

THE EFFECTIVENESS OF INTERVENTIONS TARGETING SOCIAL-COMMUNICATION
SKILLS FOR ADOLESCENTS AND ADULTS WITH AUTISM SPECTRUM DISORDER: A
META-ANALYSIS, QUALITY REVIEW, AND SINGLE-CASE ANALYSIS

A Dissertation

by

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ABSTRACT

The prevalence of adolescents and adults with autism spectrum disorder (ASD) is growing worldwide. There is a lack of services to support adolescents and adults with ASD in different areas including social-communication intervention. To fill these research gaps in the literature, the three studies in this dissertation extended the literature on social-communication interventions for adolescents and adults with ASD. The purpose of these three studies were (1) to conduct a meta-analysis determining effects of social-communication interventions in improving social-communication skills for adolescents and adults with ASD; (2) to analyze the body of literature on using social-communication interventions to adolescents and adults with ASD whether they meet the criteria for What Works Clearinghouse (WWC) basic standard and extended methodological standards; and whether that particular intervention can be considered for evidence-based practices (EBPs) to improve social-communication in adolescents and adults with ASD; (3) to identify how educators could use telepractice intervention as a tool to implement naturalistic strategies for parents with adolescents and adults with autism in their home by conducting a multiple-probe single-case experimental design across participants.

The findings of the first study indicated that each social-communication intervention is moderately effective in improving social-communication skills for adolescents and adults with ASD. There are statistically significant differences found for some potential moderators. The findings of the second study found important issues that need to be considered in this field of social-communication interventions for adolescents and adults with ASD in relation to the quality of the single-case experimental design (SCED). In addition, video modeling intervention has been established as an EBP of social-communication intervention for this population. The

findings of the third study demonstrated a functional relation between the telepractice parents coaching and parent strategy implementation with a strong effect for all three participants.

The findings of these three studies showed several implications for practice and research. Paraprofessionals and researchers should be encouraging adolescents and adults with ASD to use generalization and maintenance for any social-communication activities in their authentic settings and with their natural partners, especially their parents and peers. More details on implementation, limitations, and future research were discussed.

DEDICATION

To my big family, especially my mother, Suntaree Wattanawongwan; my father, Suporn Wattanawongwan; my little sister, Chanikan Wattanawongwan; and my aunt, Dr. Prapojanee Kittikachorn, for your endless love and your forever support.

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TABLE OF CONTENTS

	Page
ABSTRACT.....	ii
DEDICATION.....	iv
ACKNOWLEDGEMENTS.....	v
CONTRIBUTORS AND FUNDING SOURCES.....	viii
TABLE OF CONTENTS.....	ix
LIST OF FIGURES.....	xi
LIST OF TABLES.....	xii
CHAPTER I INTRODUCTION.....	1
CHAPTER II INTERVENTIONS FOR IMPROVING SOCIAL-COMMUNICATION SKILLS FOR ADOLESCENTS AND ADULTS WITH ASD: A META ANALYSIS.....	4
Method.....	8
Results.....	14
Discussion.....	18
References.....	36
CHAPTER III A QUALITY REVIEW OF SOCIAL-COMMUNICATION INTERVENTIONS FOR ADOLESCENTS AND ADULTS WITH ASD: MAINTENANCE, GENERALIZATION, AND SOCIAL VALIDITY.....	49
Method.....	53
Results.....	59
Discussion.....	63
References.....	74
CHAPTER IV TELEPRACTICE PARENTS COACHING IN NATURALISTIC STRATEGIES TO INCREASE COMMUNICATION SKILLS FOR ADOLESCENTS AND ADULTS WITH AUTISM: SINGLE-CASE EXPERIMENTAL DESIGN.....	85
Method.....	89
Results.....	98
Discussion.....	101
References.....	117

CHAPTER V SUMMARY AND CONCLUSIONS.....	124
Implications for practice.....	125
Limitations.....	126
Future research.....	127
APPENDIX 1.....	128
APPENDIX 2.....	129
APPENDIX 3.....	134
APPENDIX 4.....	136
APPENDIX 5.....	138
APPENDIX 6.....	139
APPENDIX 7.....	140
APPENDIX 8.....	141
APPENDIX 9.....	142

LIST OF FIGURES

	Page
Figure 1	PRISMA flow chart reprinted from Moher et al. (2009)..... 24
Figure 2	Forest plot of effect size..... 25
Figure 3	Forest plot of effect size for intervention moderators.....26
Figure 4	Forest plot of effect size for implementer moderators.....27
Figure 5	Forest plot of effect size for communicative function moderators.....28
Figure 6	Forest plot of effect size for setting moderators29
Figure 7	Publication bias funnel plot.....30
Figure 8	Any use of parent strategy implementation (e.g., incentivizing, modeling, prompting, and expanding)106
Figure 9	Children targeted communication skills.....107
Figure 10	Scatter plot of Pearson’s correlation between parents’ use of behavior intervention skills and children’s targeted communication skills with prompted and independent (left graph) and independent (right graph).....108

LIST OF TABLES

		Page
Table 1	Interpretive for Tau-U values based on benchmarking from included documents' effect sizes.....	31
Table 2	Effect size per each intervention.....	32
Table 3	Effect size per each implementer.....	33
Table 4	Effect size per each communicative function.....	34
Table 5	Effect size per each setting.....	35
Table 6	Extended methodological quality standard ratings by experiment.....	69
Table 7	Extended methodological quality standard ratings: summary.....	71
Table 8	Maintenance, generalization, and social validity quality substandard: summary.....	72
Table 9	Parents and children demographics.....	109
Table 10	Summary of formal assessment results for participants.....	110
Table 11	Definitions of operational behavior for each parent and child.....	111
Table 12	Inter-observer agreement: average percent agreement of each dyad.....	112
Table 13	Effects on parent strategy implementation intervention skills.....	113
Table 14	Effects of intervention on independent target behaviors in children.....	115
Table 15	Pearson's correlations between parent strategy implementation use of behavior intervention skills and the children's targeted communication skills (prompted plus independent)	116

