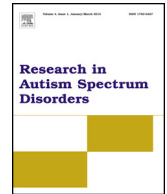




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A systematic review of the effects of choice on academic outcomes for students with autism spectrum disorder



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ABSTRACT

The present review synthesized single-case design studies whose interventions included a choice-making component to investigate their effects on academic behaviors in academic settings for students with autism spectrum disorder. Studies included were conducted between 1990 and 2013 with kindergarten to grade 12 students with autism spectrum disorder. Eight studies met the criteria for inclusion. We applied a multistep evaluation process to provide an overview of the quality of evidence across studies reviewed and to inform the interpretation of results from each study. Findings indicate that providing a choice component results in improvements in student (a) work completion, (b) behaviors (e.g., increase in on-task behavior, reduction in challenging behavior), and (c) affect and interest. Further, we noted that outcomes varied by design, with conditions that included a choice component outperforming the no choice component condition in both multiple-baseline and withdrawal designs, although results were mixed for studies employing an alternating-treatment design.

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1. Introduction

Many students with autism spectrum disorder (ASD) show very little interest in academic tasks and are often described by their teachers as lacking the “motivation” needed for desirable academic performance (Koegel, Singh, & Koegel, 2010). Difficulties in academic performance can be compounded and exacerbated by the challenging behaviors many students with ASD exhibit (Koegel et al., 2010; Ramdoss et al., 2011), resulting in what is often described as escape-maintained behaviors (Koegel et al., 2010; Taylor & Seltzer, 2011). This lack of motivation, coupled with challenging behaviors and academic difficulties, suggests a need for interventions designed for students with ASD that target engagement, challenging behaviors, and academic difficulties (e.g., reading comprehension) simultaneously.

1.1. Previous research on choice-making

Previous research has suggested that an approach to improve motivation, academic performance (Tiger, Toussaint, & Roath, 2010), and engagement (Ulke-Kurkcuoglu & Kircaali-Iftar, 2010), while also reducing challenging behaviors (Romaniuk & Miltenberger, 2001) for students with ASD is to embed the opportunity to make choices into interventions. Even though syntheses on interventions with a choice component have tended to focus on appropriate (e.g., on-task) and inappropriate behaviors (e.g., challenging; Cannella, O’Reilly, & Lancioni, 2005; Lancioni, O’Reilly, & Emerson, 1996; Shogren, Faggella-Luby, Bae, & Wehmeyer, 2004; Tullis et al., 2011), as compared to a broader range of outcomes (e.g., academic behaviors), results have been promising. A syntheses by Tullis et al. (2011) found positive findings for 10 out of 13 studies for individuals with severe and profound disabilities, and Shogren et al. (2004) found overall positive results for individuals with disabilities. Additionally, choice as an independent variable has led researchers to suggest that choice is associated with positive student outcomes across various conditions (e.g., choice in reinforcer, choice in task).

These positive outcomes have been demonstrated in studies that have investigated the impact of choice under such conditions as choice in (a) reinforcer, (b) tasks to complete, and (c) materials to use. When choice was used for individuals to identify a reinforcer, research has found that more tasks are completed when the reinforcer is highly preferred (DeLeon, Frank, Gregory, & Allman, 2009) while low preference reinforcers can also be effective, when task demands decrease (Glover, Roane, Kadey, & Grow, 2008). Furthermore as an antecedent intervention, choice was found to reduce problem behaviors when individuals were allowed to choose the task to complete (Cole & Levinson, 2002; Seybert & Ferro, 1996) and the location and materials for the task (Parsons, Harper, Jensen, & Reid, 1997). Overall, providing choice appears to be effective at reducing problem behavior, regardless of the type of choice condition that is implemented (Shogren et al., 2004).

While these studies shed light on the conditions that impact choice components in interventions for individuals with ASD, historically, the use of choice as an independent variable has been studied more heavily with populations identified with disabilities other than ASD (e.g., emotional and behavioral disorders, learning disabilities, severe/multiple disabilities, intellectual disabilities; Cannella et al., 2005; Carr & Carlson, 1993; Lancioni et al., 1996; Tullis et al., 2011; Watanabe & Sturmey, 2003). However, providing opportunities for choice-making during reinforcement delivery is emerging as a preferred method of reinforcer identification for students with ASD (Mechling, Gast, & Cronin, 2006; Tiger et al., 2010), as it may mitigate the potential of reinforcers losing their reinforcing value due to repeated presentations (i.e., abolishing operation, satiation) (Mechling et al., 2006; Murphy, McSweeney, Smith, & McComas, 2003; O’Reilly et al., 2008). Additionally, when choice-making is used as an antecedent-based intervention for students with ASD, researchers have

shown that embedding choice and interest in an intervention can (a) improve motivation and academic outcomes and (b) decrease challenging behaviors (Zein, Solis, Lang, & Kim, 2014; Koegel et al., 2010; Moes, 1998; Rispoli et al., 2013).

1.2. Purpose of this study

Despite recent findings on the use of choice, syntheses on choice have investigated the effects of a choice component on decreasing problem behavior and increasing appropriate behavior for individuals with a disability (Shogren et al., 2004) and individuals with severe to profound developmental disabilities (Cannella et al., 2005; Lancioni et al., 1996; Tullis et al., 2011). This synthesis differs from previous syntheses in that it is the first synthesis to investigate the moderating effects of (a) a choice component on academic outcomes (i.e., work completion, appropriate and inappropriate behaviors, affect and interest) for students with ASD (regardless of severity) and (b) the overall study quality that leads to these findings. Therefore, we conducted a synthesis specific to ASD to fill the void and contribute to the knowledge base while also evaluating each study's quality, based on its study design features and evidence to support a functional relationship (Kratochwill et al., 2010, 2012), for greater confidence in our findings. Due to the increasing prevalence of ASD and the current state of low academic outcomes for individuals on the spectrum (Fluery et al., 2014), this study is timely and warranted.

