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Using Individualized Reinforcers and Hierarchical Exposure to Increase Food Flexibility in Children with Autism Spectrum Disorders

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Abstract

Inflexibility is a major characteristic of autism. In the present study we addressed inflexible mealtime behaviors and collected longitudinal data across 48 foods for 3 children, ages 6.4–7.8 years, diagnosed with autism spectrum disorder, for up to 22 weeks. Participants exhibited severe challenges with adherence to an extremely restricted repertoire of foods. We employed clinical replication and multiple baseline designs across participants to assess the effects of individualized reinforcement and hierarchical exposure to increase flexibility. Results showed that following intervention, all participants expanded their food repertoire and spontaneously requested new

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foods during follow up/generalization. Implications for clinical practice and directions for further research are discussed.

Keywords

Food refusal; Inflexibility; Rigidity; Autism; Positive reinforcement; Stimulus fading

Introduction

Difficulty with flexibility and adherence to restricted patterns of behavior are frequently cited symptoms of children on the Autism Spectrum (American Psychiatric Association 2000; Green et al. 2006; Klin et al. 2007; Prior and MacMillan 1973; Turner 1999). Specific manifestations of inflexibility and rigidity include insistence on sameness and adherence to idiosyncratic rules that if interrupted, often result in disruptive behaviors including tantrums and aggression (Raiten and Massaro 1986; Reese et al. 2005). What is more, these challenges with flexibility and rigidity do not seem to be limited to one specific domain (e.g., play). On the contrary, inflexibility and rigidity in Autism Spectrum Disorders (ASD) seems to be applicable to all domains of adaptive behavior, such as play, conversation, and eating (Baker 2000; Baker et al. 1998; Dominick et al. 2007; Fodstad and Matson 2008; Malmberg 2008; Turner 1999).

Although impairments with flexibility and rigidity are commonly associated with ASD and comprise diagnostic criteria (American Psychiatric Association 2000; Rutter 2006), relatively few empirical intervention studies exist in the literature (Malmberg 2008). This is particularly interesting in light of the growing number of assessment studies indicating a need for such research (Green et al. 2006; Lam and Aman 2007; Richler et al. 2007; Szatmari et al. 2006). More recently, the literature in this area has seen a surge of studies identifying food selectivity and inflexibility as a particularly troublesome area for children with ASD (Ahearn et al. 2001; Dominick et al. 2007; Johnson et al. 2008; Keen 2008; Ledford and Gast 2006; Martins et al. 2008; Schreck and Williams 2005; Schreck et al. 2004). These recent studies indicate that up to 89% of children with ASD present a variety of restrictive and inflexible eating behaviors (Ledford and Gast 2006). For example, Dominick et al. (2007), highlight that some individuals with ASD maintain a restricted range of foods in their repertoire, whereas others display a preference for a specific texture or color. Further, Schreck et al. (2004) document that in some circumstances food restrictiveness is related to how food is actually presented on a plate (i.e., whether food items are touching each other on the plate). Additionally, research has found that children with ASD present more mealtime disruptive behavior in comparison to typically developing peers (Gentry and Luiselli 2008; Johnson et al. 2008; Martins et al. 2008) with increased disruptive behaviors when new foods are introduced. Finally, a number of studies have noted that parents of children with ASD frequently seek professional assistance in order to treat these behaviors (Gentry and Luiselli 2008; Ives et al. 1978; Werle et al. 1993).

The research has shown that behavioral interventions have been proven successful in treating symptoms of ASD (Koegel 2000; Koegel et al. 1996; Lovaas 1987). Reinforcement and stimulus fading interventions have successfully been used with children with ASD to increase and improve social interactions, communication, and challenging behaviors (Charlop-Christy et al. 2002; Cuvo et al. 2010; Koegel 2000; Koegel et al. 1996; Lang et al. 2009; Lovaas 1987; Shabani and Fisher 2006; Valdimarsdottir et al. 2010). Of particular importance to the present study is the literature which uses a combination of antecedent and reinforcement procedures for treatment of food refusal (Freeman and Piazza 1998; Gentry and Luiselli 2008; Ives et al. 1978; Valdimarsdottir et al. 2010). Although each study

employed a single participant, all of the studies gathered longitudinal data and showed improvement with regards to food refusal in noncompliant children. Collectively, these studies suggest a high degree of optimism for treatment of inflexibility and food restrictiveness. Consequently, the purpose of the present study was to expand the above line of research using multiple participants, and to assess whether food inflexibility and restrictiveness could be modified in children with autism through the use of an individualized reinforcement and stimulus fading program.

