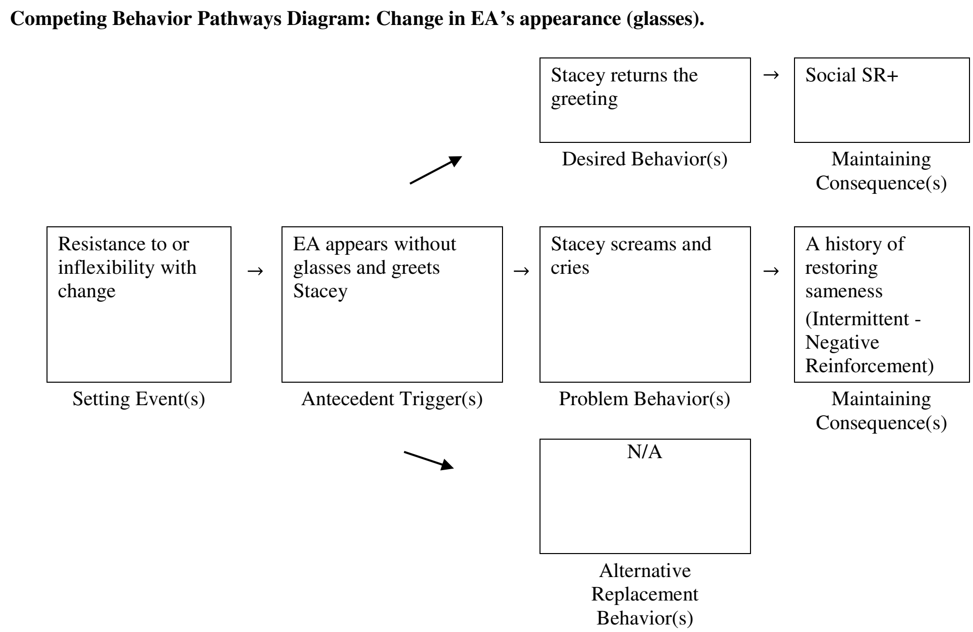


Fig. 2 Case 1: Stacey's competing behavior pathways diagram - change in single stimulus; paying attention to too few stimuli

surgery so that he no longer needed to wear glasses. Thus, teaching Stacey to ask the EA to put his eyeglasses back on (ARB) would not be acceptable or feasible. Consequently, the only appropriate response option is the socially desired behavior of Stacey learning to tolerate the change. Given this analysis of Stacey's problem behavior related to insistence on sameness, we present a set of behavior support strategies that are logically linked to each feature of the problem behavior as illustrated in the CBPD depicted in Fig. 2.

The situation in which Stacey encountered her EA without glasses and engaged in problem behavior was not foreseeable. That is, no one "knew" she had stipulated on her EA's glasses (RSC) until they were no longer present. Thus, it was implausible to have had a proactive, preventative intervention plan in place. Additionally, the fact that the antecedent and problem behavior occurred in her school made it difficult to simply recommend an extinction procedure since the (possible) corresponding extinction burst would most likely not be acceptable in that setting due to its potential to be highly disruptive. Given this, a multi-component intervention plan following the Competing Behaviors Model and consistent with the conceptual analysis above is presented in Table 4 for the next time she encounters her EA without glasses.

The multicomponent intervention plan in Table 4 illustrates a stimulus control approach to ameliorating Stacey's

Table 4 Stacey's positive behavior support plan

Setting event strategies	Preventive strategies	Teaching strategies	Consequence strategies
• Social story: Congruent with Stacey's language and cognitive skills, review daily a social story on accepting change with focus on EA no longer needing to wear glasses	• Visual contingency map: Use a visual contingency map that predicts receiving tangible reinforcer contingent on calmly responding to EA without glasses and *not* receiving tangible reinforce contingent on crying and screaming • Precorrect: Provide reminder and positive practice (i.e., role play) responding calmly to EA without glasses on just prior to planned exposure to EA (e.g., during morning arrival)	• Systematic exposure with reinforcement pairing: Avoid common triggers for problem behavior and pair EA with delivery of tangible reinforcer; and gradually over time, reintroduce typical instructional demands • Relaxation training: Congruent with her language and cognitive skills, provide daily instruction in progressive muscle relaxation, deep breathing and guided imagery that associates relaxation response with EA without glasses on. Once learned, establish a 1-min calming routine	• Praise and tangible reinforcer contingent on desired behavior: (a) calmly responding to EA without glasses on; and (b) complying to EA's requests and demands during instructional tasks • Minor problem behavior: redirect to calming routine • Major problem behavior: Implement extinction procedure and redirect to a task