1.3. Rationale and research questions

Despite these recent syntheses and an increase in the use of choice in interventions (Cannella et al., 2005; Lancioni et al., 1996; Mechling et al., 2006; Shogren et al., 2004; Tiger et al., 2010; Tullis et al., 2011), a synthesis of the literature has yet to be conducted on the effects of choice in interventions on academic behaviors (e.g., work completion) in academic settings for students with ASD. This systematic review aims to answer two questions related to the effects of choice for students with ASD: (1) What are the effects of different applications of choice-making within academic interventions for school-aged students with ASD? (2) Do the effects of different applications of choice-making within academic interventions for school-aged students with ASD differ based on the quality of the study?

2. Methods

2.1. Search procedures and study identification

A multistep process was used to conduct a comprehensive and systematic search of intervention studies that examined the effect of choice on the academic outcomes of students with ASD. First, electronic searches of the PsychINFO, ERIC, Psychology and Behavioral Sciences Collection, and Medline databases were completed to locate studies in peer-reviewed journals published between 1990 and 2014. Two of the authors independently conducted this search procedure, using identical search protocols. As a first step, each of the descriptors *autism*, *Asperger's*, *autistic*, and *PDD-NOS* was initially paired with the descriptor *choice*. The initial search yielded a large number of articles ($N=127$); however, the majority were disregarded as a result of irrelevant "choice" topics (e.g., some article titles indicated topics like "parent choice of treatment"). This preliminary search yielded 14 relevant results to be examined for possible inclusion. Further, references were gathered from the initial set of articles to identify additional articles ($N=17$). From the total number of potentially included studies, some were excluded for using non-experimental research designs (i.e., designs other than experimental group or single-case design) (Lough, Rice, & Lough, 2012; Peterson, Caniglia, & Royster, 2001). Other studies were excluded because the intervention was conducted in the home setting or in a residential facility (Carter, 2001; Dyer, Dunlap, & Winterling, 1990; Ip, Szymanski, Johnston-Rodriguez, & Karls, 1994; Watanabe & Sturmey, 2003). For the purpose of inclusion in this synthesis, the 17 studies were examined using the selection criteria discussed below.

2.2. Selection criteria

After several rounds of searching the electronic databases, as well as reference searches in relevant articles (e.g., hand-searched reference lists, Google's "cited by" feature), eight studies met the following criteria for inclusion in this synthesis:

1. The study used a group design that included a comparison condition or a single-case design to evaluate the effects of a choice intervention.
2. At least one of the dependent variables was an academic outcome, which was defined as performance during a task that is part of the class curriculum, academic engagement, and/or challenging behavior that directly influences one or more of the first two outcome types (i.e., academic performance and engagement). Academic tasks included skills taught (e.g., math, reading, social studies) in an educational setting (e.g., general education, self-contained classroom).
3. For experimental group and quasi-experimental designs, at least 50% of the participants had to have been diagnosed with autism, Asperger's, or pervasive developmental disorder-not otherwise specified (PDD-NOS). The data for all participants diagnosed with ASD in a study were disaggregated for analysis, and the data for participants without ASD diagnosis were disregarded.

Table 1
Study features.

Study	Study design	n	Age (in years)	Number of sessions	Implementer	Dependent variable	Description of treatment
Koegel et al. (2010)	Multiple baseline across participants and behaviors	3	5, 5, 7	4–17	Not reported	Latency to start task Task completion Disruptive behavior Interest	Motivational components were incorporated within academic tasks (i.e., writing and math). Participants were given choices of the materials that could be used and the setting where the task could be carried out. Easier math and writing tasks were interspersed with more difficult ones. Math and writing tasks were directly related to the natural reinforcer. Child-specific interests were incorporated
Mechling et al. (2006)	BCBC	2	13, 14	16	Researcher	Task duration	Tangible condition: participants completed three tasks and then received a tangible reinforcer identified by preference assessment Video reinforcement + choice condition: reinforcer was a video recording of their choice (choices: watching themselves engaging in the tangible condition available in class or engaging in a stimulus not available in the classroom).
Moes (1998)	ABAB and BABA	4	5, 6, 8, 9	20	Undergraduate and graduate students	Accuracy of responding Disruptive behavior Homework completion Affect	Choice condition: the child was allowed to choose the order of the homework activities, the order of specific items or problems within those selected activities, and the stimulus materials.
Newman et al. (2002)	Alternating treatment	3	7, 11, 12	10–14	Researcher	Correct responding Competing behavior	Students taught color identification, receptive object identification, shape identification, expressive letter identification, expressive number identification, and/or social questions. Student selects days: students were allowed to select the first program and were asked, "What would you like to work for?" from items based on a student's reinforcement inventory Teacher selects days: teacher chose reinforcer and order of the programs selected. Reinforcers were selected from the reinforcer inventory.
Rispoli et al. (2013)	Alternating treatment and ABAB	4	5, 7, 11, 11	19–31	Researcher and teacher	Challenging behavior during academic tasks	Across-activity choice condition: The participant chose a task to complete from activities placed on the table Within-activity choice condition: the interventionist chose the activity at random, but the participant was given a choice of how to complete the activity (i.e., how to respond, location, or materials to use)
Smeltzer et al. (2009)	Alternating treatment	3	6, 6, 8	30–32	Researcher	Challenging behavior On-task behavior Duration to complete tasks	Student-selected condition (choice): written words corresponding to three tasks placed on the student's desk to complete. The student could choose the order to complete the tasks Yoked condition (no choice): same as student-selected condition, except the student could not choose the order to complete the tasks. Experimenter-selected condition (no choice): same as yoked condition, but reinforcer was not yoked to previous condition. Concurrent operants: written words corresponding to three tasks placed on the student's desk. Student could choose or let the researcher choose the order to complete tasks.