Methods

Participants

Three children with autism (ages 6.4–7.8) participated in this study. All three children were diagnosed with autism by outside agencies using the criteria of the Diagnostic and Statistical Manual, Fourth Edition, Text Revision (DSM-IV-TR; American Psychiatric Association 2000) and were referred to an autism treatment center for intervention services. The selection criteria for participation in this particular study included: (1) the recurring presence of inflexible mealtime behaviors; and (2) a desire by the parent/caretaker to improve mealtime food flexibility. Inflexible mealtime behaviors were defined as disruptive behaviors resulting from offers to try foods outside of a very restricted food repertoire.

For the purposes of the current study, all participants will be referred to by pseudonyms. Child one, a Caucasian boy, Daniel, was 6 years and 11 months of age at the start of the study. Daniel had received a diagnosis of autism prior to entering preschool. Upon assessment of his cognitive skills, he was estimated to have low average to average intellectual ability. He was able to function at grade level with slight modifications and adaptations to the curriculum. His spontaneous language consisted mostly of stereotypic, echolalic, and learned phrases, usually related to his restricted interests. His adaptive behaviors appeared to be low average, typically requiring assistance from his mother. Daniel demonstrated inflexible mealtime behaviors such as crying, screaming, whining, and running away from the eating area when new foods were presented. His diet consisted exclusively of six foods (Rusty's pizza, french fries, chicken nuggets, ground beef, ketchup, and vanilla ice cream).

Child two, a Caucasian boy, Ken, was 6 years and 4 months of age at the start of the study. Ken had received a diagnosis of autism just before his second birthday. He had been receiving behavioral therapy services since the age of 2. Upon assessment of his cognitive skills, Ken was untestable, but was estimated to have below average intellectual ability. His spontaneous language consisted of mostly 1–2 word utterances or learned phrases with occasional 3 and 4 word utterances. His adaptive behaviors also appeared to be low average as observed by his clinicians. Ken demonstrated inflexible mealtime behaviors such as running away from the eating area, screaming, hitting, and throwing items when new foods were presented. His diet consisted of 13 foods (apple sauce, yogurt smoothies, Oreo cookies, McDonald's french fries, schnitzel chicken, goldfish crackers, spaghetti noodles with butter, pretzels, popcorn, fruit snacks, jelly beans/gummies, cheese puffs, and Trader Joe's banana waffles with peanut butter).

Child 3, a Hispanic-American boy, Robbie, was 7 years 8 months of age at the start of the study. Robbie was diagnosed with autism prior to entering preschool. Upon assessment of his cognitive skills, he was estimated to have low average intellectual ability. His spontaneous language consisted mostly of 4–5 word utterances with limited complex conversational exchanges. His adaptive behaviors appeared to be low average, typically requiring assistance from his mother. Robbie demonstrated inflexible mealtime behaviors including spitting, pushing food away inappropriately, screaming, whining, and crying when

new foods were presented. His diet consisted of 13 food interests (waffles with syrup, potato chips, cereal, macaroni and cheese, eggs with tortillas, bananas, bread, cookies, french fries, cheese and mayonnaise sandwiches, peanut butter and jelly sandwiches, chicken nuggets, and pizza).

Design

Data were analyzed in the context of two designs. In order to assess the success of the intervention on a large number of foods, a clinical replication design (Barlow et al. 2009) across a total of 48 different foods (some were the same for more than one child), was employed. All of the 48 foods were selected from a list compiled by the parents. This resulted in a list of 25 new foods for Robbie, 25 for Daniel, and 8 for Ken (10 of the foods overlapped, e.g., Fish sticks were on both Robbie and Daniel's lists). Additional new foods were presented without reinforcement 2–18 weeks after intervention ended in order to assess generalization.

