EMBEDDING RESTRICTED INTERESTS IN PRACTICE WHEN TEACHING SOCIAL SKILLS TO CHILDREN WITH ASD. A SYSTEMATIC REVIEW OF ANTECEDENT-BASED METHODS.

by

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(Under the Direction of Kevin Ayres)

ABSTRACT

Two diagnostic characteristics of autism spectrum disorder (ASD) are deficits in social communication skills and the presence of restricted and repetitive behaviors and interests (RRBIs; American Psychiatric Association, 2013). Embedding RRBIs within teaching strategies when teaching social skills provides a strengths-based approach to treatment (Ninci et al., 2020). This review evaluates 11 studies that implemented an antecedent-based approach to embedding RRBIs of individuals with ASD within interventions to effectively make social skill gains. Studies requiring the use of pre-selection criteria were analyzed in relation to primary outcomes compared to studies who did not require this. Researchers methods of determining RRBIs in relation to primary outcomes were also analyzed. Findings demonstrated mixed results, indicating more research needs to be done to identify moderators of positive performance. Current methods of determining if an interest falls within RRBIs are discussed, guidelines for future research and practice are provided.

INDEX WORDS: perseverative, circumscribed, restricted, special, autism, social

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INTRODUCTION

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Deficits in social communication skills are a defining characteristic of autism spectrum disorder (ASD). These deficits are accompanied by the presence of repetitive and restrictive behaviors and interests (RRBIs) which may have impacts on social development (American Psychiatric Association, 2013). RRBIs is a term that encompasses many forms of behaviors and interests, the DSM describes these within four general categories (American Psychiatric Association, 2013). One category is stereotypy which is defined as repetitive motor movements or language. Examples of stereotypy include hand flapping, body rocking, spinning objects, immediate and delayed echolalia, sniffing, and running objects across one's peripheral vision (Schreibman et al., 1999). Stereotypy is often related to sensory hypo- or hyperactivity in individuals with ASD, thus engaging in this behavior becomes self-stimulatory and automatically reinforcing (Ringdahl et al., 2001). Another common form of RRBIs observed is an individual's insistence on routine. Individuals who display an insistence on routine may engage in challenging behaviors such as screaming or disruption when their routine is interrupted (Cuccaro et al. 2003; Rispoli et al., 2014). Just as simpler displays of RRBIs have often been found to be related to sensory hypo- or hyperactivity, imaging studies have shown associations between high levels of insistence on sameness and specific structural differences in the brain, suggesting a biological component behind these behaviors (Hollander et al., 2005; Ringdahl et al., 2001).

Circumscribed, perseverative, and restricted interests (RIs) are synonymous terms and refer to another form of RRBIs. These RIs may involve objects or topics that that individuals have an abnormally intense interest in and thus restrict the individual's engagement with other objects or topics (Mancil & Pearl, 2008). These RIs are often unique and idiosyncratic to the individual (Ninci et al., 2017). The topics or objects of RIs can range widely including letters and numbers, mathematics, cartoon characters, specific colors, or geography (Baker, 2000; Keeling et al., 2003; Vismara & Lyons, 2007; Angell et al., 2011). A RI in letters may be accompanied by a student engaging in repetitive behaviors such as lining up letters or singing the alphabet song, however engaging in these behaviors would be related to the environmental stimuli of letters being present or a learning history with letters. RIs differ from repetitive behaviors because no environmental stimuli is required for the student to engage in repetitive behaviors. One must acknowledge that environmental stimuli *can* evoke repetitive behaviors, just that this stimuli is *not required* to evoke repetitive behaviors. This difference is likely related to evidence that repetitive behaviors often emerge from sensory hypo- or hyperactivity (Ringdahl et al., 2001). Repetitive behaviors engaged in without environmental stimuli present (or a learning history with this environmental stimuli) to evoke them are not the focus of this literature review. This review focuses on RIs which may encompass repetitive behaviors related to the environmental stimuli associated with the object or topic that is restricted.

An individual's level of cognitive functioning may impact the way their RI is expressed (Turner, 1999). For example, if an individual displays many cognitive abilities and has a RI in the animal species penguins they may engage in complex behaviors related to this RI such as learning facts related to penguins, reading books about penguins, and drawing penguins often. Expressions of a RI similar to those noted above are more common in individuals on the autism

spectrum who have higher nonverbal IQs (Bishop et al., 2006). Whereas, if an individual displays less cognitive abilities they may demonstrate this RI in penguins with simpler actions such as repetitively engaging with penguin toys or watching tv shows and movies that include penguins restrictively (Turner, 1999).

Studies have shown that individuals will engage in challenging behaviors such as screaming, aggression, and disruption when their routine is interrupted (Rispoli et al., 2014). These challenging behaviors can impact behavioral patterns and pose potential difficulties to teachers and other individuals interacting with children who express RIs. There has not been enough research related to RIs embedded in practice to determine what will be the best course of action in regard to inclusion or exclusion of these interests in the classroom. Gunn and Delafield-Butt (2016) identified three common strategies used in the classrooms in relation to RIs. Some teachers prohibit and discipline the use of RIs in the classroom as an attempt to promote social norms, others allow access only when a target behavior has been performed such as engaging in appropriate behavior or completing a task. The third view includes incorporating RIs into lessons and using a strengths-based approach to include the RI in learning (Gunn & Delafield-Butt, 2016). This strengths-based approach allows for more naturalistic contingencies advocating for shared control and increased motivation to engage with materials (Koegel & Mentis, 1985). Gunn and Delafield-Butt (2016) described strategies that include RIs in literature as either antecedent-based or consequence-based. Consequence-based strategies require the completion of a target behavior before the student is allowed access to their RI (Gunn & Delafield-Butt, 2016). Teachers often use consequence-based strategies by using students' RIs as token reinforcers (Gunn & Delafield-Butt, 2016). For example a student who has a RI in Thomas the Train will receive photos of Thomas the Train as token reinforcers per the completion of tasks and once all

tokens are earned the student will gain access to a Thomas the Train toy or video for a short period of time as a backup reinforcer (Charlop-Christy & Haymes, 1998). Antecedent-based strategies do not require students to perform a target behavior prior to gaining access to their RI. Instead, antecedent-based interventions incorporate the RI into the learning environment by embedding the RI within a game, activity, or task to promote engagement (Baker, 2000; Baker et al., 1998; Koegel et al., 2010; Gunn & Delafield-Butt, 2016).

To date, two literature reviews investigated RIs embedded in practice (Ninci et al., 2018; Gunn & Delafield-Butt, 2016). Gunn and Delafield-Butt (2016) evaluated the positive and negative effects associated with embedding RIs in practice; this review included both antecedent-based and consequence-based methods for 20 studies. Results concluded that all studies reviewed displayed positive effects of interventions such as improvement in academic or social skills or a reduction in challenging behaviors (Gunn & Delafield-Butt, 2016). Some studies included in review reported negative effects also, such as a decrease in task performance or a slight increase in repetitive behaviors related to the RI (Gunn & Delafield-Butt, 2016). Gunn and Delafield-Butt (2016) provided some evidence that the inclusion of RI in practice may be a valuable tool to help students with ASD learn both social and academic skills. This review included non-experimental and experimental studies (Gunn & Delafield-Butt, 2016).