Table 1 (Continued)

Study	Study design	n	Age (in years)	Number of sessions	Implementer	Dependent variable	Description of treatment
Tiger et al. (2010)	Multiple baseline and alternating treatment	3	7, 7	15–26	Researcher	Rate of responding to tasks	After completing a task, the participant could select one of five identical edible items (choice) or be given a single edible item (no choice; identical to those during choice sessions) Fixed-ratio assessment: the therapist delivered reinforcement following both prompted and independent responses. Choice and no choice conditions were alternated Progressive ratio assessment: same as fixed-ratio assessment, except the number of responses required to obtain reinforcement increased throughout each session (i.e., schedule values were 1, 1, 2, 2, 4, 4, 8, 8, 16, 16, etc.) Concurrent-operant assessment: drawing a line on one piece of paper resulted in the delivery of five preferred edible items from which to select one (choice). Drawing a line on the second piece of paper resulted in the delivery of one edible item identical to those delivered in the choice condition (no choice). Drawing a line on the third piece of paper resulted in the presentation of an empty plate (i.e., no tangible reinforcers were delivered; control)
Ulke-Kurkcuglu and Kircaali-Iftar (2010)	ABACA and ACABA	4	5–8	8	Teacher	On-task behavior	Activity choice: identical procedures to baseline, plus the teacher asked the participant to make a selection between two transparent boxes, each containing two sets of materials related to the activity Material choice: Procedures similar to baseline, except the participant was permitted to choose the materials associated with an activity

4. For single-case studies, at least one participant receiving the intervention had to have been diagnosed with autism, Asperger's, or PDD-NOS. For studies with some participants diagnosed with ASD, the data for those participants had to be disaggregated, and the data for participants without ASD diagnosis were disregarded.
5. The intervention was conducted in a school setting.
6. Participants were students in kindergarten to grade 12. Studies that included adults or children not yet in kindergarten were excluded (Ip et al., 1994; Watanabe & Sturmey, 2003).
7. The intervention was delivered in English.
8. The study was published in a peer-reviewed journal between 1990 and 2014.

2.3. Coding procedures

An extensive code sheet adapted from those developed for past intervention syntheses (Kim, Vaughn, Wanzek, & Wei, 2004) was used to organize essential information, based on the following study features (see Table 1): (a) participant characteristics, (b) dependent measures, (c) intervention components, (d) study findings, and (e) certainty of evidence. The coding sheet used a combination of forced-choice items (e.g., research design, assignment method, fidelity of implementation), open-ended items (e.g., characteristics of students or schools used to equate groups, age, or grades of subjects as described in the text), and written description of the treatment condition.

Prior to the coding process, two coders attended multiple training meetings, in which specific categories and codes were discussed, using sample studies. Each of the two raters (second and third authors) independently double-coded all eight articles. Three rounds of coding and double-coding were conducted. During the first round of coding, each coder independently coded the same article. The initial round of coding yielded agreement of 85%. Following a discussion of the article and reaching consensus on disagreements, 100% agreement was reached. The procedures for the second round of coding were identical to those of the first round. Agreement during this round was 95%. After reaching consensus on the disagreements, 100% agreement was reached. The third round of coding included the final six articles. In this round, each coder coded three different articles and double-coded the other three articles. Agreement during this round was 95%. After reaching consensus on the disagreements, 100% agreement was reached. Prior to reaching consensus, the average agreement

across the three rounds of coding was 92%; while after reaching consensus, the average agreement across the three rounds of coding was 100%.

2.4. Design evaluation and visual analysis

To provide an overview of the quality of evidence across the corpus of reviewed studies and to inform the interpretation of results from each study, we applied a multistep evaluation process (see Fig. 1) based on the What Works Clearinghouse single-case design standards (Kratochwill et al., 2010, 2012): (a) meets design standards, (b) meets design standards with reservations, or (c) does not meet design standards.

For a study to be identified as meets design standards, it had to meet *all* of the following four criteria. First, the independent variable had to be systematically manipulated by the researcher(s), as opposed to a naturally occurring event. Second, dependent variables had to be measured systematically over time and by multiple observers. Interobserver agreement data must have been reported for at least 20% of the sessions, with minimum percent agreement of 80%. Third, the study must have reported at least three attempts to demonstrate treatment effect, each at a different point in time. Fourth, within a study, each phase must have included a minimum of three data points (with a preference for five). We applied the fourth criterion to qualify studies as either meets design standards or meets design standards with reservations. This determination was based on the type of single-case design, the number of phases, and the number of data points gathered per phase. For an ABAB design study to be identified as meets design standards, it had to have at least four phases, with a minimum of five data points per phase. Having three or four data points in any of the phases caused the study to be identified as meets design standards with reservations. For a multiple-baseline design study to be classified as meets design standards, it had to have at least six phases (e.g., at least three baselines and three intervention phases across three participants) with at least five data points per phase. Having three or four data points per phase caused the study to be identified as meets design standards with reservations. Finally, for an alternating-treatments design study to be classified as meets design standards, it had to have at least five repetitions of the alternating sequence. An alternating-treatments design study with four repetitions was classified as meets design standards with reservations as long as it met the first three criteria.

Researchers have traditionally used visual analysis to interpret single-case study results (Horner et al., 2005; Kennedy, 2005; Kratochwill et al., 2012). Currently, there does not seem to be a consensus regarding one statistical analysis procedure to interpret results from single-case design studies (Kratochwill et al., 2010, 2012). For these reasons, we applied the evidence criteria that Kratochwill et al. (2010, 2012) suggested, which are based on four steps of visual inspection of the graph(s) as a means of assessing whether a functional relationship exists between the independent and dependent variables