Additionally, in order to provide more experimental control, five of the foods (two for Robbie and Daniel and one for Ken, whose list of foods was shorter), were chosen to analyze within the context of a multiple baseline design. We unsystematically selected five of the foods across the three children to begin intervention at later dates. For these five foods, we gathered baseline measures, intervention measures, and follow-up measures. This resulted in us unsystematically staggering the number of baseline probes, ranging from 2 to 5 probes. One probe was defined as a set of a maximum of three opportunities within any one given session to accept a food item. Probes were presented multiple times per week according the routines of the family.

Procedures

Prior to collecting baseline, parents and guardians were asked to compile a list of foods which they desired the child would eat because the foods were healthy, because they were foods typically eaten by the rest of the family, and/or because they were foods commonly eaten by the children's peers in social environments. During the baseline and intervention probes, adults presented the child with foods randomly selected from the list.

Baseline—During the baseline condition, adults presented foods (from the list compiled by the parents) to the child as they normally would during snack or mealtimes. No special instructions were given other than to offer a given food three times.

Intervention—Foods presented during intervention were also selected from the lists compiled by parents, and were presented in the same way as they were in the baseline condition with two exceptions: in the intervention condition, food was presented in a systematic hierarchical sequence, and reinforcers were presented for trying new food items. Throughout intervention, all three children chose a reinforcer which was highly motivating to the child prior to being presented with an opportunity for food flexibility. Specifically, at the beginning of each food flexibility probe the adult would ask the child what reinforcer (e.g., activity, item, object) they would like to earn. Once the child identified their desired reinforcer (e.g., french fries) they were told what behavior they would need to perform in order to earn access to their reinforcer. The child's desired reinforcer was then provided contingently after he tried the new food.

"Trying" the food was defined for each child individually based on the clinicians' observations during the first intervention probe, and then was systematically advanced to higher levels throughout intervention, with foods continuing to be presented on successive

days, until they reached a maximum of complete acceptance (level seven), as shown in Table 1.

This procedure was continued until children tried 15 new foods or reached a maximum of 22 weeks. Once a child was successful (e.g., would try a food during three consecutive probes without disruptive behavior), they were advanced to the next level. For example, initially, Ken only had to pick up the food and touch it to his lips before being rewarded. However, later in intervention, trying the food was defined as taking a bite and swallowing. Adults clearly stated what was expected of the child at each phase (e.g., “We just have to try the food. That means touching it to your lips and then you get to watch the video!”). Adults offered reinforcers contingent upon the individualized step for each child. Once the child made an attempt to try the food item, reinforcement, including praise and high affect, was immediately presented. If the child refused the food, he was reminded of the need to make an attempt before receiving the reinforcer, but was never forced to try the food item. If an attempt was not made, the reinforcer was not provided.

Dependent Measures

The dependent variables measured within this study were (a) number of foods accepted, (b) spontaneous requests for new foods, (c) modal/representative comments, and (d) level of acceptance of each food item.

Number of Foods Accepted—Foods that the child accepted were defined as foods which were accepted at a level 7 (see Table 1: levels of acceptance scale). The number of foods accepted at level 7 was tabulated.

Spontaneous Requests for New Foods—Spontaneous requests for new foods was defined as any spontaneous request by the child for a new food item without encouragement or prompting from an adult.

Modal/Representative Comments—The comments the children made during baseline and intervention were recorded on video, and the comments made most frequently were listed as the modal comment for each condition. If no comment was made more than once, then a representative comment identified by two independent observers was recorded.

Hierarchical Levels of Acceptance Scale—Table 1 describes the levels of acceptance. Designed in a hierarchal fashion, a level of acceptance of zero indicated that the child refused to try the food, either with or without displaying disruptive behavior. Level one was touching the new food (e.g., touching the apple with index finger). Level two was touching the new food to the lips. Level three was biting the new food. Level four was the child biting the new food and holding it in his mouth, but refusing to swallow it. Level five was chewing the new food, but not swallowing the food (spitting it out). Level six was swallowing the new food with some displeasure (e.g., whining or complaining). Finally, a level seven was swallowing the new food without any signs of displeasure or disruptive behavior. For each food flexibility probe, the child was offered the food item three times and the highest level of acceptance was recorded. For example, if during one probe for an individual food item, the levels of acceptance were 6, 6, and 7, a level 7 would be recorded for that probe.