CHAPTER I

INTRODUCTION

The number of individuals with autism spectrum disorder (ASD) broadened from 6.7 to 18.5 per 1,000 of all individuals who were aged 8 years old across the United States (Maenner et al., 2020). A similar growing number is present in this population worldwide (Davidovitch, 2013; Hansen et al., 2015; Neik et al., 2014). Ultimately, this population will transition and become adolescents and adults. Most of them frequently have insufficient communication skills, and they require instruction and strategies to improve their communication skills in their levels of age when they reach adulthood (Hong et al., 2019). Delayed language skills and speech are typical characteristics of ASD; about 40% of them do not use verbal communication (Centers for Disease Control and Prevention [CDC], 2018). There are lacking numbers of services and research to support transitioning adolescents with ASD in different areas including social and communication interventions (Ganz et al., 2017; U.S. Department of Health and Human Services, 2018). Parents, teachers, and researchers could prepare the strategies to support this population by knowing which strategies and tools are the most effective. As this population gets older, the demand for services to improve academic skills, functional living skills, and social-communication skills also increases (Gerhardt & Lainer, 2011; Hong et al., 2017).

To fill these research gaps in the literature, the three studies in this dissertation extended the literature on social-communication interventions for adolescents and adults with ASD. The first study, Chapter II, of this dissertation, is a meta-analysis review of interventions in improving social-communication skills for this population. The second study, Chapter III, of this dissertation, is an analysis of the methodological quality of social-communication intervention

research, identifying which social-communication interventions for this population could be considered evidence-based practices (EBPs). The third study, Chapter IV, of this dissertation, is a single-case experimental design (SCED) and evaluated the effects of telepractice parent coaching on naturalistic strategies to improve communication skills for adolescents and adults with ASD. Finally, the gaps in the literature were also discussed regarding social-communication interventions to improve social-communication skills of adolescents and adults with ASD.

The first study (Chapter II) reported the effect sizes of interventions in improving social-communication skills for adolescents and adults with ASD. We investigated the social-communication outcomes in each intervention category. The author included single-case experimental designs (SCEDs) in this meta-analysis. The research questions are: (a) what is the overall effect of each intervention type (i.e., video-based instruction, in-vivo instruction, high-tech augmentative and alternative communication (AAC), low-tech AAC, behavioral skills training, and social skills training) on the social-communication skills of adolescents and adults with ASD, and are there differential effects comparing across intervention types; (b) are there differential effects by categories within the implementers variables (i.e., researcher versus teacher, peer-mediated versus non-peer-mediated)?; (c) are there differential effects by categories within the communicative function variables (i.e., behavioral regulation, social interaction, and joint attention); and (d) are there differential effects by categories within the settings variables (i.e., authentic settings [home, classroom, employment, and community] and didactic settings [clinic and separate room])?

The second study (Chapter III) conducted the quality review of social-communication interventions and identified which social-communication interventions for this population could be considered evidence-based practice (EBP). The purpose of the quality review was to apply the

WWC guidelines to the literature of social-communication interventions for individuals with ASD. The research questions of this quality review are: (a) does the body of literature on using social-communication interventions to adolescents and adults with ASD meet the criteria for WWC basic standard review as outlined by Kratochwill et al. (2014; 2018)?; (b) does the literature meet extended methodological standards (i.e., participant description, setting and materials description, implementer description, baseline and intervention description, generalization, maintenance, procedural integrity, and social validity)?; (c) what social validity criteria are targeted?; (d) how many generalization sessions and what types of generalization are targeted?; (e) how many maintenance sessions and how long is the latency between cessation of intervention and maintenance data sessions?; and (f) does this body of literature for particular interventions meet the criteria for EBPs for any interventions to improve communication in adolescents and adults with ASD (NTACT, 2018)?

The third study (Chapter IV) was a single-case experimental design (SCED); the author conducted the effects of telepractice parent coaching on naturalistic strategies to improve communication skills for adolescents and adults with ASD. This study identified how educators could use telepractice intervention as a tool to implement naturalistic strategies for parents with adolescents with autism in their home. The research questions are: (a) is there a functional relation between the telepractice parent-coaching intervention and parents' rate of implementation of intervention elements to teach adolescents and adults with ASD to communicate?; (b) is there a correlation between the parent implementation of intervention components and the use of communication skills of adolescents and adults with ASD?; and (c) what is the social validity for the parent with adolescents and adults with ASD for the intervention?

CHAPTER II

INTERVENTIONS FOR IMPROVING SOCIAL-COMMUNICATION SKILLS FOR ADOLESCENTS AND ADULTS WITH ASD: A META-ANALYSIS

The recent decade has seen a prevalence of individuals with autism spectrum disorder (ASD) (Maenner et al., 2020). There has been a recent 15 percent increase in children with ASD across the United States, with the rates from 1 in 68 children in 2012, to 1 in 54 in 2016 (Maenner et al., 2020) and similar rising numbers worldwide (Davidovitch et al., 2013; Hansen et al., 2015; Neik et al., 2014). With the increase in ASD prevalence, the number of adolescents and adults with ASD is also rapidly increasing, which increases the number of adults with disabilities seeking services. As individuals with ASD get older, the demand for services to improve academic skills, functional living skills, and social-communications skills also increases (Gerhardt & Lainer, 2011; Hong et al., 2017).