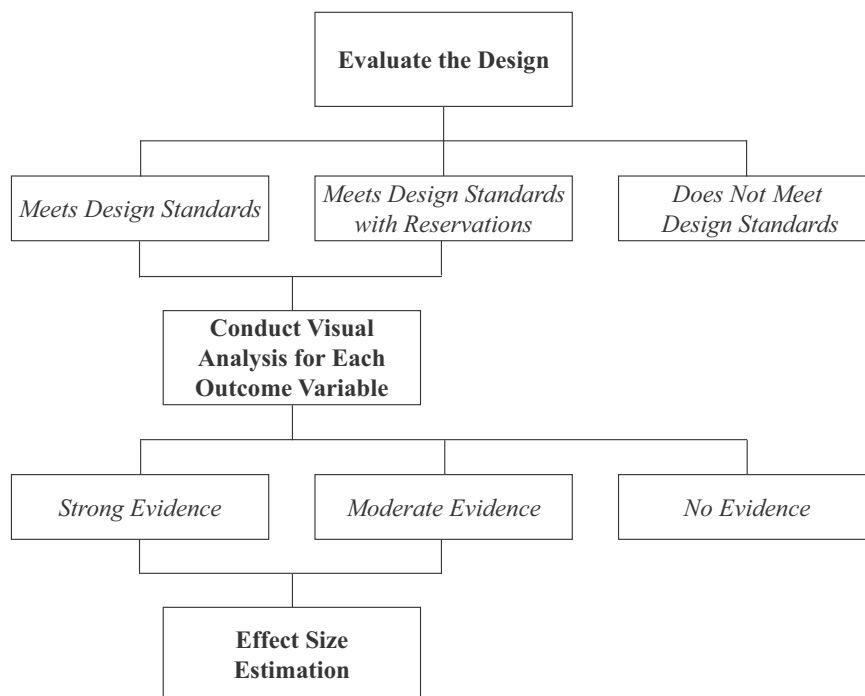


Fig. 1. Design evaluation flow chart.

Adapted from Kratochwill et al. (2010). U.S. Department of Education, Institute of Education Sciences, National Center for Education Evaluation and Regional Assistance, What Works Clearinghouse. Source: What Works Clearinghouse single-case design technical documentation Version 1.0. Available at http://ies.ed.gov/ncee/wwc/pdf/wwc_scd.pdf.

Table 2
Evidence ratings.

Study	Dependent variable	Level	Trend	Variability	Immediacy of effect	Overlap	Rating (reason)
Koegel et al. (2010)	Latency to start task	All participants: lower during intervention	All participants: ascending during baseline Descending or stable during intervention	All participants: higher during baseline	All participants: immediate effect between phases	Writing: 0/9; 0/7; 1/4 Math: 0/8	Strong evidence (no indication of noneffect)
	Task completion	All participants: higher during intervention	All participants: descending during baseline Neutral trend during intervention	Two participants: higher during intervention Two participants: similar between phases	All participants: immediate effect between phases	Writing: 0/9; 0/7; 0/4 Math: 1/8	
	Disruptive behavior	All participants: lower during intervention	All participants: ascending during baseline Descending during intervention	All participants: mixed variability between phases	All participants: immediate effect between phases	Writing: 0/9; 0/7; 0/4 Math: 0/8	
	Interest	All participants: higher during intervention	All participants: descending during baseline Ascending during intervention	All participants: mixed variability between phases	All participants: immediate effect between phases	Writing: 0/9; 0/7; 0/4 Math: 0/8	
Mechling et al. (2006)	Task duration	All participants: higher during tangible condition than video plus choice condition	All participants: ascending during tangible condition Neutral during video plus choice condition	All participants: higher during tangible condition than video plus choice condition	All participants: immediate effect between phases	8/16	Moderate evidence (one indication of noneffect due to overlap)
Moes (1998)	Accuracy of responding	All participants: higher during intervention	All participants: ascending trends during choice condition Neutral and descending during the no choice condition	All participants: no differentiation between phases	All participants: immediate effect between phases	1/10; 1/10; 1/10; 5/10	Moderate evidence (one indication of noneffect due to overlap)
	Disruptive behavior	All participants: lower during intervention	All participants: neutral trends for most phases	All participants: no differentiation between phases	All participants: immediate effect between phases	1/10; 0/10; 1/10; 10/10	
	Homework completion	All participants: higher during intervention	One participant: ascending during intervention Three participants: neutral for all phases	All participants: no differentiation between phases	All participants: immediate effect between phases	0/10; 0/10; 1/10; 8/10	
	Affect	All participants: higher in the choice condition	All participants: ascending during the choice condition Neutral and descending during the no choice condition	All participants: no differentiation between phases	All participants: immediate effect between phases	0/10; 2/10; 4/10; 9/10	

Table 2 (Continued)

Study	Dependent variable	Level	Trend	Variability	Immediacy of effect	Overlap	Rating (reason)
Newman et al. (2002)	Correct responding	All participants: no differentiation between conditions for any dependent variable	All participants: ascending for both conditions No differentiation	All participants: slightly higher in student-directed condition	All participants: no differentiation between conditions	N/A ^a	No evidence (more than one indication of noneffect)
	Competing behavior	All participants: lower during student-directed condition	All participants: Ascending in teacher-directed condition Neutral in student-directed condition	All participants: no differentiation between conditions	Immediate effect between phases	N/A ^a	
Rispoli et al. (2013)	Challenging behavior (ABAB)	All participants: lower during intervention	All participants: neutral during baseline and intervention	Three of four participants: lower during intervention	Immediate effect between phases	0/20; 0/20; 3/19; 0/20	Moderate evidence for MBL (one indication of noneffect due to overlap) No evidence for AT (more than one indication of lack of differentiation)
	Challenging behavior (AT)	One participant: lower during across-activity choice Three participants: no differentiation	All participants: neutral for both conditions No differentiation	All participants: no differentiation between phases	All participants: no differentiation between conditions	N/A ^a	
Smeltzer et al. (2009)	Problem behavior	All participants: highest in experimenter-selected condition No differentiation between conditions	All participants: neutral for most conditions One ascending phase for one student-selected condition No differentiation	Mixed, with highest variability in experimenter-selected condition	Mixed for experimenter-selected condition No differentiation for other two conditions	N/A ^a	No evidence (more than one indication of noneffect due to overlap and trend)
	On-task behavior	All participants: highest during student-selected condition, then yoked and experimenter-selected conditions	All participants: no differentiation Neutral for all conditions	Mixed, with highest variability in experimenter-selected condition	Experimenter-selected condition had high immediacy No differentiation in other conditions	N/A ^a	
	Duration to complete tasks	No differentiation	All participants: slight descending for yoked condition No differentiation and neutral for other two conditions	Mixed across all conditions	Mixed across all conditions	N/A ^a	