Reliability

Two adults independently coded the data for 15% of the sessions for reliability purposes. One of the observers was blind to the experimental conditions. The reliability observer viewed videotapes of probes with the participants in random order, in order to control for observer drift. Interobserver agreement was calculated by dividing the number of

agreements by the total number of agreements plus disagreements and then multiplying by 100 to obtain the percentage. Agreement was defined as both observers generating identical ratings for the child. Mean interobserver agreement for levels of acceptance of foods offered was 92.76% across all sessions, with a range of 89% to 100%. Mean interobserver agreement for modal/representative comments was 100%.

Results

Table 2 provides data for the clinical replication design regarding the number of foods accepted, spontaneous requests for new foods, and modal/representative comments.

Results presented in Table 2 show that all participants increased the number of foods they accepted from baseline to follow up/generalization. Further, results indicate that although all participants did not spontaneously request new foods during baseline, by generalization, all three children were making spontaneous requests for new food items. The table also shows the modal comments made by each child during the baseline and follow up/generalization conditions. The table shows that the modal/representative comments prior to intervention were universally negative, such as “No thank you” etc. In contrast, the modal/representative comments at follow up/generalization were universally positive, such as “delicious” etc.

Figure 1 shows the cumulative number of foods that were accepted by each child in the baseline, intervention, and follow-up conditions in the clinical replication design.

During the 10 weeks prior to the intervention, the total number of new foods accepted remained at zero for all three children. That is, during this period of time, although all three children were given opportunities to try and add new foods to their existing repertoire, none did so. However, once intervention began, all three children exhibited increases in the number of new foods they accepted. Intervention continued until children tried approximately 15 new foods with some degree of success (level three or above), or for a maximum of 22 weeks, whichever came first. Throughout intervention, all three participants continued to demonstrate gains, with some variability across sessions. By the completion of intervention, Ken accepted five new foods at a level seven, that is, full acceptance, and Robbie and Daniel accepted nine and eight new foods, respectively at level seven.

Figure 1 also includes follow-up data assessing the children’s generalization of treatment gains. During the follow-up period, the children did not receive any type of reinforcement beyond the typical type of verbal praise presented by a parent for trying a new food. During this period, displayed as open shapes in the graph, all three children continued to show high levels of new foods accepted into their eating repertoire. As indicated by the data in Fig. 1, Ken increased his total number of foods accepted, accepting one additional new food in follow-up, totaling six new foods overall. Robbie accepted six new foods, totaling fifteen new foods overall. Daniel accepted eight new foods, totaling sixteen new foods overall.

Figure 2 is a secondary analysis of progress documenting the levels of food acceptance for the specific foods selected for analysis within a multiple baseline design.

Data for two separate food items are presented for Daniel and Robbie and one food for Ken (whose food list was shorter than Daniel and Robbie). As indicated by the graph, all three participants demonstrated a level zero of food acceptance (i.e., refuses to try food “with or without disruptive behaviors”) for each specific food item (i.e., fried ham, grilled cheese, nuggets, cherries, oranges) during baseline. However, with the introduction of intervention each participant exhibited immediate improvements in their level of food acceptance. By the end of intervention, all three participants were demonstrating food acceptance at level seven,

the highest level (i.e., accept food without any signs of displeasure or disruptive behavior). These gains were maintained during follow-up for all three participants.

Discussion

The results of the present study showed that the participants' flexibility in their willingness to try new foods increased following an intervention based upon reinforcement for flexibility coupled with a hierarchical exposure to the foods. The importance of systematically using reinforcement and hierarchical exposure procedures in addressing behavioral challenges in children with ASD has been established in the literature. The current study corroborates previous evidence related to the success of reinforcement-based and hierarchical exposure strategies with other populations and target behaviors, and also adds to the literature by suggesting that these techniques are applicable to the amelioration of rigidity and inflexibility related to food literature (Charlop-Christy et al. 2002; Koegel 2000; Koegel et al. 1996; Lang et al. 2009; Lovaas 1987; Shabani and Fisher 2006). Additional research in this area with respect to other types of rigidity and inflexibility, which are hallmarks of autism, is likely to be very productive. It is also interesting that in the current study, although participants were initially unwilling to try new food items, they eventually enjoyed some of the foods.