In Gunn and Delafield-Butt's (2016) evaluation, negative effects were found almost exclusively in consequence-based interventions, relative to other intervention approaches. For example, Charlop-Christy and Haymes (1990) used RIs of specific objects as reinforcers in attempt to increase task performance for three children with ASD. Initially an increase in the repetitive behaviors associated with the interest was observed before a decrease was observed. Charlop-Christy and Haymes used this same method in attempt to decrease inappropriate

behaviors and increase task performance for three children with ASD. Negative effects were associated with students' outcomes, including a decrease in task performance for one student and an increase in engagement of inappropriate behaviors for another student (Charlop-Christy & Haymes, 1996). Gunn and Delafield-Butt reported one negative outcome associated with an antecedent-based method but described it as a "small" increase in the intensity of the RI, this was only reported for one participant out of three (Kryzak et al., 2013). Authors reported a one-point increase on a rating scale that asked parents about the intensity of their child's RI, although one caregiver's rating increased by one point, the other caregiver's rating stayed the same for said participant (Kryzak et al., 2013). However, the target behavior of responding to joint attention initiations increased during intervention and generalized to preferred activities for all three participants (Kryzak et al., 2013). From a behavior analytic standpoint, one can hypothesize that negative consequences are associated with more consequence-based methods because once the student's reinforcement break is over, access to the RI is denied. Some students may have a learning history of engaging in challenging behaviors and contacting reinforcement in the form of a tangible item, thus denying access to the RI may evoke challenging behavior for some students (Cooper et al., 2006). A characterizing trait of interests being marked as restricted or perseverative is that the student becomes highly agitated when they are interrupted while engaging with the interest, thus these challenging behaviors are likely (Vismara & Lyons, 2007). Antecedent-based methods allow access to RIs without the requirement of completing a target behavior or task. This approach may avoid evoking challenging behaviors as discussed with consequence-based methods. Antecedent-based methods may also increase engagement for some children as RIs are considered to be intrinsically motivating (Gunn & Delafield-Butt, 2016). Gunn and Delafield-Butt (2016) provided a comprehensive and descriptive review of current

literature. Areas yet to be investigated are the substantiation of RIs to be abnormal in their intensity, as well as the quality and rigor of included articles.

Ninci et al. (2018) reviewed the quality of articles that embedded RIs into the learning environment, specifically those that used a single-case and group-based methodology. Results demonstrated insufficient and mixed but sufficient support based on two quality rubrics, Council for Exceptional Children Standards for Evidence-Based Practice in Special Education and What Works Clearing House, respectively (Ninci et al., 2018). Identifying what variables are moderating these mixed results is key in identifying successful interventions for students with ASD. Based on negative effects reported in Gunn and Delafield-Butt (2016) the type of intervention strategy may be an important point to consider. Ninci et al. (2016) also discuss this as a limitation in their review, acknowledging that intervention types may be a potential moderator of student outcomes. Thus this review exclusively evaluates studies using an antecedent-based intervention to help students make gains.

Ninci et al. (2017) evaluated the quality of studies embedding RIs in practice for both social and academic skills. This evaluation found nearly sufficient support for the use of interventions that embed RIs to help children with ASD make social skill gains. However, more research is needed to validate these effects (Ninci et al., 2017). Authors also suggest that the research base of embedding RIs to help students with ASD make academic gains is limited and additional research is needed to draw accurate conclusions about outcomes of these interventions (Ninci et al., 2017). For example in Gunn and Delafield-Butt's (2016) evaluation of 20 articles related to embedding RIs in practice, only five studies included implemented interventions to help students make academic gains. Whereas 14 studies included implemented interventions to help students make social skill gains (Gunn & Delafield-Butt, 2016). Due to the research base

available and implications suggested for future research this review will focus on interventions that aim to make social skill gains for students with ASD.

The current review extends previous findings by evaluating the quality and rigor as well as primary outcomes of interventions using antecedent-based methods that address social skill deficits in students with ASD in relation to two potential moderators of success. These potential moderators are the inclusion of pre-selection criteria as well as the strategy used by researchers to identify RIs. Further, this review explores the methodology used to substantiate RIs and provides guidelines for future research.

Method

Search Procedures

The first author systematically searched the following four databases: PsycINFO, Education Resource Information Center (ERIC), EBSCOHost, and JSTOR. The journal TEACHING Exceptional Children Plus was also searched. This journal was hand searched after initial database searches did not identify articles found in other reviews of RIs in practice (Gunn & Delafield-Butt, 2016). This hand search identified five articles meeting inclusion criteria. The following filters were used for all searches: academic journals, linked full-text, peer-reviewed, and English language. If available, the subject of education was chosen. Studies were not limited by publication year. Inclusion criteria required that articles: (1) were peer-reviewed; (2) in English-language; (3) include participants younger than 18 years of age; (4) used single-case design or group-design methodology and quantitative data to evaluate effectiveness; (5) used antecedent-based strategies in combination with children's RIs to make social skill gains, these gains may include cognitive, social, and emotional skills; (6) determined the RI through formal or informal observations, parent, teacher, or staff interviews/reports or a combination these. Articles were excluded if they did not state how authors determined that the interest was a RI. Search terms used were *special interest, obsess*, preservative, ritualistic, circumscribed,* and *interest*. These terms were searched in combination with the word *social* and *autis** or *Asperger*. Ten potentially eligible articles resulted from a title and abstract search. Screening full-text articles excluded four articles with six articles remaining. Articles were excluded due to the lack of an antecedent-based approach and including participants above the age of 18. Ancestral hand

searches were conducted for the six remaining articles using a Google Scholar database search of references. Article titles and abstracts were reviewed, resulting in 10 additional articles. After full-text screening three articles were excluded based on inclusion criteria. Specifically, authors did not state the methodology used for determining RIs, leaving a total of seven articles from the ancestral hand search. Following database searches and the ancestral hand search a total of 11 articles were included for review. The primary reasons for exclusion were the lack of using single-case design methodology, embedding RIs into consequence-based strategies, or evaluating gains in academic areas rather than social areas. Studies identified in database searches that did not use a single-case design methodology most often collected qualitative data or exploratory surveys. RIs being extremely individualized can make it more difficult for researchers to conduct large randomized control trials related to this research area. Figure A displays search procedures from initial database searches into ancestral hand searches following PRISMA guidelines (Moher et al., 2009).

Coding Procedures

The first author coded seven variables related to participant and setting information. These variables include characteristics such as gender, age, and diagnosis. Variables coded related to experimental characteristics included data collection method, independent variables, and methodology used to determine RIs. Experimental outcomes had variables related to effectiveness, experimental design, and dependent variables.

Quality Evaluation Tool

The *Single-Case Analysis and Design Framework* (SCARF) is a tool used to evaluate the quality and rigor of single-case designs (Zimmerman et al., 2018). Ten categories use a rating score of 0–4, these scores are derived from responses to multiple yes or no questions in seven

categories (data sufficiency, reliability, fidelity, social and ecological validity; condition, participant, and dependent variable descriptions) as well as yes or no questions and 0–4 categorical ratings for 3 categories (maintenance, response generalization, and stimulus generalization measurement). Designs are only evaluated within this framework if at least three potential demonstrations of effect are present.