Tiger et al. (2010)	Fixed-ratio assessment for rate of responses (MBL)	All participants: higher during intervention phase	All participants: neutral in baseline Ascending in the choice condition Descending trends in the no choice condition	All participants: higher during intervention	All participants: immediate effect between phases	0/14; 0/10	No effect (one indication of noneffect due to overlap)
	Fixed-ratio assessment for rate of responses (AT) Progressive ratio for number of responses (AT)	No differentiation between conditions ^a One participant: higher during the choice condition One participant: no differentiation	Choice condition: mixed No choice condition: mixed	One participant: no differentiation One participant: higher during no choice condition	N/A	N/A ^a	
Ulke-Kurkcuoglu and Kircaali-Iftar (2010)	On-task behavior (ABACA; comparing treatments to baseline)	All participants and both conditions: higher during interventions	All participants: Neutral trend for all phases and conditions	All participants: low during all phases and conditions	All participants: immediate effect between phases	Activity choice: 0/4; 0/4; 0/4; 1/4 Material choice: 0/4; 0/4; 0/4; 0/4	Moderate evidence (one indication of noneffect)
	On-task behavior (ABACA; comparing the two treatment conditions)	No differentiation between conditions ^b					

Note: AT, alternating-treatment design; MBL, multiple-baseline design.

^a No overlap due to alternating-treatment design.

^b No overlap due to comparing two choice conditions.

Table 3
Design ratings.

Study	Evidence of clear manipulation of independent variable (s)?	3 attempts to demonstrate intervention effect?	IOA reported (at least 20% of sessions with 80% agreement)?	At least 4 phases (for withdrawal), 6 phases (for MBL), and/or 4 alternating sequences (for AT)?	5 or more data points for each phase or condition?	Rating
Koegel et al. (2010)	Yes	Yes	Yes	Yes (8 phases)	No; 1 phase had 4 data points; 2 phases had 3 data points	MDSR
Moes (1998)	Yes	Yes	Yes	Yes (4 phases)	Yes; 5 data points per phase	MDS
Mechling et al. (2006)	Yes	Yes	Yes	Yes (4 phases)	No; 2 phases had 3 data points	MDSR
Newman et al. (2002)	Yes	Yes	Yes	Yes (7 alternating sequences)	Yes; 7 data points per condition	MDS
Rispoli et al. (2013)	Yes	Yes	Yes	Yes (4 phases)	Yes ^a	MDS
Tiger et al. (2010)	Yes	Yes	Yes	Yes (6 phases; 4 alternating sequences)	No; fixed ratio: 1 phase had 4 data points; progressive ratio: 1 phase had 3 data points	Fixed ratio: MDSR Progressive ratio: DNMSD
Ulke-Kurkcuglu and Kircaali-Iftar (2010)	Yes	Yes	Yes	Yes (5 phases)	No; 4 data points per phase	MDSR
Smeltzer et al. (2009)	Yes	Yes	Yes	Yes (at least 4 alternating sequences per phase)	No; 4 data points in the concurrent operant phase	MDSR

Note: IOA, interobserver agreement; MBL, multiple-baseline design; AT, alternating-treatment design; MDSR, meets design standards with reservations; MDS, meets design standards; DNMSD, does not meet design standards.

^a The extreme challenging behavior justifies the lower threshold of data points during the return to baseline phase for two participants (Kratochwill et al., 2012).

as well as the magnitude of this relationship (see Horner, Swaminathan, Sugai, & Smolkowski, 2012, for more details). For studies that met standards (with or without reservations), we examined the graphs following four steps and six features of the outcome measure to determine whether the study provided (a) strong evidence, (b) moderate evidence, or (c) no evidence (see Table 2). Step 1 involves documentation of a stable baseline data pattern. Step 2 consists of interpreting the data pattern within each phase (e.g., level, trend). Step 3 consists of comparing data from each phase to those in the adjacent or similar phase (e.g., immediacy, overlap). Finally, Step 4 involves determining whether there are demonstrations of the observed effect at three different points in time.

For each of the studies that met standards (with or without reservations), two researchers (a doctoral candidate and a third-year doctoral student under the supervision of the lead author) with experience in single-case design and visual analysis inspected the graphs for (a) level, (b) trend, (c) variability, (d) overlap, (e) immediacy of the effect, and (f) consistency of data patterns across similar phases (Kratochwill et al., 2010, 2012). Based on the visual analysis, if the study failed to demonstrate at least three demonstrations of treatment effect, it was rated as providing no evidence. If the study demonstrated an effect yet had one indication of a noneffect, it was rated as providing moderate evidence. Studies that demonstrated a treatment effect during every effect opportunity (e.g., treatment effect is evident across the four phases in an ABABA design, treatment effect demonstrated in every alternating sequence for alternating-treatments design) were rated as providing strong evidence. The multidimensional feature of the rating system made it possible for a single-case study that meets design standards to be classified as providing moderate evidence. It was also possible for a study that meets design standards with reservations to be identified as providing strong evidence (Table 3).

3. Results

3.1. Summary of studies

The eight studies that met the inclusion criteria included 21 participants, ranging in age from 5 to 14 years (mean = 8.10; SD = 2.81). Nineteen participants were male and two were female. As mentioned in each study, all participants met inclusion criteria for ASD; however, none of the studies reported any diagnostic used in making a diagnosis of ASD. Additionally, five participants had an intellectual disability and one was diagnosed with fragile X syndrome.

A total of 21 separate dependent variables were measured across studies, including latency to start a task, task duration, task completion (e.g., homework completed, tasks completed, accuracy of tasks completed), on-task behavior, challenging behavior (e.g., competing behaviors, problem behavior), and affect or interest. All the studies employed single-case designs. Three studies used either a withdrawal or reversal design, one study used a multiple-baseline design, two studies used an

alternating-treatment design, and two studies used a combination of designs (e.g., multiple baseline with alternating treatments). Four studies used a preference assessment (Mechling et al., 2006; Rispoli et al., 2013; Smeltzer, Graff, Ahearn, & Libby, 2009; Ulke-Kurkcuoglu & Kircaali-Iftar, 2010). Seven studies reported the person who implemented the intervention. Five studies used either a researcher or university student, one study used a teacher, and one study used a researcher and a teacher. The number of sessions across all the included studies ranged from 2 to 32.