Secondly, the current study has implications for how food selectivity issues in ASD are perceived. That is, a common assumption is that food selectivity problems in ASD are related to impairments in sensory processing (Dominick et al. 2007; Keen 2008; Schreck et al. 2004). If so, then the results of this study suggest that for at least a group of individuals with ASD, it is possible that sensory processing may be influenced by this intervention. Given the speed and ease with which improvement took place, it is also possible that sensory processing was not a variable at all, and that motivation to try new foods was the primary variable being addressed. In either case, the results suggest that the problem of rigidity in food acceptance may not be as difficult to change as has been suspected in the past.

As such, this raises questions about what specific mechanisms are in place that enable such quick responses to intervention. Understanding the underlying mechanism of this behavioral change is especially important given the necessity that children receive proper nutrition and the stress that families experience when their child exhibits food refusal. Relatedly, it might be particularly helpful to better understand how food preferences in individuals develop. That is, do people innately favor certain foods or food textures, or are such food preferences primarily a function of environmental experiences? Moreover, the results from the current study showing that food preference may be easily altered is consistent with the literature in the area of taste aversion which has shown extremely rapid conditioning of food tastes and preferences (Bures et al. 1998; Flint and Marino 2007; Miranda et al. 2003). Further research along these lines may be profitable in understanding food preferences and in establishing interventions for altering food flexibility and fostering more appropriate nutritional choices. Additionally, although the present study provides some data for up to 18 weeks on maintenance, it would be interesting in future research to examine variables influencing long-term follow-up.

All of the above possibilities are interesting to ponder. However, whatever the mechanism of change may be, the results of the present study indicate that behavioral interventions can be used to treat symptoms of rigidity and inflexibility with respect to mealtime and eating behaviors, and that further research on both food flexibility and flexibility in general is likely to be highly productive for children with autism.

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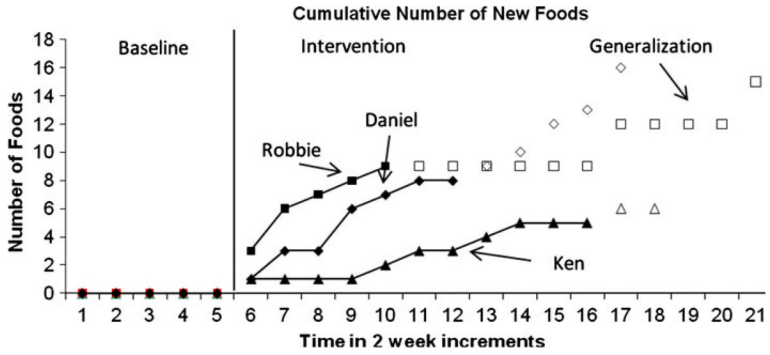

Fig. 1.

Cumulative number of new foods in the clinical replication design accepted at level seven (complete acceptance) by each participant over the course of baseline and intervention. *Open symbols* represent generalization probes