Individuals diagnosed with ASD, of all ages, have difficulty interacting with others because of their deficits in social communication and restricted repetitive behaviors (American Psychiatric Association [APA], 2013; Ganz, 2015; Holyfield et al., 2017). There are three primary areas of social-communication deficits that impact communication and verbal skills of individuals with ASD: deficits in understanding others' feelings and thoughts, deficits in understanding nonverbal communication (body language and facial expressions), and deficits in interacting and showing interest with others (APA, 2013). The communication goals of adolescents with ASD differ from the goals of young children with ASD who typically communicate primarily with needs and wants (Holyfield et al., 2017). Communication difficulties in adolescents and adults with ASD are typically of more complex and intricate

language (e.g., initiating, turn-taking, greetings, responding to questions, and finding topics for conversation) (Bellini & Akullian, 2007; Kelly et al., 2018) and social interaction (e.g., social closeness) (Holyfield et al., 2017).

To meet their communication needs, individuals with ASD, including adolescents, required evidence-based interventions for supporting them, such as the video self-modeling (VSM) (Bellini & Akullian, 2007), functional communication training (FCT) (Chezan et al., 2018), multimodal communication, augmentative and alternative communication (AAC) (Ganz et al., 2012a, 2012b; Holyfield et al., 2017), conversation skills training, social skills training (Merrill, 2017; Palman et al., 2012), written scripts (Dotto-Fojut et al., 2011), modeling, tact training (May et al., 2013), and prompting (Holyfield et al., 2017). Prior studies on these practices are either meta-analysis or systematic review of individual strategies and give an example of how to apply each intervention with individuals with ASD. However, there is no study that compared the effect sizes across all social and communication intervention categories for adolescents and adults with ASD to allow fine-grained analyses of what practices are most effective for this age range. This result might be unique compared to what is effective for young children, who are the subject of a large proportion of such research.

A significant amount of studies showed evidence-based practices (EBPs) for early childhood and school-age children with ASD in the early intervention and services. Although the practices reported the implications for adolescents with ASD, there is a lack of identifying EBPs for adults with ASD (Wong et al., 2014). The majority of the participants in EBPs studies reported in prior reviews were 3-11 years, while the report showed a significant minority of studies included individuals with ASD aged 12 years and up (Wong et al., 2014). There is a need for continuing the research that concentrates EBPs for this age group. Prior meta-analyses in

communication interventions reported comparative magnitudes of effect disaggregated between preschool age, elementary school age, and secondary school age groups (Ganz et al., 2012a; Heath et al., 2015). However, there were a small number of studies within the adolescents and adults age range to support confident determinations, and researchers need to expand and indicate more in the future (Ganz et al., 2017). Knowing which intervention category is the most beneficial in each different variable (e.g., implementer, communication function, or setting) could help educators and parents to carefully choose the most efficient intervention to support their individuals' communication skills.

As individuals with ASD grow up, their social-communication issues seem to increase and require more complex skills (Chawarska et al., 2007). They tend to have more opportunities to communicate and participate with different people. Much of the research on this population has taken place in the clinic or resource room that exclude individuals from the natural settings, where social skills are particularly relevant for this population (Nuernberger et al., 2013). To successfully teach adolescents and adults with ASD to develop social communication skills, researchers and educators should include strategies to increase generalization of social communication skills across different people (different implementers), different settings, and with instruction in varied communicative functions (i.e, behavior regulations, social interaction, joint attention). There are critical needs for evaluating the efficacy of communication interventions on more complex language use for this adolescents and adults age ranges to address the most effective and suitable interventions for this population across implementers variables, communicative function variables, and setting variables.

Researchers used meta-analysis, a statistical procedure of quantitative studies, to identify the magnitude of effects for interventions by combining data from all studies in particular

interest topics (Borenstein et al., 2009). For single-case experimental designs (SCEDs), Tau-U was used to generate effect size for measuring non-overlapping data between baseline and intervention phases in SCEDs (Parker et al., 2011a). Tau-U is an extension from Non-overlap of All Pairs (NAP) and includes an adjustment for baseline trends, while other prominent effect size measures do not (e.g., extended celeration line [ECL, White & Haring, 1980], the percentage of nonoverlapping data [PND; Scruggs et al., 1987]). Adjusting for baseline trends is critical because it controls for undesirable trends and discriminates well between the data series of results. Tau-U (Parker et al., 2011b) extends [Tau] to control for undesirable positive baseline trend (monotonic trend). Monotonic trend is the upward progression of data points in any configuration, whether linear, curvilinear, or even in a mixed pattern of “fits and starts” (p. 11) (Parker et al., 2011a). Tau-U has stronger and effective statistical data of effect size than other measures (Parker et al., 2011b). Moreover, when compared Tau-U to others effect size measures, it showed no influence by a ceiling effect, unlike commonly used effect sizes, such as all nonoverlap indices (Parker et al., 2011b).