problem behavior associated with the EA no longer wearing glasses. Setting event and antecedent strategies predict, motivate, and/or prompt the desired behaviors of remaining calm in the presence of the EA without glasses, and of complying to the EA's instructional requests. Teaching strategies are designed to teach the desired behavior while consequence strategies are designed to reinforce the desired behavior. Thus, the plan represents the three essential steps in establishing stimulus control: (a) bringing the learners attention to the relevant stimuli that should occasion the desired behavior (EA without glasses), (b) teaching and prompting the desired behavior, and (c) reinforcing the desired behavior.

Andrew and His Toys

Figure 3 depicts Andrew's CBPD for problem behavior related to changes in his elaborate toy arrangements. When Andrew encounters one of his elaborately arranged toys out-of-place or disturbed, he engages in problem behavior. The situation may not have been foreseeable until the first instance of problem behavior. Thus, it was not possible to have had a proactive and preventative intervention plan in place. In this case, however, it is possible to teach an appropriate mand (ARB) for restoring the missing item, if the item can be located and his parent(s) agree to provide it. For example, depending on Andrew's language/cognitive abilities, he could be taught to mand via vocal-verbal behavior, sign language, or a picture exchange system to restore the missing piece. However, for some children in this situation, an ARB (i.e., mand) that is effective and efficient may not be feasible if the children are not able to specify exactly which item is missing, or if the missing item cannot be located. Therefore, longer-term goals that would prevent future episodes of this type of problem behavior would be to teach Andrew to tolerate changes in his arrangement of toys in the short term and appropriate toy play in the longer term. A hypothetical multicomponent intervention plan that includes these plan components and that is consistent with the competing behaviors model and conceptual analysis above is presented in Table 5.

Similar to the plan for Stacey, the multicomponent intervention plan in Table 5 illustrates a stimulus control approach to ameliorating Andrew's problem behavior associated with changes in his elaborate toy arrangements. Setting event and antecedent strategies predict, motivate, and/or prompt the desired behaviors of remaining calm and continuing to play with his toys in the presence of a change in the arrangement of his toys. Teaching strategies are designed to teach this desired behavior while consequence strategies are designed to reinforce the desired behavior. An extinction procedure was added to the consequence strategies so that problem behavior, whose function is to prompt a parent to re-establish the previous toy arrangement, is not reinforced. In addition, setting event strategies include the long-term goal of teaching Andrew a wider variety of toy play and leisure skills that will serve to replace his tendency to build elaborate arrangements with his toys, as doing so may render irrelevant problem behavior related to changes in elaborate arrangements of toys.

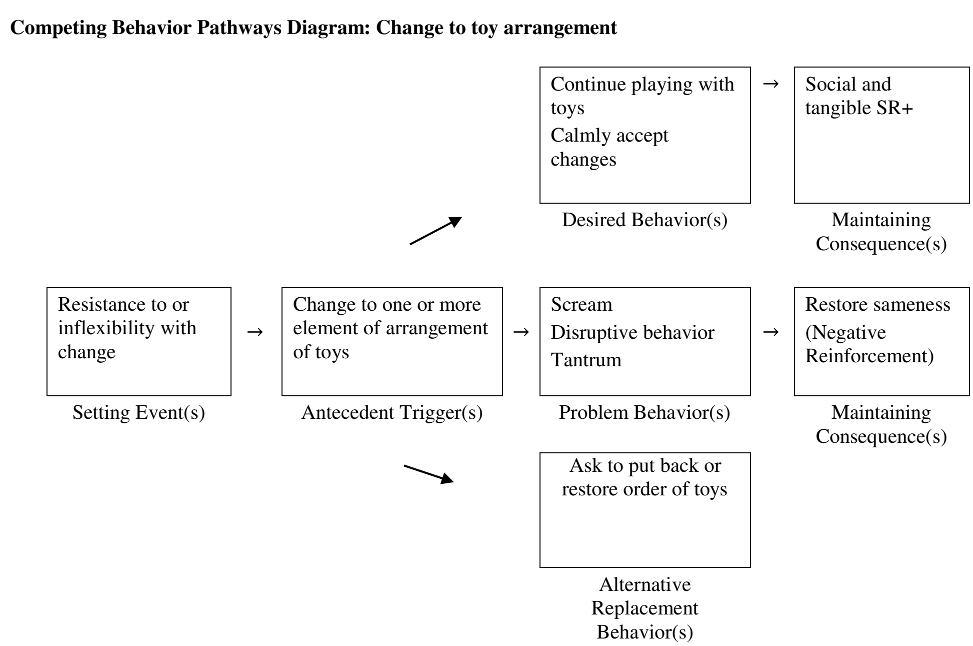


Fig. 3 Case 2: Andrew's competing behavior pathways diagram — paying attention to too many stimuli simultaneously