The ten categories are divided into rigor (dependent variable reliability, procedural fidelity, and sufficiency of data) as well as quality of measurement (social and ecological validity, participant and condition descriptions, dependent variables, response and stimulus generalization, and maintenance). Framework results are displayed in a scatter plot with the score for average design quality and rigor on the x-axis and the outcomes score on the y-axis. An intervention is classified as an evidence-based practice (EBP) using single-case design methodology if a majority of data points fall into the top right quadrant of the scatterplot which indicates the experiments demonstrate high quality evidence of positive effects. If data points are displayed in the lower right quadrant of the scatter plot this indicates that they do not meet standards of high quality and evidence displays negative or null effects (Zimmerman et al., 2018).

Participant and Setting Characteristics

The coded variables were sample size, gender, age, diagnosis, interventionist, experimental setting, if students engaged in challenging behavior, and the form of challenging behavior. Sample size was coded as total *n* as well the number of male and female participants included. Gender was coded as male, female, or not reported, all studies reported participants gender. The first author coded participant age whether it fell between 0 to 5 years old, 6 to 12 years old, or 13 to 18 years old, studies including participants above 18 years old were excluded,

all studies reported participant's age. Codes for participant diagnosis included ASD or Pervasive Developmental Disorder not otherwise specified (PDD-NOS), intellectual disability (ID), developmental delay, or not reported. Experimental settings included grade schools, early intervention programs, homes, and clinics, the first author also coded if multiple settings were used. Interventionists were coded as therapist/experimenter/author, teacher/paraprofessional, parent/caregiver, or not reported. The first author coded whether it was reported that each participant engaged in "challenging," "inappropriate," or "problem" behaviors. How many participants engaged in multiple challenging behaviors was also coded. Pre-selection criteria of each participant was coded as either reported or not reported. Table 1 displays participant and setting characteristics.

Experimental Characteristics

Codes for data collection methods included dimension as well as specific unit (e.g., percent or minute). These codes were latency, duration, mean duration, frequency, partial-interval recording, whole-interval recording, percent of directions followed, percent of time spent in others-focused conversation, percent of time engaged in a social interaction, and percent of joint attention initiations. Authors determined participants' RIs many different ways, this was typed and coded as additional information. Independent variables included the Power Card Strategy (PCS), modified PCS, video modeling, prompt fading, embedding the RI within a game or activity, Pivotal Response Training (PRT) with perseverative stimuli as well as non-perseverative stimuli, choice condition, alternating treatment condition, and social praise. The first author coded if studies implemented one type or multiple types of independent variable conditions. Table 2 displays experimental characteristics.

Experimental Outcomes

Codes for experimental outcomes included study design, effectiveness, pre-selection criteria, and dependent variables. Codes for study design were alternating treatment design, withdrawal/reversal design, multielement, group design, multiple probe or multiple baseline across participants, settings, or materials. No articles included in review reported the use of a group design. The first author coded whether or not a study used multiple/combined study designs. Effectiveness was coded based on whether authors stated the intervention was effective or not. Pre-selection criteria differed from study to study, thus it was written and coded as additional information. Dependent variables included minutes spent on playground, percent of directions followed, appropriate initiating/relinquishing a turn, appropriate commenting, percent of time spent in others-focused conversation with typical peers, percent or frequency of joint attention initiations, mean latency of seconds, latency to initiation, percent of time engaged in social interaction or play, percent of time engaged in thematic ritualistic behaviors, duration of challenging behavior, frequency of initiations towards typical peers, intervals with general prompts given, and percent of intervals of engaging in challenging behavior. Each study was also coded for measuring one or multiple dependent variables. Table 3 displays experimental outcomes.

Results

Eleven single-case design research studies were included in this review. A total of 30 participant outcomes were evaluated. Pre-selection criteria was reported for 23 participants and not reported for seven participants (three studies). Researchers used interviews or teacher, parent, or caregiver reports as well as formal or informal observations to determine the student's RI for 21 participants (seven studies). RIs were determined for the remaining nine participants through *either* an interview/report or a formal or informal observation. The SCARF was conducted for all experiments in regard to generalized and maintained outcomes. This coding was conducted separately for experiments that chose participants based on pre-selection criteria and those that did not. The first author isolated and coded studies who used both observations *and* interviews/reports to determine a student's RIs. Studies that used *either* observations or interviews/reports to determine the participants' RI were also isolated and coded. The first author coded participant and setting characteristics, experimental characteristics and outcomes, displayed in Tables 1, 2, and 3.

Participant and Experimental Characteristics and Outcomes

Most studies included participants with a diagnosis of ASD (Table 1). Several studies included took place in the school setting, however others took place in clinics, homes, or early intervention programs. Several studies included participants below the age of 13, one study included participants 13 years or older. Most studies interventionists were reported as teachers or paraprofessionals. Several studies reported students engaging in challenging behaviors, few

studies did not. Several studies reported pre-selection criteria, few studies did not. Table 2 displays that some studies used additional information such as parent surveys in conjunction with observations and interviews/reports to determine participants RIs. Several studies used duration as a data collection method (Table 2). Several studies independent variable was embedding a RI within a game/activity (Table 2). Table 3 displays that several studies used a multiple probe or multiple baseline design to demonstrate effectiveness. Table 3 numbers the primary dependent variables authors used in correspondence with the interventions' effectiveness in the column to the right.

Evaluation of Outcomes in Relation to Pre-Selection Criteria

Scatter plots generated from SCARF can be evaluated by their scales as well as quadrants. Data points falling into the top right quadrant of the scatter plot indicate experiments that demonstrate high quality evidence of positive effects. Data points falling into the lower right quadrant of the scatter plot indicate not meeting standards of high quality evidence as well as displaying negative or null effects (Zimmerman et al., 2018).

Figure 1 displays the outcomes as well as the overall quality and rigor of experiments that used pre-selection criteria, there are more data points to evaluate in Figure 1 considering a majority of experiments included required this component. Figure 2 displays the outcomes as well as overall quality and rigor of experiments for those who did not require pre-selection criteria for participants. Although there are more data points in Figure 1, none fall below two on the scale of overall quality and rigor. Whereas in Figure 2, two experiments fall below two on the scale of overall quality and rigor; this accounts for 16.67% of all experiments displayed in Figure 2, compared to 0% of all experiments displayed in Figure 1. No experiments (0%) in Figure 2 are at or above three on the scale of overall quality and rigor. One of these two

experiments that falls below two on the scale of overall quality and rigor in Figure 2 demonstrates the strongest primary outcomes in Figure 2. However, Figure 1 displays three experiments that demonstrate stronger overall quality and rigor as well as more positive primary outcomes compared to this experiment in Figure 2. In Figure 1 all studies fall into quadrants 2 and 4 whereas in Figure 2 studies are spread out in all quadrants.