The purpose of this meta-analysis is to determine effectiveness of social and communication intervention for adolescents and adults with ASD, primarily discriminated by these variables: implementers, communicative functions, and setting. We investigated the social-communication outcomes in each intervention category. The author included single-case experimental designs (SCEDs) in this meta-analysis. The research questions of the current meta-analysis are: (a) what is the overall effect of each intervention type (i.e., video-based instruction, in-vivo instruction, high-tech augmentative and alternative communication (AAC), low-tech AAC, behavioral skills training, and social skills training) on the social-communication skills of adolescents and adults with ASD and are there differential effects comparing across intervention

types; (b) are there differential effects by categories within the implementers variables (i.e., researcher versus parent and peer-mediated versus non-peer-mediated)?; (c) are there differential effects by categories within the communicative function variables (i.e., behavior regulations, social interaction, and joint attention); (d) are there differential effects by categories within the settings variables (i.e., authentic settings [home, classroom, employment, and community] and didactic settings [clinic and separate room])?

Method

Literature Search Procedures

A research librarian who has experience in conducting literature and systematic reviews searched in different scientific databases (PsycINFO, Academic Search Ultimate, MEDLINE Complete, ERIC, Education Source, CINAHL Complete, Education Full Text (H.W. Wilson), Social Sciences Full Text (H.W. Wilson), Communication Source, Sociology Source Ultimate, SocINDEX with Full Text) through EBSCO. The author selected these databases because to make sure that all documents that meet criteria were included in the review process. The search from all databases was limited to documents in English and published in the peer-reviewed journals between January 1985 and September 2019. Once all documents were identified through the full-text stage, we conducted the first author search, ancestral search, and forward search of all included documents. The search combined three search categories including autism, communication interventions, and participants' age of adolescents and adults, using keywords and thesaurus terms. The search procedures resulted in 2,992 documents (e.g., articles, dissertations, books, book chapters, etc.). See Figure 1 for the PRISMA flow chart of each search at each stage.

Following the first batch of title/abstract and full text reviews, the author searched for more potential documents that possibly met the inclusion criteria in this meta-analysis. From the 33 documents that had been included following the first round of review steps, the author used the Web of Science database to review (a) first authors' other studies that have been published (first author search), (b) all references that have been cited in the 33 initially included documents (ancestral Search), and (c) any published articles that cited the 33 included documents (forward search). After reviewing all of the references obtained from these additional searches, a total of 127 additional documents were found and reviewed for duplicate removed processes.

Title and Abstract Review

The first author and the three raters (a researcher with doctoral degree and two doctoral students in special education) reviewed the titles and abstracts of each of the 2,353 documents obtained across all of the searches, after duplicates were removed. A free web tool called Rayyan was used to screen and select documents. We excluded documents based on exclusion criteria: (a) did not include participants with a diagnosis of autism spectrum disorder, Asperger disorder/syndrome, pervasive developmental disorder, childhood disintegrative disorder, or Rett syndrome, (b) did not include at least one dependent variable involving social-communication skills, (c) did not a SCED that include at least three replications to demonstrate effect (e.g., multiple-baseline, multiple-probe, alternating treatment/multiple element, reversal/ withdrawal, changing criterion, or embedded designs of multiple components of the designs) (d) did not include adolescent and adult participants (age more than 12 years) or (e) not in English. The first author and all raters included the documents in the full-text review if the information to exclude was not clear enough in the title and abstract of the document to make a decision to exclude. The search procedures in title and abstract review resulted in 344 documents that continued to the

full-text review. Following completion of title and abstract review of results from first author, ancestral, and forward searches, a total of additional 43 documents were submitted to full text review.

Full Text Review

We conducted a full text review on a total of 387 documents that were obtained from all of the searches and were not excluded at the title and abstract review stage. For SCEDs, the full text criteria inclusion criteria are following, that the document: (a) include at least one participant with ASD age 12 years old and up, (b) include at least one SCED that makes at least 3 attempts to demonstrate effects at different points in time (i.e., ABAB or reversal with at least 4 phases, multiple baseline/probe with at least 3 levels, alternating treatment/multiple element with at least four data points per condition, or at least 4 phases for changing criterion design), (c) include at least one SCED that has a line graph with three data points minimum per phase for every baseline and intervention phase, (d) include at least 20% of sessions inter-observer agreement were conducted with the minimum agreement score of 80%, (e) include a social-communication interventions for the participant with ASD (e.g., Behavioral interventions, Naturalistic interventions, Peer and parent mediated intervention, Augmentative and Alternative Communication [AAC]), and (f) include written English. We excluded documents if they: (a) implemented a non-concurrent multiple-baseline or multiple probe single-case experimental design, (b) involved dependent variables of communication that respond to the academic lessons. A total of 33 documents obtained from initial search procedures were included as a result of full-text review. Following completion of full text review of the documents obtained via first author, ancestral, and forward searches, 8 additional documents were included in this study. In total, 41 documents were included in this meta-analysis.

Data Extraction

Data Extraction for SCEDs

Moderator Coding and Extraction of Descriptive Information. Documents that meet the full-text criteria were coded following these variables: (a) intervention categories (i.e., video-based instruction, in-vivo instruction, high-tech AAC, low-tech AAC, behavioral skills training, and social skills training) (b) implementer (i.e., researcher versus teacher, peer-mediated versus non-peer-mediated), (c) communicative function (i.e., behavior regulation, social interaction, joint attention, mixed communicative function), (d) setting (i.e., authentic settings [home, classroom, employment, community] and didactic settings [clinic, separate room]). See Appendix 1 for moderator coding and operational definition. After the moderator coding stage, we withdrew or combined some variables codes based on how the categories were developed with an adequate amount of data from all documents.