Table 5 Andrew's positive behavior support plan

Setting event strategies	Preventive strategies	Teaching strategies	Consequence strategies
• Social story: Congruent with Andrew's language and cognitive abilities, daily review of a social story focused on accepting changes in toy play arrangements • Expand toy and leisure play repertoire: Teach Andrew a variety of indoor toy play and leisure activities that do not lend themselves to making atypical elaborate arrangements (e.g., hot wheel car and racetrack, Wii race car interactive video game)	• Visual contingency map: Use a visual contingency map that predicts receiving tangible reinforcer contingent on continuing to play with toys in the presence of a change in the arrangement of toys and *not* receiving tangible reinforce contingent on screaming, disruptive behavior or tantrum • Precorrect: Prior to playing with his toys, provide reminder and positive practice in continuing to play with toys in presence of a change in toy arrangement	• Functional communication training (FCT): As appropriate to his language/cognitive abilities, teach Andrew to request (i.e., mand) that toy arrangement be restored (if *possible)* • Systematic exposure: Gradually and systematically introduce minor changes to toy arrangement while simultaneously pairing with the delivery of tangible reinforcer • Relaxation training: Provide daily instruction in progressive muscle relaxation and deep breathing. Once learned, make it a one minute calming routine	• Provide praise and tangible reinforcer contingent on remaining calm and continuing to play in face of increasing increments of change required • When Andrew appropriately asks that a toy arrangement be restored, honor his request (if possible) • When minor problem behavior occurs, prompt calming routine, redirect back to task and pair change with praise and tangible reinforcer • When major problem behavior occurs, remove to safe area, prompt the calming routine again, wait until Andrew calms down, and redirect back to play. Do not deliver tangible reinforce

Riley and the Driving Route

Figure 4 depicts Riley's CBPD for problem behavior related to changes in the driving route used to travel to his grandmother's house. When Riley engaged in problem behavior evoked by a change in driving route (sequence), the situation might not have been foreseeable until the first instance of problem behavior. Thus, it was not possible to have had a proactive and preventative intervention plan in place.

A logically appropriate alternative replacement behavior (i.e., functionally equivalent behavior) would be for Riley to ask the driver to go back and take the usual and expected route. If Riley were willing and able to do so, this would efficiently achieve the same function as the problem behavior (restore sameness; negative reinforcement). However, although conceptually logical from a functional behavior perspective, this would not be an acceptable alternative response in the real world. We can assume that there would be a variety of factors that would prevent the driver from back-tracking in order to follow Riley's expected route (e.g., time pressures, traffic congestion, wasted fuel, etc.). Thus, teaching Riley to ask the driver to go back and take the expected route would not be realistic. Consequently, the pragmatic appropriate response option is teaching the desired behavior of Riley learning to tolerate changes in his route to grandmother's house. In addition, Riley's family would prefer to minimize the occurrence of tantrums during plan implementation, and so the use of proactive strategies that may prompt or motivate the desired behavior and prevent or minimize problem behavior are desired. Given this, a hypothetical, multicomponent intervention plan following the competing behaviors model and consistent with the conceptual analysis above is presented in Table 6.

Similar to the plan for the other two children, the multicomponent intervention plan in Table 6 illustrates a stimulus control approach to ameliorating Riley's problem behavior associated with changes in the car route taken to visit his grandmother. Setting event and antecedent strategies predict, motivate, and/or prompt the desired behaviors to at first calmly accept the changes in the route and eventually enjoy the ride despite a change in route. Teaching strategies are designed to teach Riley to continue enjoying the ride despite changes in the route and to engage in a self-managed calming routine when unexpected changes occur. Consequence strategies are designed to reinforce the desired behavior and place tantrum behavior on extinction. The overall plan is compatible with the family's preferences and thus likely to be more acceptable to the family because the proactive and teaching strategies minimize reliance on the extinction procedure as the primary means to ameliorate Riley's problem behavior. In contrast, the long-term focus of the plan is to teach Riley a new repertoire of behaviors (e.g., flexibility) that may prevent similar problems in the future and thus enhance his and his family's overall quality of life.