Evaluation of Outcomes in Relation Determining a RI

Figure 3 displays the primary outcomes as well as overall quality and rigor of each experiment that included *both* observations and adult interviews/reports. Figure 4 displays the primary outcomes as well as the overall quality and rigor of each experiment that used *either* observations or adult interviews/reports. Figure 3 displays more data points to interpret, considering a majority of studies used both observations and adult interviews/reports. Figure 4 shows two outlier experiments which demonstrate primary outcomes falling below one on the scale, this accounts for 28.57% of all experiments displayed. Whereas, 100% of primary outcomes in Figure 3 are above one on the same scale. The overall quality and rigor of experiments falls in the same range of two to four in both Figures 3 and 4. However both Figures 3 and 4 have one data point that falls just below two on this scale, this accounts for 14.29% of experiments on Figure 4 and 9.1% of experiments in Figure 3. The data points in Figure 3 are more consistent than those seen in Figure 4, however both are variable. In Figure 3, the overall quality and rigor of most studies fell between two and three on the scale, however primary outcomes varied from 1.5 to above four. Both Figures 3 and 4 display multiple data points in quadrants 2 and 4.

Evaluation of Maintained and Generalized Outcomes of All Studies

Figure 5 displays the latency of maintenance measurement as well as maintained outcomes for all experiments included in review (*n* = 18). Figure 6 displays the generalized outcomes as well as quality and rigor of generalization measurement for all experiments included in review. All maintenance probes displayed in Figure 5 were conducted at least one-week post intervention. All experiments in Figure 5 fell above two on the scale depicting maintained outcomes. All generalized outcomes in Figure 6 were experimentally evaluated. However, the data points vary widely in Figure 6, ranging from below one to above four on the scale. When maintained and generalized outcomes were isolated in relation to their method of determining RIs no major differences were found. Studies who included pre-selection criteria and those who did not were also isolated in relation to maintained and generalized outcomes, again no major differences were found.

Discussion

This literature review served two purposes. First, to evaluate the use of pre-selection criteria in relation to the quality and rigor as well as primary outcomes of studies. Second, to evaluate how interests were determined to be RIs and investigate this in relation to the quality and rigor as well as primary outcomes of studies. The first author evaluated eleven studies including 30 participants in total.

Experimental Characteristics and Outcomes

Data in Table 2 display the independent variables used in studies, the most common was embedding a RI into a game/activity. However, some authors opted to add additional environmental contingencies such as verbal praise for appropriate behavior (Angell et al., 2015; Kryzak & Jones, 2014). Other studies added prompt fading or video modeling to the intervention (Jung & Sainato, 2015; Kryzak & Jones, 2014). These additional contingencies may be key components in learner's success. Although embedding a RI can evoke engagement in some children, environmental contingencies need to be in place for individuals to learn appropriate behavior, such as error correction or providing reinforcement for correct responses (Cooper et al., 2006).

Pre-Selection Criteria

The variable of using or not using pre-selection criteria was coded in SCARF within participant descriptions, thus it was expected that studies who did not have said criteria would be rated lower in regard to overall quality and rigor (Figure 2). This may account for some of the differences between Figures 1 and 2 in regard to overall quality and rigor. As all experiments in Figure 1 were above the halfway mark on the scale of overall quality and rigor (two), and 16.67% of experiments in Figure 2 were not. Results of primary outcomes are varied and affected by outliers for both Figures 1 and 2. The unequal amounts of data points displayed between the two figures make it difficult to draw strong conclusions. However, multiple experiments in Figure 1 had better ratings of primary outcomes than the highest rating of primary outcomes found in Figure 2.

Although these results should be interpreted with caution due to the small number of studies evaluated, the requirement of pre-selection criteria adds to the technological nature that single-case design researchers are to exemplify (Cooper et al., 2006). Previous literature has demonstrated that the most successful outcomes of interventions who have embedded RIs in practice were aimed to increase social communication skills (Ninci et al., 2018; Ninci et al, 2020). Many social skills that were targeted in studies included in this review had prerequisite skills that were necessary even if it was not explicitly stated as pre-selection criteria. For example, Keeling, Myles, Gagnon and Simpson (2003) implemented an intervention embedding RIs to teach sportsmanship skills to a 10-year old girl with ASD and failed to report pre-selection criteria. However, the student would need to have the behavior of reading in her repertoire to engage with the material used in the intervention (a power card), as well as show a history of understanding the rules of the game being played before successfully learning the skill of

sportsmanship. Baker et al. (1998) implemented an intervention that aimed to increase the percent of intervals three students with ASD engaged in social interaction during games. This study failed to state pre-selection criteria, although the definition of social interaction provided by authors would require the prerequisite skills of joint attention and turn taking for all three students (Baker et al., 1998). Interventions that embed RIs and demonstrate the strongest gains are related to the area of social communication skills which often require pre-requisite skills; researchers will benefit by including this information or explicitly stating if there are no prerequisite skills needed to successfully make gains. This addition will also improve the quality of articles by making them more replicable, a design standard all single-case researchers should strive to adopt (Cooper et al., 2006).

Determining RIs

There is currently no standard way in which interests are determined to be actual RIs. After evaluating how studies determined this there were two primary methods found in articles. The first method was using either formal or informal observations, these can be conducted by the teacher, researcher, parents, and/or other staff members. The second method was to interview parents and staff members about the child's RI, some studies used a combination of these methods. Table 2 displays and codes the methods authors used to determine RIs. Many articles used both strategies to determine the individuals RI (Baker et al., 1998; Baker, 2000; Boyd, 2007; Angell et al., 2011). Some articles also added an operational definition of what would constitute a RI. These operational definitions often included that the child "preseverated" or had an "intense preoccupation" on the topic/object to an abnormal extent, and that interrupting engagement with the interest would cause the child to become "extremely agitated" (Angell et al., 2011, Baker et al., 1998; Baker, 2000; Vismara & Lyons, 2011). The terms noted above are

subjective in nature. Authors are urged to keep these definitions as operational as possible with the least amount of subjectivity achievable by including topographical definitions of challenging behaviors engaged in when interacting with the RI is interrupted as well as how consistently the individual chooses that topic or object over others available. Describing what behaviors the student engages in to seek out the topic object is also beneficial for technological purposes for example singing songs, collecting items, watching videos, etc. The addition of this information will help clarify gaps in research in relation to what constitutes a RI. Some researchers also required that an interest be considered a RI only if all observers agreed the interest was "abnormally preservative and problematic" (Baker et al., 1998; Baker, 2000). The addition of operational definitions will increase the replicability of studies and help clarify in the literature what practitioners should be considering when determining their students' RIs.

Figures Related to Determining a RI

The variable patterns displayed in Figures 3 and 4 are consistent with previous findings of study outcomes that embedded RIs within interventions (Ninci et al., 2017). These results indicate that practitioners should be cautious when using interventions embedding interests even if these interventions use antecedent-based methods and a structured method of determining RIs. More research must be done to identify moderators of primary outcomes.

Maintenance and Generalization

Six experiments opted to not generalize outcomes. However, all studies that attempted generalized outcomes experimentally (Figure 6). This is likely related to the criteria of only including studies which used single-case design methodology, as it provides an experimental analysis. However, the generalized outcomes of these attempts varied widely with data points spread throughout the scale. Eight experiments lacked maintenance probes. All studies that

conducted maintenance probes did so in a timely fashion of at least one-week post intervention

(Figure 5). Maintained outcomes were not as varied as generalized outcomes. However, the data

points of maintained outcomes were still inconsistent ranging from two to above four on the

scale. Maintenance and generalization are key components of successful interventions. Such

varied findings indicate that more research needs to be done in regard to maintaining successful

outcomes and generalizing skills. Although findings are not consistent, studies have successfully

generalized engagement from a RI to a neutrally preferred item. Vismara and Lyons (2007)

successfully generalized joint attention behaviors to non-preferred stimuli for three students with

ASD. Baker et al. (1998) successfully generalized appropriate social play to games that did not

include their RI for three children with ASD. These outcomes give promising results for the use

of antecedent-based interventions to help students make gains and generalize those to other

materials.