Raw Data Extraction and Calculating Effect Size Analysis. The data of documents which are remaining from full-text review were extracted. A-B contrasts for the participants and dependent variables were extracted from all documents for multiple baseline, multiple probe, reversal, and alternating treatment designs. An A-B contrast is the process of comparing data between baseline data (phase A) and intervention data (phase B) before calculating the percentage of data improvement between those phases. The first author took a screenshot of each graph and used the digitizer software named Engauge Digitizer (Mitchell et al., 2017; markumitchell.github.io/engauge-digitizer), freely available, to digitize a scanned graph into (x,y) data. The authors chose this software because it shows high reliability between coders (Shadish et al., 2009) and have been used to conduct systematic reviews of SCED study (Gage & Lewis, 2012; Lequia, Wilkerson, Kim, & Lyons, 2014).

Data Analysis

The research questions involve investigating factors that influence the magnitude of the effects of intervention type on the social-communication skills of adolescents and adults with ASD and are their differential effects compared across intervention types.

Effect Size Analysis

Then, we calculated effect sizes and its standard error (SETau) by using the web free tool Tau-*U* calculator (Vannest et al., 2016). Tau-*U* was used to control baseline trends and it has effective statistical data of effect size than other measures (Parker et al., 2011a). Moreover, Tau-*U* showed no impact of a ceiling effect when comparing with other effect size measures (Parker et al., 2011b). The range of effect sizes from -1.0 to 1.0 value of effect sizes between baseline phase and intervention phase for each level. A decrease of dependent variable when compared between baseline and intervention phases was shown to have a negative score (-1.0), an increase in the improvement of dependent variable between baseline and intervention phases was shown a positive score (1.0). The author reported statistical significance and confidence intervals to compare and evaluate between documents. These statistics were measured by using Kendall's S in Tau-*U* which provided the degree of statistical power (Parker et al., 2011a).

Omnibus Effect Size

After Tau-*U* effect sizes and SETau were calculated by each AB phase contrast that we separated according to each dependent variable and participant; each effect size was weighted based on inverse variance for each AB contrast to find the omnibus effect sizes per each document via Tau-*U* calculator (Vannest et al., 2016). Tau-*U* formula was defined as $Tau-U = \frac{S_P - S_A}{mn + m(m-1)/2}$. Then, Tau-*U* and SETau data for each document were calculated using RStudio

Team (2019) software with the metafor package to aggregate an omnibus effect size with standard error and confidence interval (CI).

Moderator Analyses

The author calculated each moderator effect size by computing each AB phase contrasts and combined to report an omnibus effect size for each moderator. A Kruskal–Wallis one-way analysis of variance was used to evaluate the statistical significance of the results (Kruskal and Wallis, 1952). Then, a Dunn post hoc test was used for more than three variables to examine the pairwise combinations across variable levels (Dunn, 1964) if the author finds the statistically significance on any of the variables.

Publication Bias

Given the reason for large effect size and limited studies collected, the author ran tests for publication bias by using the RStudio Team (2019) with the metafor package for all included and was presented in visual inspection of the funnel plot (graphical diagnostics). If the data points are falling outside of the funnel, it means there is some publication bias. The author also used Egger’s regression test to provide significant evidence for publication bias (Egger et al., 1997; Stanley & Doucouliagos, 2014). The trim and fill model were used to determine the unbiased effect size (Dural & Tweedie, 2000).

Inter-rater Reliability

All included documents throughout the title and abstract review stage were evaluated and at least 30% of the documents in full-text stage, moderators coding, raw data extraction stage was collected by another four raters. Disagreements resolved by either the first author independently reviewing the discrepancies or discussing the discrepancies of any disagreements among two raters to come to consensus. The author randomly chose documents for training with

all raters to reach more than 90% accuracy before independently reviewed by each rater. If rates fall below 90% agreement score, discussion and retraining were taken.

To calculate inter-rater reliability (IRR) in each stage, the author used percentage agreements. For the title and abstract review stage, IRR was collected on 100% of the included documents by four raters and IRR scores were 93% agreement. For the full-text review stage, IRR was collected on 33% of the included documents by two raters and obtained 93% agreement. Then, IRR in the moderator coding stage were collected by two raters for 34% of the included documents and the agreement was 92%. For data extraction, the other rater independently extracted 34% of the included documents and obtained 94% agreement.

Results

Descriptive Review

Forty-one documents published between 2002 to 2019 that met the inclusion criteria were included in the meta-analysis. A total of 98 participants (70 adolescents and 28 adults) were included and the documents produced 208 phases of AB contrast for the effect size calculation. Participants' ages were reported between 12 to 39 years. See Appendix 2 summarizes each study's descriptive information.

Omnibus Effects

Effect sizes were calculated by separating each AB phase contrast, then we combined each AB contrast to find the omnibus effect sizes per each document. The author developed benchmarking with percentile rank in 5 categories for Tau-*U* values from the included documents' effect sizes. See Table 1 for interpretation of Tau-*U* values. The overall results of social-communication interventions for adolescents and adults with ASD indicated a moderate

effect of 0.72 CI 95 [0.67, 0.77]. The effect size of individual documents ranged between -0.25 to 1.00. See Figure 2 for forest plot and effect sizes by document.

Moderator Analysis

Moderator Effect for Intervention Variables

We grouped the interventions by 6 categories which are video-based instruction, in-vivo instruction, high-tech AAC, low-tech AAC, behavioral skills training, and social skills training. The interventions that included fewer than 10 AB phase contrast and did not fit the definition in those categories were excluded from moderator analyses. Video-based instruction was compared with in-vivo instruction. Furthermore, high-tech AAC was compared with low-tech AAC.