3.2. Design and evidence ratings

Three studies were classified as meets design standards (Moes, 1998; Newman, Needelman, Reinecke, & Robek, 2002; Smeltzer et al., 2009). Five studies were classified as meets design standards with reservations due to insufficient data points during one of the phases (Koegel et al., 2010; Mechling et al., 2006; Rispoli et al., 2013; Tiger et al., 2010; Ulke-Kurkcuoglu & Kircaali-Iftar, 2010), the Tiger et al. study met this classification for its fixed-ratio component, yet the progressive ratio reinforcement schedule component of the study was classified as does not meet design standards.

Visual analysis of each study graph was conducted following the evidence criteria developed by the What Works Clearinghouse panel for evaluating findings from single-case design studies (Kratochwill et al., 2012). Table 2 includes information regarding evidence ratings based on the six visual analysis elements: level, trend, variability, immediacy of effect, overlap, and consistency. Of the eight studies included in this synthesis, one was identified as providing strong evidence (Koegel et al., 2010). Three of the studies were classified as providing moderate evidence (Mechling et al., 2006; Moes, 1998; Ulke-Kurkcuoglu & Kircaali-Iftar, 2010) due to overlapping data points either between phases or conditions. Three studies were classified as providing no evidence (Newman et al., 2002; Smeltzer et al., 2009; Tiger et al., 2010) due to more than one indication of lack of differentiation in outcomes between the choice and no choice conditions. The Rispoli et al. (2013) study was classified as providing mixed evidence, with moderate evidence for the multiple-baseline component of the design and no evidence for the alternating-treatment component (due to more than one indication of lack of differentiation between conditions) (Table 3).

3.3. Dependent variables

In this synthesis, dependent variables were divided into three broad groups: (a) work completion, (b) appropriate and inappropriate behaviors, and (c) affect and interest. Work completion includes the dependent variables of time to begin a task (i.e., latency), task duration, task completion, homework completion, correct responding, total number of correct responses, percent of correct responses, and responses per minute. Appropriate and inappropriate behaviors include the dependent variables of on-task behavior, disruptive behavior, competing behaviors, challenging behaviors, and problem behaviors. Affect and interest include two researcher-designed dependent measures of affect and interest.

3.3.1. Work completion

Six studies included at least one dependent variable that addressed work completion, as described above (Koegel et al., 2010; Mechling et al., 2006; Moes, 1998; Newman et al., 2002; Smeltzer et al., 2009; Tiger et al., 2010). The dependent variables within this group were divided into two categories: (a) rate, accuracy, and frequency of work trials completed and (b) latency and task duration.

3.3.2. Rate

Four studies investigated the effects of choice on the rate of trials completed over five dependent variables (Koegel et al., 2010; Moes, 1998; Newman et al., 2002; Tiger et al., 2010). Of these five dependent variables, three had a baseline phase included in the design (i.e., withdrawal or multiple-baseline design). During the intervention phase of these studies, all the participants had (a) higher levels, (b) more positive trends, and (c) an immediacy of effect as compared to baseline. The pooled overlap of data points was 11 of 92 (12%; 8 data points of overlap were from one participant). Two of the five dependent variables used an alternating-treatment design, with one using two treatment conditions and one using a choice vs. no choice condition. Neither of these variables had any clear differentiation between conditions.

3.3.3. Accuracy

Two studies investigated the effects of choice on the accuracy of academic responses (Moes, 1998; Newman et al., 2002). Moes used a withdrawal design, and the results favored the treatment condition for all participants on level and trend, showed an immediacy of effect between phases, and showed no differentiation on variability. The pooled number of overlapping data points was 3 of 30 (10%). Newman et al. (2002) used an alternating-treatment design with two treatment conditions. They did find differentiation between conditions on level or trend, and visual analysis of results does not indicate immediacy of effect.

3.3.4. Work trials completed

Tiger et al. (2010) used a progressive ratio of reinforcement. Results were mixed in terms of level, trend, and variability. Overall, these findings were inconclusive.

3.4. Latency and task duration

Three studies included at least one dependent variable that addressed latency to start a task and task duration (Koegel et al., 2010; Mechling et al., 2006; Smeltzer et al., 2009). The dependent variables within this group were divided into two categories: (a) latency, which was defined as the number of minutes that passed from the presentation of the task stimulus and the student initiation to respond, and (b) duration, which was defined as the number of minutes that passed from the moment the student initiated the response until task completion.

3.4.1. Latency

Koegel et al. (2010) investigated the effects of choice on latency to begin a task, using a multiple-baseline design. All participants showed positive effects on level, trend, and variability, and showed an immediacy of effect, when comparing the intervention phase to the baseline phase. The number of pooled overlapping data points was 1 of 28 (4%).

3.4.2. Task duration

Two studies investigated task duration (Mechling et al., 2006; Smeltzer et al., 2009). Mechling et al. (2006) used a BCBC withdrawal design with choice and no choice conditions (i.e., choice of video and access to tangible reinforcer). Results suggested positive effects in level, trend, and immediacy of effect when the participants were given the choice condition. The number of pooled overlapping data points was 8 of 16 (50%). In the study by Smeltzer et al. results were either mixed or showed no differentiation across level, trend, and variability.

3.5. Challenging and desired behavior

Six studies included at least one dependent variable that addressed challenging and desired behavior (Koegel et al., 2010; Moes, 1998; Newman et al., 2002; Rispoli et al., 2013; Smeltzer et al., 2009; Ulke-Kurkcuoglu & Kircaali-Iftar, 2010). The dependent variables within this group were divided into two categories: (a) problem behavior (e.g., challenging behavior, disruptive behavior) and (b) on-task behavior.