Implications for Research and Practice

These findings of mixed and varied results fall in line with prior systematic reviews of

RIs embedded in practice (Ninci et al., 2017; Ninci et al., 2020). Exclusively reviewing

antecedent-based methods may have provided more consistent results than prior studies but they

are not strong enough to be interpreted with confidence. There may be other factors that are

causing these variations in outcomes rather than whether the approach is consequence or

antecedent-based. Previous evidence has suggested that an individual's severity of ASD may

play a role in the success of outcomes. Ninci et al. (2020) found that participants who had more

mild forms of ASD on average made more treatment gains than those with moderate or more

severe forms of ASD. This may be related to the distractibility associated with RIs and that those

who have more cognitive abilities can redirect attention more easily than individuals with less

cognitive abilities (Ninci et al., 2020). These variations may also be accounted for by what types of stimuli reinforce participants' behavior. Studies have provided evidence that individuals with ASD who engage in more automatically reinforcing behaviors compared to behaviors mediated by social reinforcers are less likely to make treatment gains through early intervention (Klintwall & Eikeseth, 2012). This difficulty is likely due to interventionists ability to easily simulate socially mediated reinforcers compared to the difficulty of simulating sensory stimulation that is reinforcing an individual's behavior (Klintwall & Eikeseth, 2012). Researchers are encouraged to explicitly state the pre-selection criteria necessary to attain target skills when investigating this topic for two reasons. First, this allows studies to be replicated with as much fidelity as possible, thus increasing confidence in findings. Second, this information may be a key factor in making social skills gains through interventions that embed RIs.

A majority of studies included in review were conducted within a school setting. This is beneficial as it provides a naturalistic environment. However, it does raise concern in regard to interventionists and intervention integrity. The two main interventionists used in the studies reviewed were either teachers/paraprofessionals or experimenters/authors/researchers. The number of participants who had a teacher or paraprofessional conduct the intervention was slightly higher than studies who used an experimenter/author/researcher, 13 and 10, respectively. Future research should evaluate the rigor of training given to indigenous implementers. If procedures are not implemented with fidelity, researchers cannot be confident in findings. This may account for variations found in previous reviews. Evaluating how interventionists are trained and what impact that has on the success of outcomes is an area should be researched. Considering these interventions will likely continue to be embedded within schools, interventionists' procedural fidelity is a primary concern that needs to be evaluated.

Practitioners are encouraged to use the antecedent-based method in conjunction with EBPs. As mentioned earlier, some authors included in review opted to use additional teaching strategies such as prompting procedures (Most to Least) or video modeling in addition to the antecedent-based method (Jung & Sainato, 2015; Kryzak & Jones, 2014). These studies both reported successful outcomes, which may be related to the use of EBPs in addition to the use of RIs in practice.

Considering that some students have had very successful outcomes related to interventions that embed their RI and others have not, monitoring progress is a critical component to participants' success (Ninci et al., 2017). This allows practitioners to change treatment if undesirable outcomes occur, such as an increase in stereotypical behaviors. Authors have reported evidence of these undesirable outcomes, specifically for individuals with more severe forms of ASD (Ninci et al., 2020). Deficits in social communication are a central component of ASD (American Psychiatric Association, 2013). Thus, using a strengths-based approach to evoke such behaviors is appealing, specifically when considering that identifying reinforcers potent enough to evoke engagement of target social behaviors can be a difficult task. Incorporating an interest that practitioners are aware will likely evoke engagement in social activities is a desirable way to promote learning social skills that can later be generalized to other neutral stimuli. Practitioners should be as technological as possible when conducting studies to help clarify gaps in this area of research. This includes explicitly stating who interventionists are and how they were evaluated as properly trained. Researchers should also explicitly state how interests were determined to be RIs with the addition of an operational definition to inform readers what authors are considering a RI. Authors are encouraged to keep these definitions truly operational by using the least amount of subjectivity achievable and including

topographical descriptions of challenging behaviors engaged in when interacting with the

RI is interrupted. Including how consistently the individual chooses that topic or object

over others available and what behaviors the student engages in to seek out the topic or

object is also beneficial in improving research quality and standards. As with all

interventions, monitoring progress regularly is extremely important to promote the best outcomes

for individuals and follow behavior analytic best practices (Cooper et al., 2006).

Limitations

There are limitations to consider in the present review of literature. As stated earlier, the total amount of studies reviewed is low ($n = 11$), thus, results should be taken with precaution. There are many different types of independent variables that include RIs. Therefore, a larger more comprehensive review may provide more clarity in regard to what outcomes are associated with certain independent variables in specific contexts. Outcomes were not evaluated in relation to the severity of disabilities of participants. It is possible that the cognitive abilities of individuals are a moderator of successful outcomes. The analysis of pre-selection criteria in relation to overall quality and rigor of articles may have been affected by SCARF's coding variables that accounted for this information. The final limitation of this study is the potential of publication bias, which is the tendency that studies are more likely to be published if they have strong, positive results compared to weak or neutral effects (Shadish et al., 2016). All studies included were peer-reviewed publications, thus publication bias is likely. A review of the literature that includes dissertations and theses may provide more information on the effectiveness of these interventions.