The first moderator comparison was a video-based instruction in 13 documents with 92 AB phase contrasts and was an in-vivo instruction in 28 documents with 116 AB phase contrasts. The results demonstrated moderate effect size with 0.76 for video-based instruction and 0.69 for in-vivo instruction. The Kruskal-Wallis H test indicated there was not a statistically significant difference between these two types of intervention, $\chi^2(1) = 1.71, p = 0.40$.

The second intervention moderator comparison, high-tech AAC and low-tech AAC, was conducted. There was a total of 8 documents with 25 AB phase contrast for high-tech AAC and a total of 3 documents with 13 AB phase contrasts for low-tech AAC. The results showed moderate effect size with 0.75 for high-tech AAC intervention and small effect size with 0.44 for low-tech AAC intervention (See Table 2). Then, the Kruskal-Wallis H test indicated a statistically significant difference between high-tech and low-tech AAC intervention with $\chi^2(1) = 5.19, p = 0.02$. Given the small number of phase contrasts and participants included in the low-tech AAC, these results should not be considered definitive. See Figure 3 for intervention forest plot.

Although the other interventions (i.e., behavioral skills training, and social skills training) were not able to be analyzed for comparison due to the characteristics of intervention, each intervention's effect sizes are reported in Table 2.

Moderator Effect for Implementer Variables

Within the implementer's variables, the studies were grouped in two ways. Researcher implementation was compared with teacher implementation. Furthermore, implementation involving peer-mediation was compared with implementation without peer-mediation. The parent implementer variable was excluded from analysis procedures because we are unable to generalize based on 3 contrasts. The implementer was a researcher in 27 documents with 123 AB phase contrasts and was a teacher in 8 documents with 22 AB phase contrasts. The results of implementers showed moderate effect sizes with 0.71 for researcher implementers and 0.72 for teacher implementers. The results showed no statistically significant differences between researcher and teacher moderators, $\chi^2 (1) = 0.028, p = 0.867$.

Peer-mediation was involved in 11 documents with 57 AB phase contrasts, and non-peer-mediated was involved in 30 documents with 151 AB phase contrasts. The results indicated moderate effect sizes with 0.82 for interventions with peer implementers and 0.691 for interventions without peer as an implementer. The results of the Kruskal-Wallis H test showed statistically significant differences between the intervention with peers and without peers, $\chi^2 (1) = 8.005, p = 0.004$. Results in a random-effects model revealed that there were statistically significant differences between those implementers. See Figure 4 for implementers forest plot. Each implementers' effect sizes are reported on Table 3.

Moderator Effect for Communicative Functions Variables

Within the communicative function variables (i.e., behavior regulations, social

interaction, joint attention), the communicative function was behavior regulation in 13 documents with 36 AB phase contrasts, social interaction in 26 documents with 131 AB phase contrasts, and joint attention in 10 documents with 27 AB phase contrasts. The results indicated moderate effect sizes with 0.75 for social interaction and 0.68 for behavior regulations. The results demonstrated small effect sizes for joint attention (0.58). The results of the Kruskal-Wallis H test showed a statistically significant difference in social-communication outcome with three communicative functions variables, $\chi^2(2) = 6.51, p = 0.04$. Dunn's post hoc results showed that there were statistically significant differences between social interaction and joint attention ($p = 0.04$). However, there is no statistically significant difference when comparing behavior regulation to social interaction or joint attention. See Figure 5 for communicative function moderators forest plot. Each communicative function's effect sizes are reported in Table 4.

Moderator Effect for Setting Variables

The settings variables were grouped into authentic settings (i.e., home, classroom, employment, community) for 22 documents with 119 AB phase contrasts and didactic settings (i.e., clinic or separate room) for 21 documents with 89 AB phase contrasts. The results showed moderate effect sizes with 0.79 for authentic settings and small effect sizes with 0.63 for didactic settings. The Kruskal-Wallis H test showed a statistically significant difference in social-communication outcomes across types of settings, $\chi^2(1) = 7.26, p = 0.01$. See Figure 6 for setting moderators forest plot. Each setting's effect sizes were reported on Table 5.

Reporting Publication Bias

Publication bias was evaluated by using Egger's regression test. Egger's regression showed no significant evidence for publication bias [$z = 0.413, p = 0.679$]. However, the visual

analysis of funnel plot showed asymmetry, which can be demonstrative of outcome reporting bias. Then, trim and fill were tested and showed $Q(df=50) = 169.37$, with a p-value <0.0001 . These results are statistically significant indicating the effect sizes show heterogeneity. The overall unbiased mean effect size is 0.65 with 0.04 variability and a 95% CI [0.57, 0.74], this confirmed a statistically significant moderate effect size. These results showed the effect size would be smaller with slightly less variability if accounting for missed studies. See Figure 7 for publication bias funnel plot.

Discussion

Overall, this meta-analysis investigated the effectiveness of social and communication interventions for adolescents and adults with ASD by examining differential effects based on the moderator categories, including type of intervention, implementers, communicative functions, and type of setting. After analyzing 41 SCED documents with 208 AB phase contrasts across a total number of 98 participants— 70 of whom were adolescents (71%) and 28 of whom were adults (29%), the overall effect size for social and communication interventions for this population were found to have a moderate effect on social-communication outcomes. There was a statistically significant difference in social-communication outcomes across some moderators (between peer-mediated and non-peer-mediated, between social interaction and joint attention communicative functions, and between authentic and didactic settings).