3.5.1. Problem behavior

Five studies investigated problem behavior with the use of choice (Koegel et al., 2010; Moes, 1998; Newman et al., 2002; Rispoli et al., 2013; Smeltzer et al., 2009). Moes used a withdrawal design, Koegel et al. used a multiple-baseline design, Newman et al. and Smeltzer et al. used an alternating-treatment design, and Rispoli et al. used an alternating-treatment design with baseline and withdrawal phases. Of six dependent variables measured, five compared a choice condition to a no choice condition. In four of the six dependent variables, the choice condition had positive effects on level with an immediacy of effect between phases. Trends were either neutral or favorable toward the intervention condition. Pooled overlap of data points was 15 of 154 (10%; 10 data points of overlap were from one participant).

The additional two dependent variables of problem behavior both used alternating treatments (Rispoli et al., 2013; Smeltzer et al., 2009). Smeltzer et al. had three alternating treatments (choice, no choice with a yoked reinforcer from choice, or no choice without a yoked reinforcer). Rispoli et al. compared two different choice conditions. The results comparing level, trend, variability, and immediacy of effect across treatments were either mixed or resulted in differentiation between treatments.

3.5.2. On-task behavior

Two studies investigated on-task behavior with the use of choice (Smeltzer et al., 2009; Ulke-Kurkcuoglu & Kircaali-Iftar, 2010). Smeltzer et al. used an alternating-treatment design, with the participant-selected reinforcer resulting in higher levels of on-task behavior. Immediacy of effect was visible in the researcher-selected condition, resulting in a decrease in on-task behavior. No differentiation was observed in trend and variability, with mixed results in the level of the on-task behavior. When Ulke-Kurkcuoglu and Kircaali-Iftar compared an activity choice and material choice to the baseline phase in an ABACA design, they found higher levels of on-task behavior and lower variability for the choice conditions and an immediacy of effect between phases. Pooled overlap of data points was 1 of 32 (3%). The study found no differentiation on level, trend, variability, or immediacy of effect when comparing the two treatment conditions.

3.6. Affect and interest

Two studies investigated the effect of choice on affect and interest (Koegel et al., 2010; Moes, 1998). Both of these studies found higher levels of affect or interest during the choice intervention condition as compared to baseline and an immediacy of effect during phase changes. The pooled overlap of data points was 15 of 48 (31%) with one participant accounting for 9 of the overlapping data points.

3.7. Evaluating choice vs. no choice by study design

This section highlights the effects of a choice condition when compared to a no choice or baseline phase. These outcomes varied by research design and therefore will be divided into (a) multiple-baseline and withdrawal designs and (b) alternating-treatment designs.

3.7.1. Multiple-baseline and withdrawal designs

Across all six studies that implemented either a multiple-baseline or withdrawal design (Koegel et al., 2010; Mechling et al., 2006; Moes, 1998; Rispoli et al., 2013; Tiger et al., 2010; Ulke-Kurkcuoglu & Kircaali-Iftar, 2010), all of the dependent variables for all of the participants had performance levels during the choice condition that outperformed the no choice condition (i.e., lower levels of inappropriate behavior, higher levels of appropriate behavior). Trends tended to be positive or neutral in favor of the treatment. The immediacy of effect was observed across all phases, dependent variables, and participants in favor of the choice condition. The pooled overlap of data points was 58 of 423 (14%).

3.7.2. Alternating-treatment designs

Across the two studies (Newman et al., 2002; Smeltzer et al., 2009) that implemented a choice condition and no choice condition in an alternating-treatment design, the results were mixed. In the Newman et al. study, there was a lack of differentiation between conditions for correct responding, although the choice condition outperformed the no choice condition on competing behavior in level, trend, and immediacy of effect. For the Smeltzer et al. study, when comparing the participant-selected condition (choice) to the researcher-selected condition (no choice), the no choice condition had a greater degree of variability across participants and dependent variables, the level of problem behaviors was highest for the no choice condition, and there was an immediacy of effect in a negative direction for the no choice condition. The levels were also highest for on-task behavior during the on-task condition. For the remaining dependent variables, there was a lack of consistency in level, trend, and immediacy of effect across participants and dependent variables.

4. Discussion

This synthesis critically reviewed studies on the effect of choice on academic outcomes specifically for students with ASD in typical school settings. All of the studies but one component of one study either met or met with reservations the What Works Clearinghouse standards (Kratochwill et al., 2010, 2012). From the studies reviewed, two trends emerged: (a) choice can have a positive effect on work completion, appropriate and inappropriate behavior, and affect and interest; and (b) results varied by the type of design used.

For studies where overlap of the data points was available to be calculated and the choice condition was compared to a no choice condition, level, trend, and immediacy of effect all tended to favor the choice condition. The choice condition had the greatest effect on level, with 15 of 19 (79%) variables showing improvement for all participants; followed by immediacy of effect, with 14 of 19 (74%) variables showing improvement for all participants; trend, with 9 of 19 (47%) variables showing improvement for all participants; and variability, with 2 of 19 (11%) variables showing improvement for all participants. These findings suggest that although a choice condition raises the dependent measure on central tendency fairly consistently and immediately when the intervention is implemented, variability and trend are not as consistently affected by the implementation of the choice intervention, when compared to a no choice intervention. The pooled overlap of data points across all participants and all measures was 58 of 407 (14%). One participant accounted for 32 of those overlapping data points (i.e., 55% of all overlapping data points can be attributed to one participant).

Additionally, pooled overlap was lowest (i.e., indicating largest effect) for measures of work completion (i.e., rate and accuracy), with the pooled overlap of data points across all participants and all measures at 14 of 122 (11%); followed by challenging and desired behavior (i.e., challenging behavior and on-task behavior), with a pooled overlap of data points across all participants and all measures at 31 of 234 (13%); latency and task duration, with a pooled overlap of data points across all participants and all measures at 58 of 407 (14%); latency and task duration, with a pooled overlap of data points across all participants and all measures at 9 of 44 (20%); and affect and interest, with a pooled overlap of data points across all participants and all measures at 15 of 48 (31%).