As an illustrative clinical anecdote, while preparing this manuscript, the first author encountered a case in which a child with autism (Amy) stipulated on the door that she used to enter her school; that is, if she entered the school through the front door, she insisted on exiting the school through the same door. However, depending on the circumstances, it was not always convenient or appropriate to exit the school through the same door that she entered the school. Sometimes it was more appropriate to exit the school through a classroom door to the outside or through the school's backdoor to the playground. If a teacher directed Amy to exit the

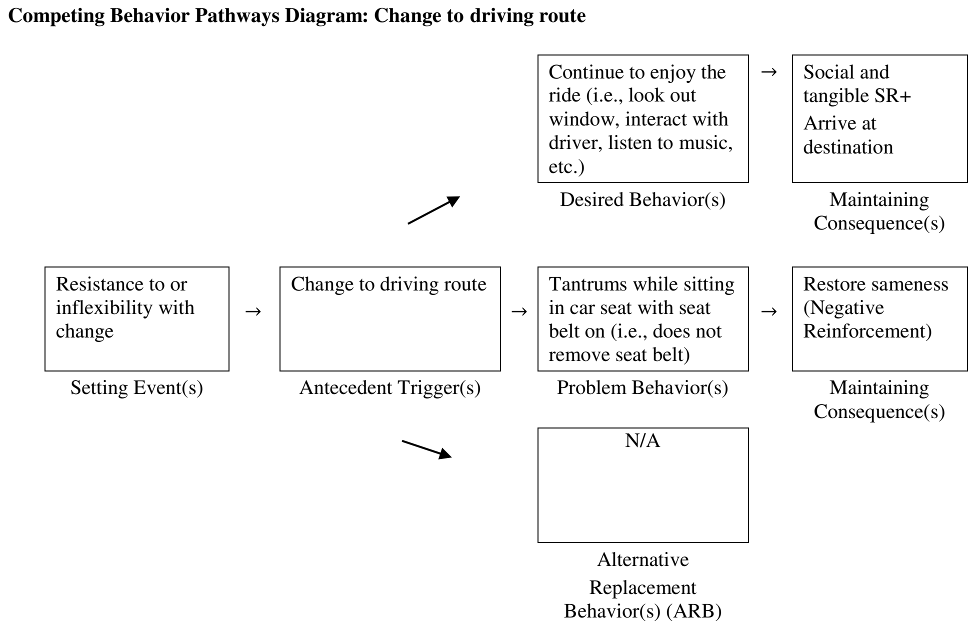


Fig. 4 Case 3: Riley's competing behavior pathways diagram — paying attention to sequential stimuli

school through a different door, she would engage in problem behavior including crying, screaming and flopping on the floor. Upon further inquiry, Amy's mother informed the school that the same phenomena occurred when her daughter joined the family on community outings to local malls, shopping centers, or recreation centers. The mother further reported that problem behavior only ceased when Amy was allowed to return to the original entrance doorway and exit through it.

This case provided an opportunity to employ the conceptual logic presented in this paper. Using the competing behaviors model and conceptual analysis employed for the three case studies, the first author determined that Amy's insistence on leaving a building through the same door that she entered the building represented the first type of faulty stimulus control — paying attention to too few stimuli.

Employing the conceptual logic described above, a multicomponent intervention was developed and implemented. The plan included the following preventive, teaching, and consequence strategies: (a) a visual contingency map that predicted tangible reinforcers (i.e., I-Pad and preferred snack) contingent on leaving the school through a different door; (b) a verbal reminder (i.e., precorrection) to remain calm while exiting; (c) positive practice exiting the school through the classroom door to attend recess on the playground and through the backdoor to go home with her mother; (d) praise and delivery of tangible reward immediately contingent on calmly exiting through the other doors; and (e) an extinction procedure that would involve actively ignoring problem behavior and guiding Amy out the other door into the playground or to the parent's car to go home. The plan was implemented by Amy's SEA and by her mother at school. The SEA supported Amy's exit through the classroom door to the playground and her mother supported her exit from the school to the family car to go home. Across three trials of implementation, the school staff and Amy's mother reported an almost instantaneous reduction in problem behaviors related to exit door use. School staff also reported the maintenance of these improvements over the next few weeks. During this time, Amy's mother also reported that she had begun to use a core plan strategy (i.e., delivery of tangible reinforcer contingent on exiting through a different door) in community settings such as recreation centers, malls, and grocery stores, and that Amy no longer insisted on sameness in regard to door use in these settings; rather, she readily exited through any door that was appropriate or convenient.