We compared the effect between video-based intervention and in-vivo intervention; the results showed there is no significant difference in effect size between video-based and in-vivo intervention. This finding suggests that video-based interventions could improve social-communication skills in adolescents and adults with autism as much as in-vivo intervention. Thus, it is not required for implementers to spend extra time creating the video-based

intervention unless the reason for the video-based intervention leads to a quicker acquisition of the new skills than in-vivo intervention (Charlop-Christy & Freeman, 2000). There are clinical implications related to use of video-based versus in-vivo. Although educators could use both video-based and in-vivo instructions to improve their students' social-communication skills effectively, video-based instruction showed more benefits than in-vivo instruction in several areas. For example, after using video-based, students showed a more improved generalization of skills in daily-living (Wertalik & Kubina, 2017) and social-communication (Charlop-Christy & Freeman, 2009), than they did in-vivo instruction (Rayner et al., 2009). It is critical to maximize opportunities for generalization to expand new skills for adolescents and adults with ASD (Holyfield et al., 2017). In addition, video-based instruction can be individualized for different settings and skills, controlled over the intervention procedures, and allows educators or parents to reuse videos with different students to teach the same skills (Morlock et al., 2015).

We compared effects of high-tech AAC with effects of low-tech AAC; high-tech AAC were found to be significantly more effective for adolescents and adults with ASD than low-tech AAC in this study. The current study expanded on prior work (Ganz et al., 2017) that found high-tech AAC is an effective social-communication intervention for children with ASD; we found that it is also effective for adolescents and adults with ASD. Although this study found high-tech AAC is the most effective for this population; the prior study (Ganz et al., 2012b; Holyfield et al., 2017) suggests that adolescents and adults with ASD are able to learn to improve their communication skills using AAC across any levels (i.e., no-tech, low-tech, and high-tech). Thus, educators and parents can benefit from both levels of AAC to improve their children's social-communication skills in different communicative functions. There were only 8 documents

of high-tech AAC included in our meta-analysis, and that indicated a need for caution when interpreting these results.

We investigated the differential effects of implementer types (i.e., between researcher and teacher; between peer-mediated and non-peer-mediated). The author found there were no statistical differences between teacher and researcher; however, there were statistical differences between peer and non-peer implementer. Peers as an implementer were found to be more effective than without peers. These results indicated that it is possible that educators can teach peers to be participants in social-communication intervention, which would increase the likelihood of adolescents and adults with ASD using communication skills across a range of natural communicative partners and also allow them to maintain generalization skills (Dean et al., 2019). Although, for the parent implementer, the author could not analyze the effect size of the parent due to the small number of phases; the included article authors reported that parents and caregivers were the most valuable implementer, and that they could maintain and generalize social and communication skills with their adolescents and adults with ASD in natural settings (Volkmar et al., 2014). This finding expanded on prior research (Mandelberg et al., 2014) that found parents could support adolescents to generalize social skills better in their natural settings; we also found parent-mediated intervention showed the most effective results when compared with other interventions. Parents play an important role not just for the younger age but also adolescents and adults (Franzone, 2009; Roberts & Kaiser, 2011).

We analyzed three communicative functions (i.e., behavior regulations, social interaction, joint attention). The differences between social interaction and joint attention were statistically significant. The social interaction variable was found to be more effective compared to the joint attention variable. This result is consistent with previous studies examining the difficulty to

develop intervention for individuals with ASD to increase their joint attention because it involved social-cognitive neurodevelopment (Minsky, 2017; Mundy & Newell, 2007). There is a need for researchers and practitioners to focus more on intervention to teach adolescents and adults to improve their joint attention skills, such as how to initiate topics and making eye contact (Mason et al., 2012). Joint attention is important to social skills at all ages. However, adolescents and adults who lack joint attention skills showed decreasing ability of interpersonal relations such as friendships, interaction, and affection with others (Mundy & Newell, 2007). Adolescents who have practiced and developed their joint attention skills would get along with their friends, community, and have good relationships with their families. In order to produce meaningful joint attention abilities, educators play a crucial role in collaboration between schools and homes to allow opportunities to practice these skills throughout their routines and generalize in different situations. Unfortunately, there were also only 10 documents of joint attention included in this study, and that indicated a gap in the field and a need for caution when interpreting these findings.

Finally, we investigated the effects of the settings in which the intervention for this population was implemented. Our finding indicated that there was a significant difference in effectiveness between authentic settings (e.g., home, classroom, employment, community) and didactic settings (e.g., clinic, private room). This finding is consistent with previous studies (Ganz et al., 2017; Peterson, 2009) that it is important to prioritize social-communication intervention for individuals with ASD in authentic settings to improve their generalization communication skills across their settings; the finding in this study confirmed the same effective results for adolescents and adults with ASD. There are practical implications related to settings which educators and parents should generalize social-communication skills for adolescents and

adults with ASD in their natural settings as much as they can. To encourage practicing the skills in their natural settings allows them to maintain the skills over time. These areas are also particularly relevant given the need for adolescents and adults to be able to use their communication skills across their routines, activities, and workplaces as they normally do with their communicative partners.

Limitations

There are some limitations in this meta-analysis that need to be considered. First, the author used the Tau-*U* calculator (Vannest et al., 2016), with corrected baseline for AB phase contrasts, which in some cases resulted in Tau-*U* values over 1.0. Second, some of the moderator categories were not included to analyze due to the small number of AB phase contrast. This limited the breadth we were able to investigate related to for whom, with what intervention, and under what conditions interventions for social-communication outcomes are more effective. Third, all documents were searched by a research librarian in several different scientific databases and the researcher searched reference and first author's citation for the additional documents; however, there was possibility of missing some of potential documents due to the key words of searching for social-communication outcomes, because we may have missed interventions that were more comprehensive in targeted outcomes. Fourth, this study was limited to SCED research only due to the inability to combine the effect size between SCED and group designs (Borenstein, 2011; Shadish et al., 2015). Fifth, the possible inflation of the type I error rate due to using a Dunn post hoc test for running multiple analyses. Sixth, random-effects model was not usually use for the case of SCED which included more than one effect size per study. Moreover, Kruskal–Wallis one-way analysis of variance was usually used for moderator analysis

for the small sample sizes moderators, however, some of included moderators in this study are more than 90 phase contrasts.