Of the six studies where overlap of data points summaries were available, (a) four studies incorporated the choice in how or where a task was completed (e.g., materials, setting, order tasks are presented) and (b) two gave a choice of reinforcer. For the studies that incorporated choice in how or where a task was completed, there was a pooled overlap of data points across all participants and all measures of 50 of 183 (13%). For studies that incorporated choice in the reinforcer, there was a pooled overlap of data points across all participants and all measures of 8 of 45 (18%).

Although these results should be interpreted with caution due to the small number of available studies, they do suggest that choice can produce positive effects in work completion, challenging and on-task behavior, latency and task duration, and affect and interest. The results also suggest that although choice of how or where a task is completed may be more effective than choice of a reinforcer, both methods can be effective. Additionally, no conclusive findings emerged that one choice treatment condition outperformed another within a two-treatment study (Rispoli et al., 2013; Ulke-Kurkcuoglu & Kircaali-Iftar, 2010). This finding suggests that offering students with ASD the opportunity to choose, regardless of the type of choice (e.g., choice of material, activity order, setting, reinforcer), is a promising intervention for improving academic outcomes.

Studies where overlap was available to be calculated included a baseline or withdrawal phase, and these studies tended to have positive findings for the choice condition. For alternating-treatment studies, which did not incorporate a baseline phase, results tended to be mixed across level, trend, variability, and immediacy of effect (Newman et al., 2002; Smeltzer et al., 2009). When the Newman et al. and the Smeltzer et al. studies were compared to those that incorporated a baseline phase on similar characteristics—such as length of treatment, preference assessment, adaptive and cognitive skills, or type of

choice intervention condition delivered—no clear trends emerged to explain why studies with a baseline phase consistently outperformed the studies without a baseline phase.

5. Conclusion

This review suggests that choice-based interventions designed to improve the academic outcomes of students with ASD within school settings can be effective. Findings from this synthesis are consistent with previous research, suggesting that choice may enhance academic performance and improve engagement in academic tasks while also reducing challenging behaviors of students with ASD during academic tasks (Romaniuk & Miltenberger, 2001). Additionally, findings from the present synthesis are consistent with previous reviews of the literature on choice interventions with individuals with various types of disabilities. These reviews suggested that choice interventions have clear positive outcomes on reducing challenging behaviors of individuals with disabilities (Shogren et al., 2004; Tullis et al., 2011). Nevertheless, when evaluating choice, it is important to note that the type of design used affects whether treatment effects of choice are detected. As it is well documented that students with ASD are often disinterested in academic assignments (Koegel et al., 2010), our findings are particularly relevant and offer promise for elevating the academic performance of students with ASD. Furthermore, all studies reviewed were conducted within typical school settings, as opposed to residential or clinical settings, to provide evidence that it is feasible to incorporate choice into academic-oriented activities within the traditional school day.

In their literature review to identify evidence-based interventions for students with ASD, Odom et al. (2003) suggested that incorporating students' choice within learning tasks is an encouraging educational practice that deserves further investigation by researchers. Findings from the present systematic review are consistent with that review, and based on the preliminary results from the individual studies reviewed, we suggest that choice-making is a promising antecedent-based intervention that may enhance academic outcomes of students with ASD.

Due to the small number of included studies and participants, findings presented here are best regarded as holding possibilities for future investigations. We applied a multistep evaluation process to provide an overview of the quality of evidence across the studies and to better inform our interpretation of results from each study. Although the What Works Clearinghouse design standards for single-case designs (Kratonchwill et al., 2010, 2012) are being piloted and include limitations noted by their authors, we believe their inclusion is helpful to inform the readers and to advance knowledge of evidence-based practices in the schools.

5.1. Limitations

Several limitations to this study suggest directions for future research. As with all systematic reviews, our findings are limited by the quality and quantity of the research included. None of the included studies conducted independent assessments to verify the autism diagnosis or reported the specific assessment results used to make autism determinations. Continued work is needed to improve the design, implementation, and methods to analyze single-case studies. Although a small number of studies were included, the studies were of high quality, and we believe this work provides useful insight to practitioners and researchers. In addition, our initial review allows for extensive opportunities to explore the role of choice in academic outcomes of students with ASD, using various methods (e.g., meta-analysis, traditional narrative review, best-evidence synthesis). Our evaluation methods are currently being piloted, and our interpretation of findings based on these methods should be viewed with caution. Although we believe the approach is innovative, more work is needed to overcome some of the issues with calculating effect sizes for single-case research designs.

5.2. Areas for future research

Given that only three of the reviewed studies were classified as meets design standards (Moes, 1998; Newman et al., 2002; Smeltzer et al., 2009), more research is needed to identify choice interventions as an evidence-based practice for improving academic outcomes of students with ASD. Future research efforts are also warranted to investigate the differential effects of choice and preference, as the two have been discussed as separate but related variables (Mechling et al., 2006; O'Reilly et al., 2008), and the differential effects of choice of reinforcer and choice of aspects of an academic task (e.g., setting, materials, order of task). Embedding choice within academic tasks in a way that eliminates the influence of preference to the furthest extent possible is necessary to determine whether preference (e.g., preference of task order, materials, reinforcers) or the act of making a choice related to the academic task is more effective in enhancing academic outcomes of students with ASD.

Along the same lines, Cullen (1999) raised an important issue when he argued that the main question in determining the effects of choice interventions should be how meaningful the choices are to the participants. In other words, researchers are encouraged to assess the participants' level of preference in regard to the presented choices when examining the influence of choice interventions on academic outcomes. Future research efforts are warranted to investigate the impact of the significance, or the "meaningfulness," of the choices on the effectiveness of choice interventions.

Finally, future research can investigate the differences in participant outcomes that are associated with this type of single-case design (e.g., withdrawal, alternating treatment), in that after examining several variables (e.g., participant characteristics, duration of intervention), no clear trends emerge to explain the differences in learner outcomes associated with the given studies.

Conflict of interest

The authors declare no conflict of interest.

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