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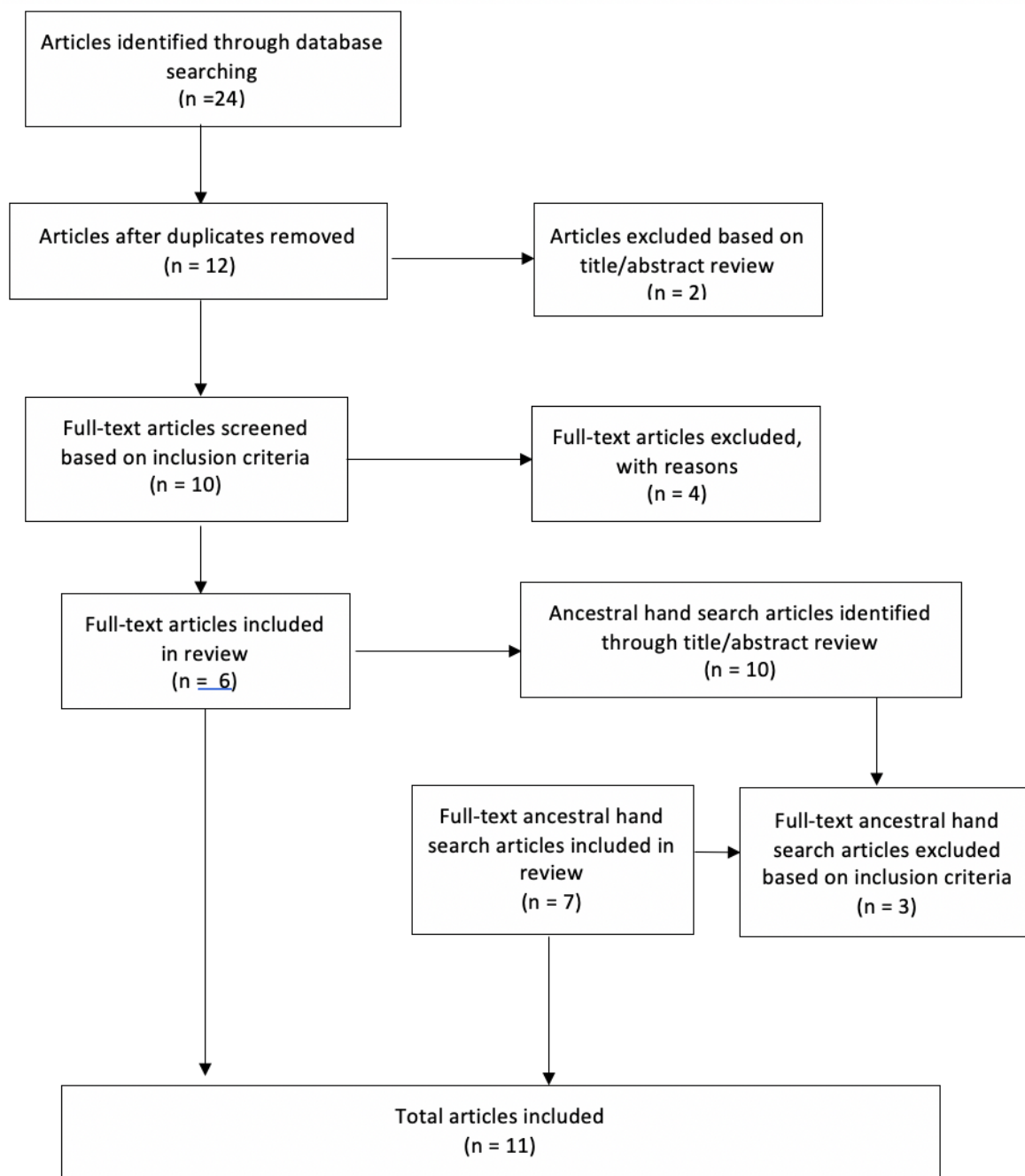*Research in Developmental Disabilities. (79)*8, 19-32.

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Figure A. Search procedures

Table 1

Participant and Setting Characteristics

Characteristics	N	Percent
Gender		
Male	23	76.67
Female	7	23.33
Not reported	0	0.00
Age		
0-5	12	40.00
6-12	15	50.00
13-18	3	10.00
Not reported	0	0.00
Diagnosis		
ID	2	6.67
ASD/PDD	28	93.33
Developmentally Delayed	0	0.00
Other	3	10.00
Multiple	3	10.00
Setting		
School	21	61.76
Home	5	14.71
Clinic	6	17.65
Early intervention program	2	5.9
Multiple	4	11.76
Interventionist		
Therapist/experimenter/author	10	30.30
Teacher/paraprofessional	13	39.39
Parent/caregiver	4	12.12
Not reported	6	18.18
Multiple	3	10.00
Challenging Behavior		
Reported	18	60.00
Not reported	12	40.00
Multiple behaviors	7	23.33
Pre-selection criteria		

Reported	23	76.67
Not reported	7	23.33

ASD = Autism Spectrum Disorder; PDD = Pervasive Developmental Disorder

Table 2

Experimental Characteristics

Author (s)	Year	N	Method of determining RIs	Data collection method	Independent variable(s)
Angell, Nicholson, Watts, & Blum	2011	3	• Interviewed classroom staff and family members • Operational definition provided	Duration	Power card strategy
Baker	2000	3	• Interviewed teachers and parents • Parent survey • Informal observations	PIR	Embedding RI within game or activity
Baker, Koegel, & Koegel	1998	3	• Interviewed teachers and parents • Informal observations	PIR	Embedding RI within game or activity
Boyd, Conroy, Mancil, Nakao, & Alter	2007	3	• Interviewed parents and teachers • Direct observations • Reviewed school records	Latency & duration	Embedding RI in game or activity

Campbell & Tincani	2011	3	• Interviewed teachers and participants • Informal observation	Frequency	Power card strategy
Daubert, Hornstein & Tincani	2015	2	• Interviewed teachers • Informational observations	Frequency	Modified power card strategy
Davis, Boon, Cihak, & Fore	2010	3	• Informal observations • Teacher reports	Duration	Power card strategy
Jung & Sainato	2015	3	• Interviewed teachers • Parent survey • Paired assessment	PIR, WIR, & Duration	Embedding RI in video modeling & embedding RI in game or activity
Keeling, Myles, Gagnon & Simpson	2003	1	• Informal observations • Teacher reports	Duration	Power card strategy
Kryzak & Jones	2014	3	• Informal observations • Parent interview	Frequency	Embedding RI in a game or activity & prompt fading (Most to Least)

Vismara & Lyons	2007	3	• Parent interviews	Frequency	Pivotal Response Training with perseverative
			• Informal observations		interest stimuli
			• Operational definition provided		

RI = Restricted interest; PIR = Partial interval recording; WIR = Whole interval recording;

Table 3

Experimental Outcomes

Author(s)	Year	N	Study Design	Pre-selection criteria reported	Dependent Variable (s)	Demonstrated Effectiveness
Angell, Nicholson, Watts, & Blum	2011	3	Withdrawal	No	1. Mean latency in seconds of responding to teacher cues	1. Yes
Baker	2000	3	Multiple baseline across participants	Yes	1. Percent of time engaged in social play 2. Percent of time engaged in thematic ritualistic behaviors	1. Yes 2. Yes
Baker, Koegel, & Koegel	1998	3	Multiple baseline across participants	No	1. Percent of time engaged in a social interaction	1. Yes
Boyd, Conroy, Mancil, Nakao, & Alter	2007	3	Alternating treatment design	Yes	1. Latency to initiation 2. Percentage of time engaged in social interaction	1. Yes 2. Yes

|						
Campbell & Tincani	2011	3	Multiple baseline across participants	Yes	1. Percent of directions followed	1. Yes
Daubert, Hornstein & Tincani	2015	2	Multiple probe across conditions	Yes	1. Appropriate initiating a turn 2. Appropriate relinquishing a turn 3. Appropriate commenting	1. Yes 2. Yes 3. No
Davis, Boon, Cihak, & Fore	2010	3	Multiple baseline across participants	Yes	1. Percent of time spent on other-focused conversation	1. Yes
Jung & Sainato	2015	3	Multiple probe across participants	Yes	1. Percent of time engaged with game 2. Percent of time engaged in social interaction 3. Percent of intervals with inappropriate behaviors	1. Yes 2. Yes 3. Yes
Keeling, Myles, Gagnon & Simpson	2003	1	Multiple baseline across conditions	No	1. Duration of challenging behavior	1. Yes
Kryzak & Jones	2014	3	Multiple probe across participants	Yes	1. Percent of joint attention initiations	1. Yes
Vismara & Lyons	2007	3	Reversal with ATD	Yes	1. Number of joint attention initiations	1. Yes