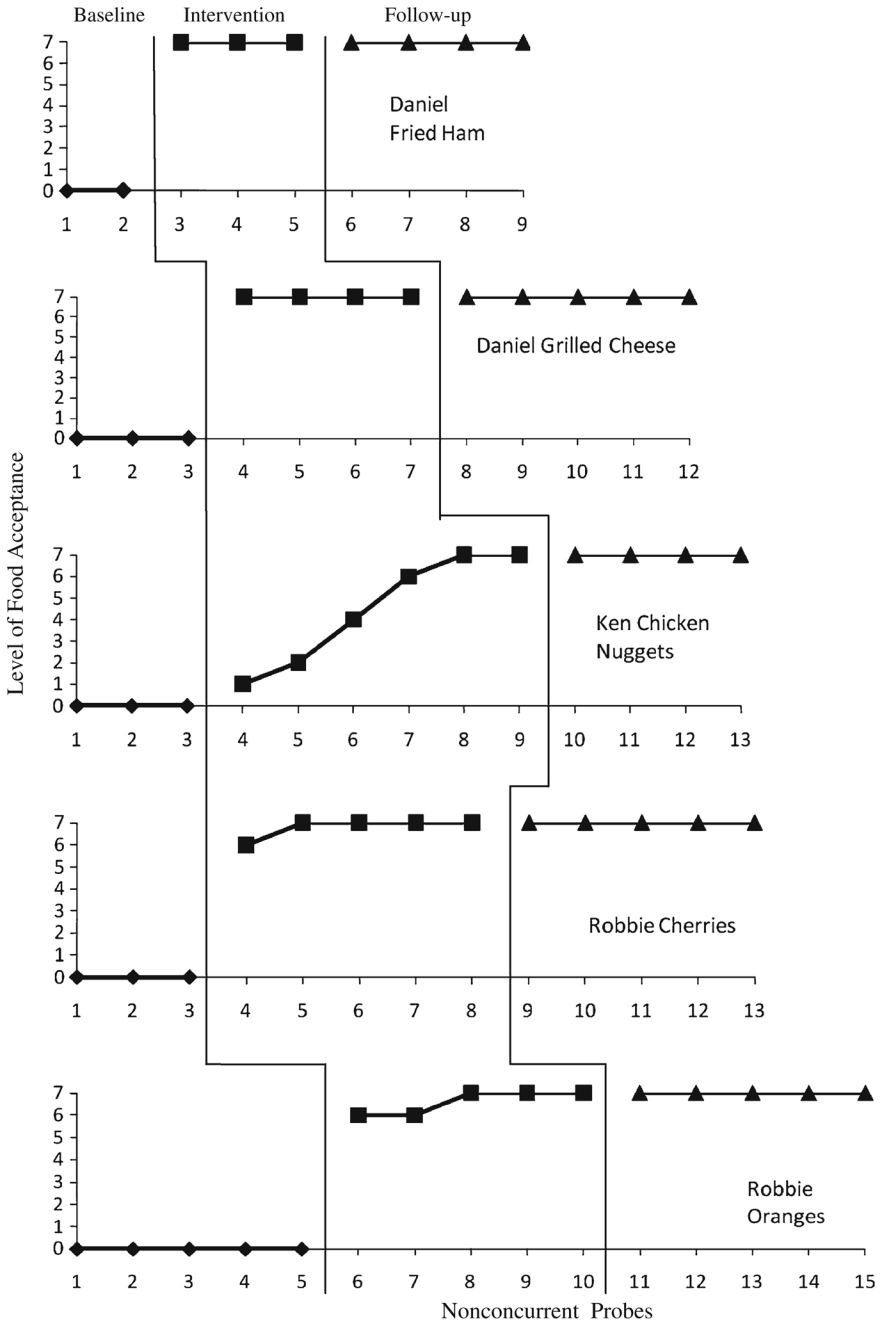

Fig. 2.

Levels of food acceptance for each participant in the multiple baseline design over the course of baseline, intervention, and follow-up

Table 1

Hierarchical levels of acceptance scale

Hierarchical level of acceptance	Description
0	Refuses to try food (with or without disruptive behavior)
1	Touches the food and motions it towards mouth (does not include touching the food as an act of disruptive behavior such as throwing the food)
2	Puts the food to lips
3	Bites the food
4	Bites and puts in mouth, refuses to swallow
5	Chews the food but refuses to swallow
6	Swallows the food reluctantly
7	Accepts the food without any signs of displeasure or disruptive behavior

Table 2

Number of spontaneously requested foods pre- and post-intervention

	# Of new foods accepted at baseline (outside of the restricted diet)	# Of new foods accepted by follow-up/ generalization	New Foods Spontaneously requested at baseline?	Spontaneously requested at post-intervention?	Modal/representative comments made when foods were offered in the baseline condition	Modal/representative comments made when foods were offered in the intervention condition
Daniel	0	16	No	Yes	“No thank you.”	“Delicious!”
Ken	0	6	No	Yes	“N-o-o-o-o-o!” and running away	Smiles and says “more”
Robbie	0	15	No	Yes	“No, I don’t want it” or “No, thank you”	“Mmm. Mmm, mmm…Cherry tastes good! Woohoo, now I like cherries! I think I’m gonna cry!”