Future Considerations

For nearly 70 years, insistence on sameness has been a commonly cited characteristic of many autistic people. However, this phenomenon has been largely ignored in the behavioral literature. Employing a stimulus control analysis, we concluded that the concept of stimulus overselectivity does not account for problem behavior evoked by an insistence on sameness. Instead, our analysis suggests that violations of sameness are aversive to the person experiencing the stimulus change because the stimulus condition that has been associated with reinforcement in the past has been altered in such a way that it no longer predicts reinforcement. To re-establish the stimulus condition that predicted reinforcement in the past, the person insists on sameness

Table 6 Riley's positive behavior support plan

Setting event strategies	Preventive strategies	Teaching strategies	Consequence strategies
• Social story: Congruent with Riley's language and cognitive abilities, review daily a social story focused on accepting changes in car route	• Visual contingency map: Use a visual contingency map that predicts receiving a tangible reinforcer contingent on calmly tolerating a change in route, and *not* receiving tangible reinforcer when Riley has a tantrum • Precorrect: Prior to each planned exposure to a different car route, provide reminder and positive practice to calmly tolerate the car ride in the presence of the change	Systematic exposure: Systematically introduce unexpected changes (i.e., turns) to the expected driving route while simultaneously pairing with the delivery of tangible reinforcers Relaxation training: Congruent with his language and cognitive abilities, provide daily instruction in progressive muscle relaxation, deep breathing and guided imagery that associates relaxation response with changes in car route; once learned, establish a one-minute calming routine	Praise and tangible reinforce contingent on: (a) improvements in behavior in face of increasing increments of change in car route; and (b) unprompted, spontaneous acceptance of change When minor problem behavior occurs, redirect to calming routine, and pair relaxation response with praise and tangible reinforcer When major problem behavior occurs, actively ignore, continue driving to destination, redirect to calming routine at destination

and learns through operant selection that engaging in problem behavior often restores sameness. When sameness is restored, the problem behavior(s) are negatively reinforced, which serves to strengthen and make more persistent this behavioral pattern in the presence of altered stimuli.

Recognizing that we are proposing a conceptual analysis that is not currently supported in the empirical literature, next steps will need to include experimental manipulations to determine the effectiveness of intervention strategies that are based on this conceptual analysis; in particular, the exposure and pairing with reinforcement strategy, which we considered a critical element in any plan to ameliorate problem behavior associated with insistence on sameness. Additionally, beyond interventions to reduce problem behaviors evoked by violations of sameness that are inadvertently discovered, research should investigate strategies that may function to inoculate individuals against future occurrences of the same phenomena (Iwata, 2011).

To this end, we believe the competing behaviors model, which seeks to resolve the presenting problem while also achieving broader quality of life gains, offers a promising conceptual model towards the goal of "inoculation." Once an individual's pattern of insistence on sameness has been identified (that is, a tendency for RSC, uRSC, or sequential stipulation), then steps may be taken to reduce the likelihood of developing faulty stimulus control in the future. For example, if a person has a history of stipulating on the sequence of events, then on-going, purposeful variations paired with the delivery of reinforcers may, overtime, serve to reduce the likelihood of the person developing faulty stimulus control characterized by an insistence on sameness, engaging in problem behavior, and subsequently being negative reinforced when sameness is re-established. It is our hope that this conceptual analysis of a common problem experienced by children with autism, to the historical and continued vexation of their families, teachers, and care providers, will spur this new line of intervention research. We believe it holds much promise for advancing evidence-based practice in assessing, preventing, and ameliorating problem behavior of this nature in autistic children.

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Author Contribution RS: conducted the initial conceptual analysis and wrote the first draft of the manuscript. JL: collaborated in the conduct of the conceptual analysis and reviewed and edited all versions of the manuscript.

Declarations

Ethical Approval This article does not contain any studies with human participants or animals performed by any of the authors.

Conflict of Interest The authors declare no competing interests.

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