ATD = Alternating treatment design
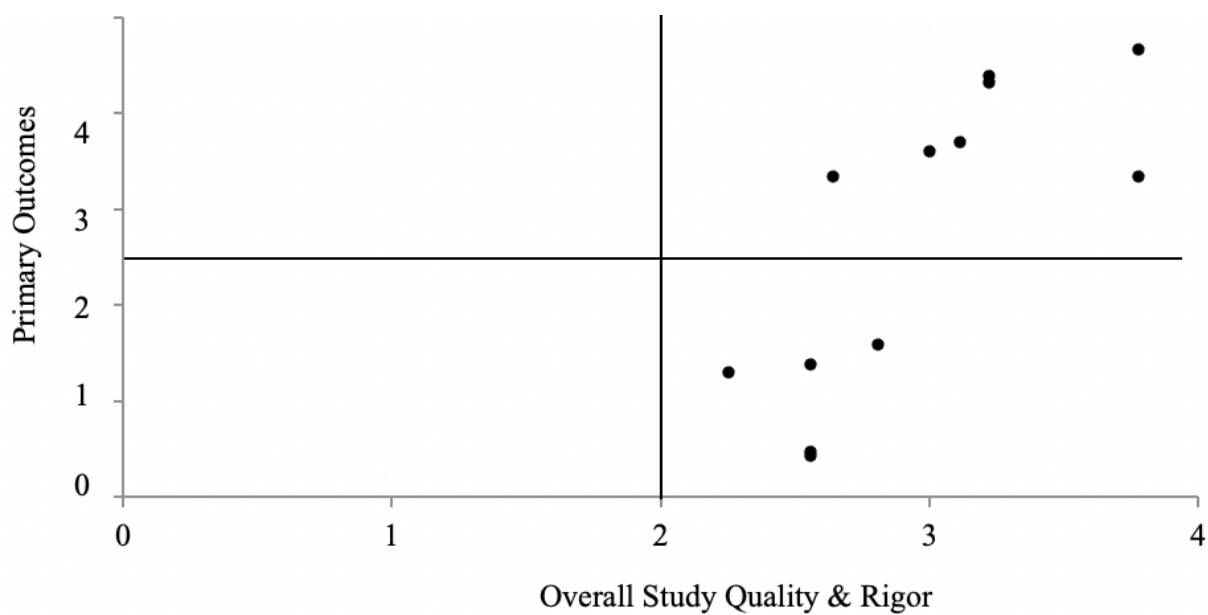
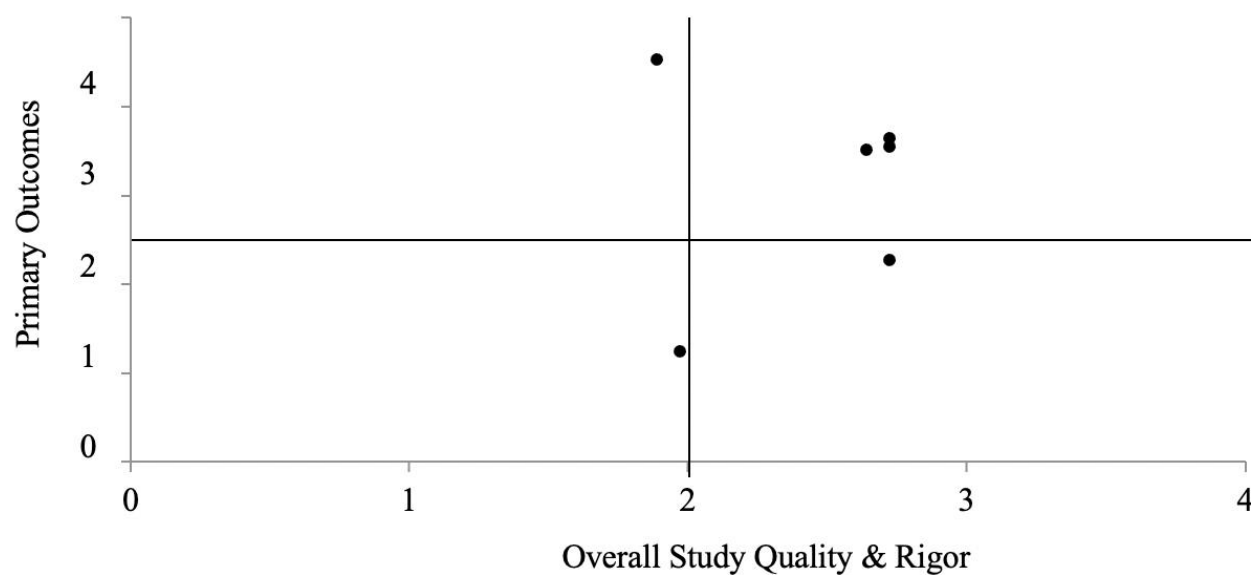Figure 1. Outcomes of Experiments With Pre-Selection Criteria

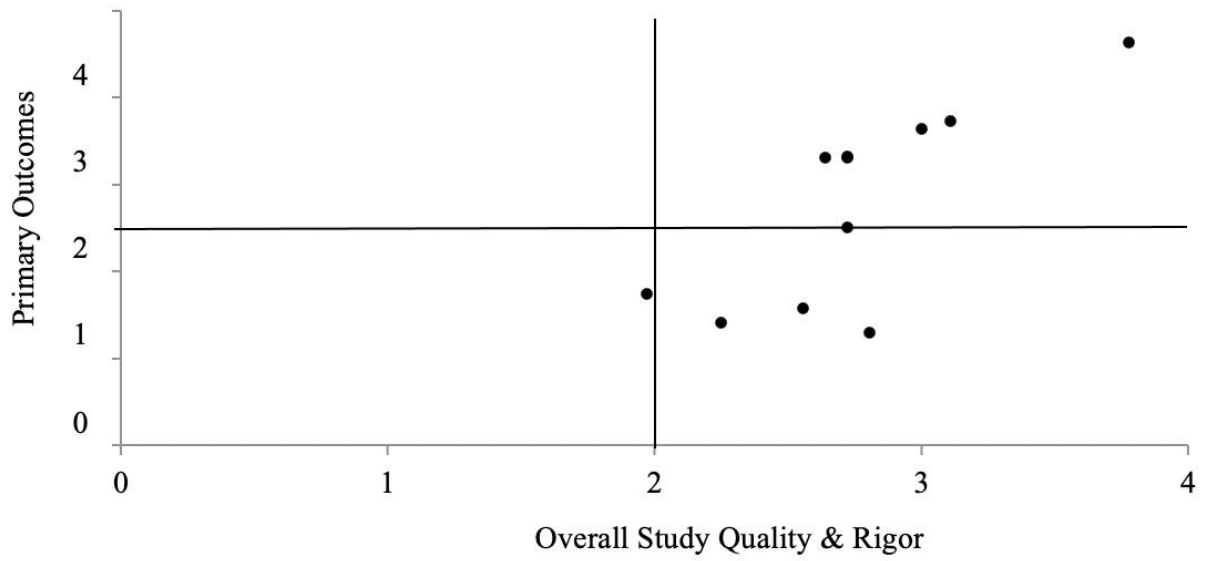Figure 2. Outcomes of Experiments Without Pre-Selection Criteria

Figure 3. Studies That Used *Both* Observations and Adult Interviews/Reports
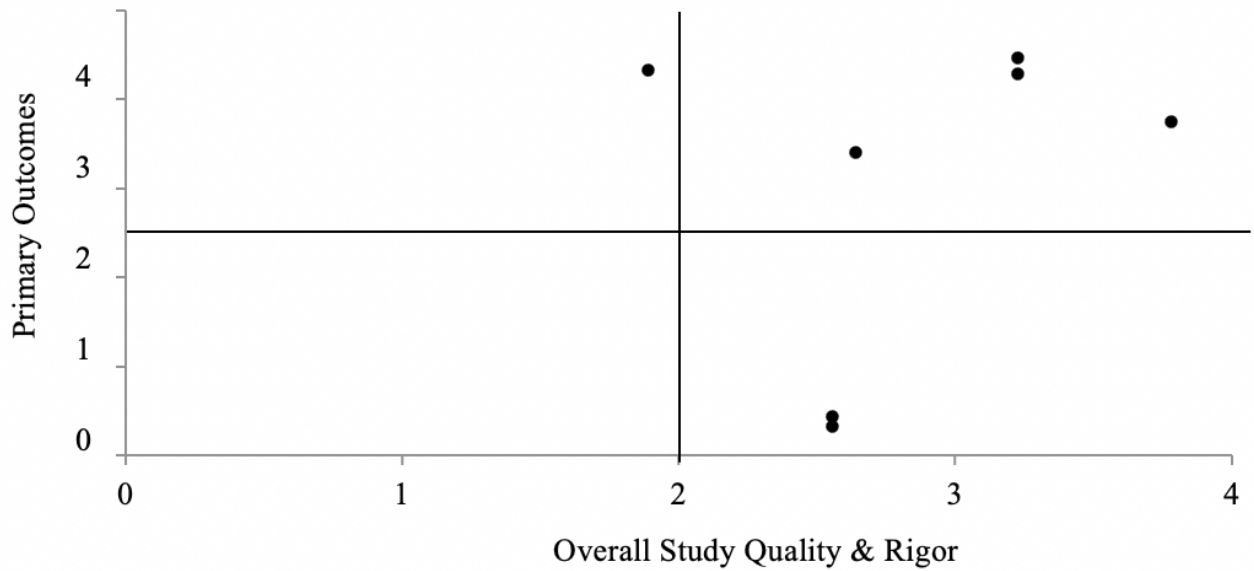

Figure 4. Studies That Used *Either* Observations or Adult Interviews/Reports
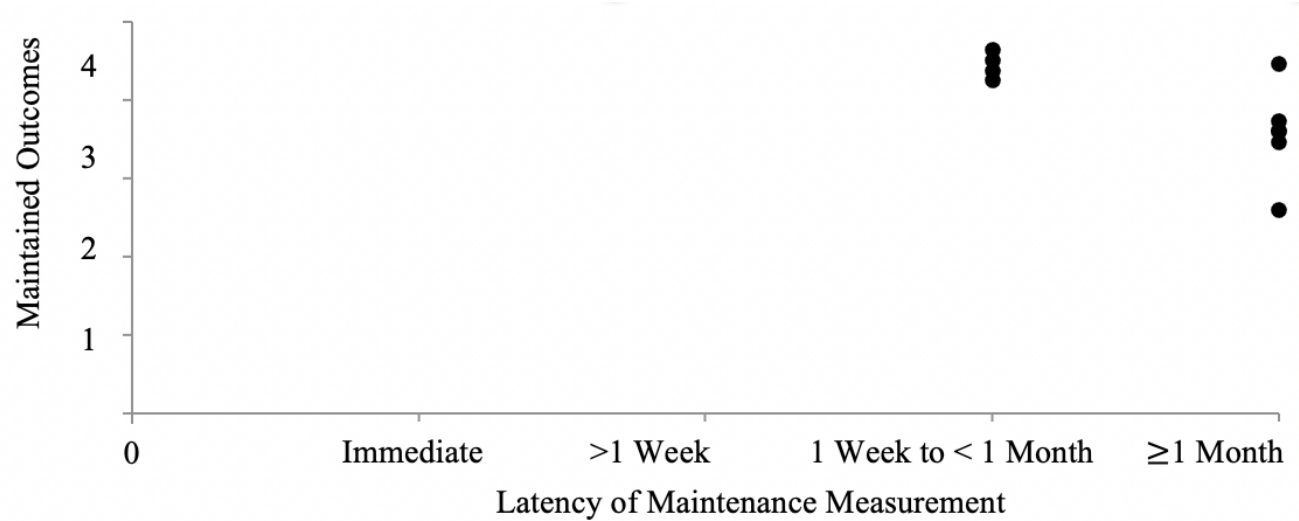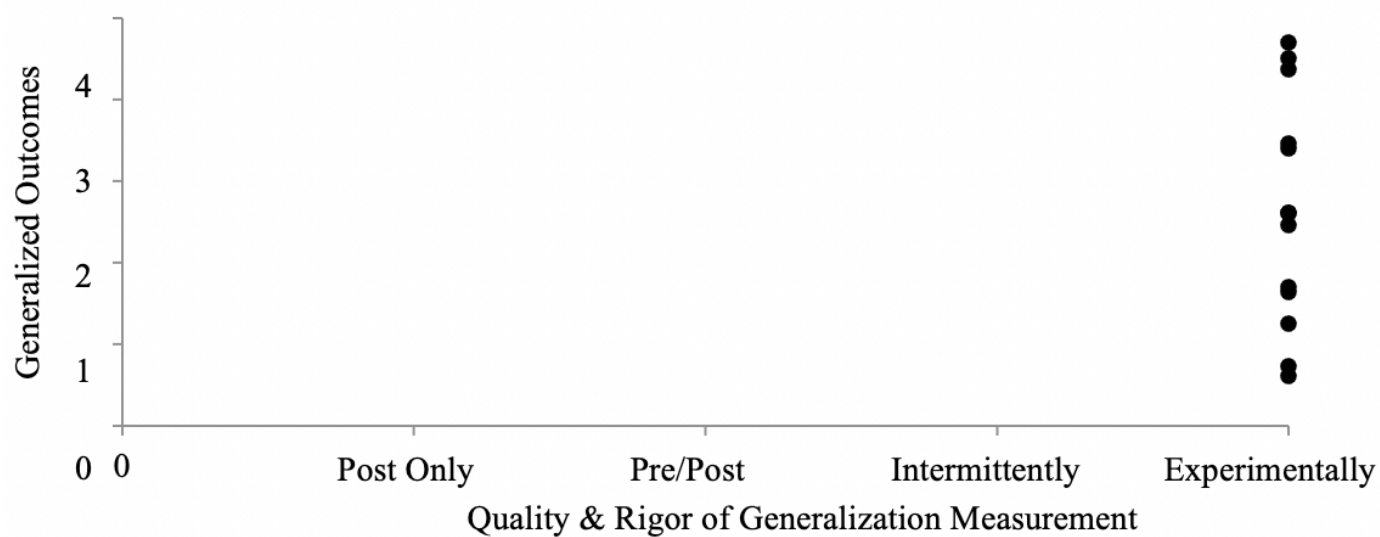
Figure 5. Maintained Outcomes of All Experiments

Figure 6. Generalized Outcomes of All Experiments