Future Research

There are also several areas in this meta-analysis to support further research in this area. First, the researcher could expand research to focus for more details of differences between high-tech and low-tech AAC intervention across all adolescents and adults with other disabilities rather than just focusing on individuals with ASD. Second, research regarding this population should focus more on teaching natural communicative partners, such as their peers or parents, to generalize social-communication skills across communicative partners and in natural settings. Third, authentic settings had more significant effect results than didactic settings. More joint attention intervention needs to be developed for learned skills. For example, adolescents and adults with ASD had difficulty expanding and applying joint attention when it came to social-communication opportunities with their natural partner (Ingersoll et al., 2013). Therefore, research is needed to investigate and develop to find more effective interventions to promote and maintain joint attention function for this population. Educators and researchers could conduct more studies on how to improve the joint attention of individuals with ASD with their natural partners across the routines.

Figure 1
 PRISMA Flow Chart Reprinted from Moher et al. (2009)



PRISMA 2009 Flow Diagram

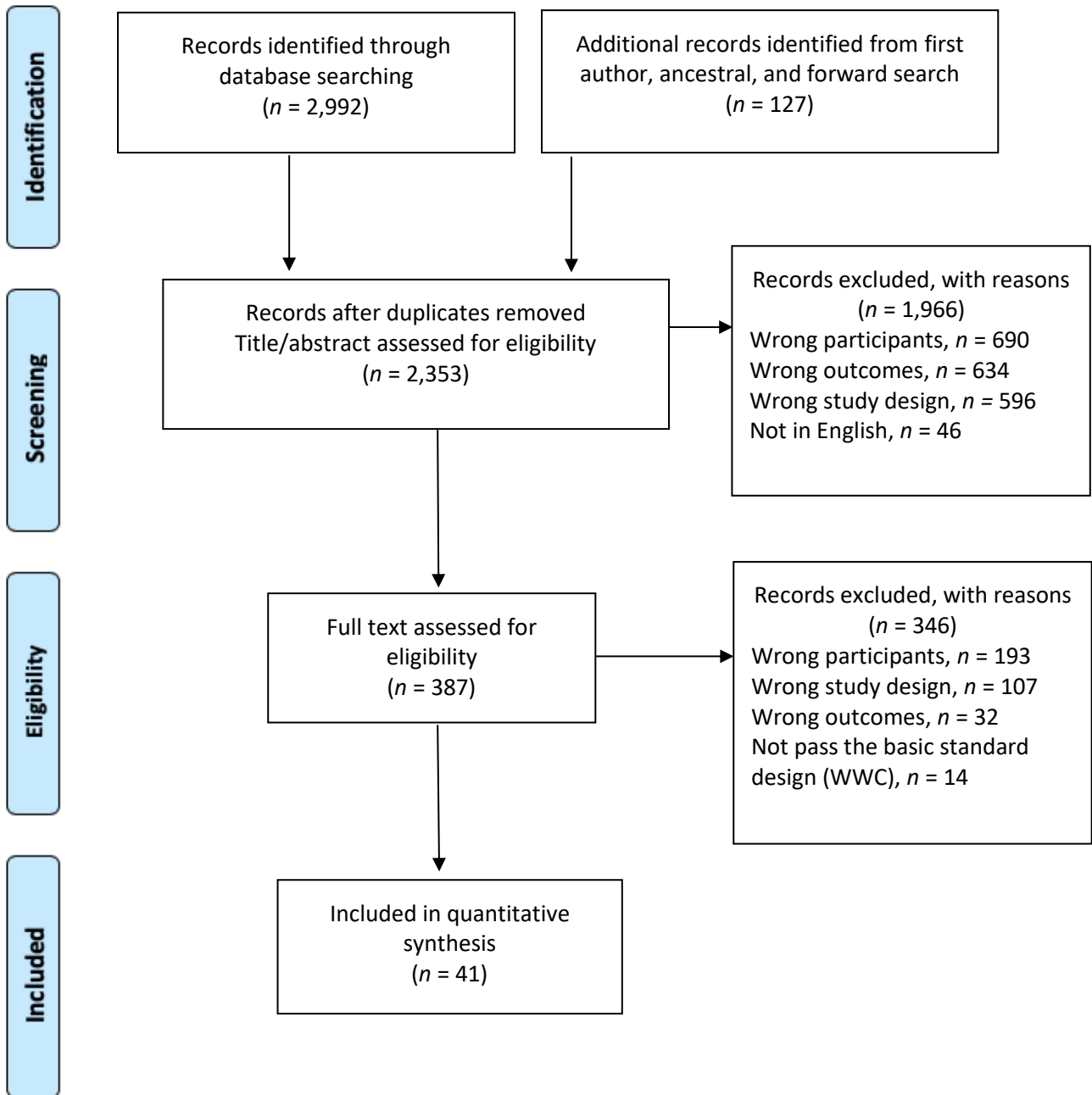


Figure 2
Forest Plot of Effect Size

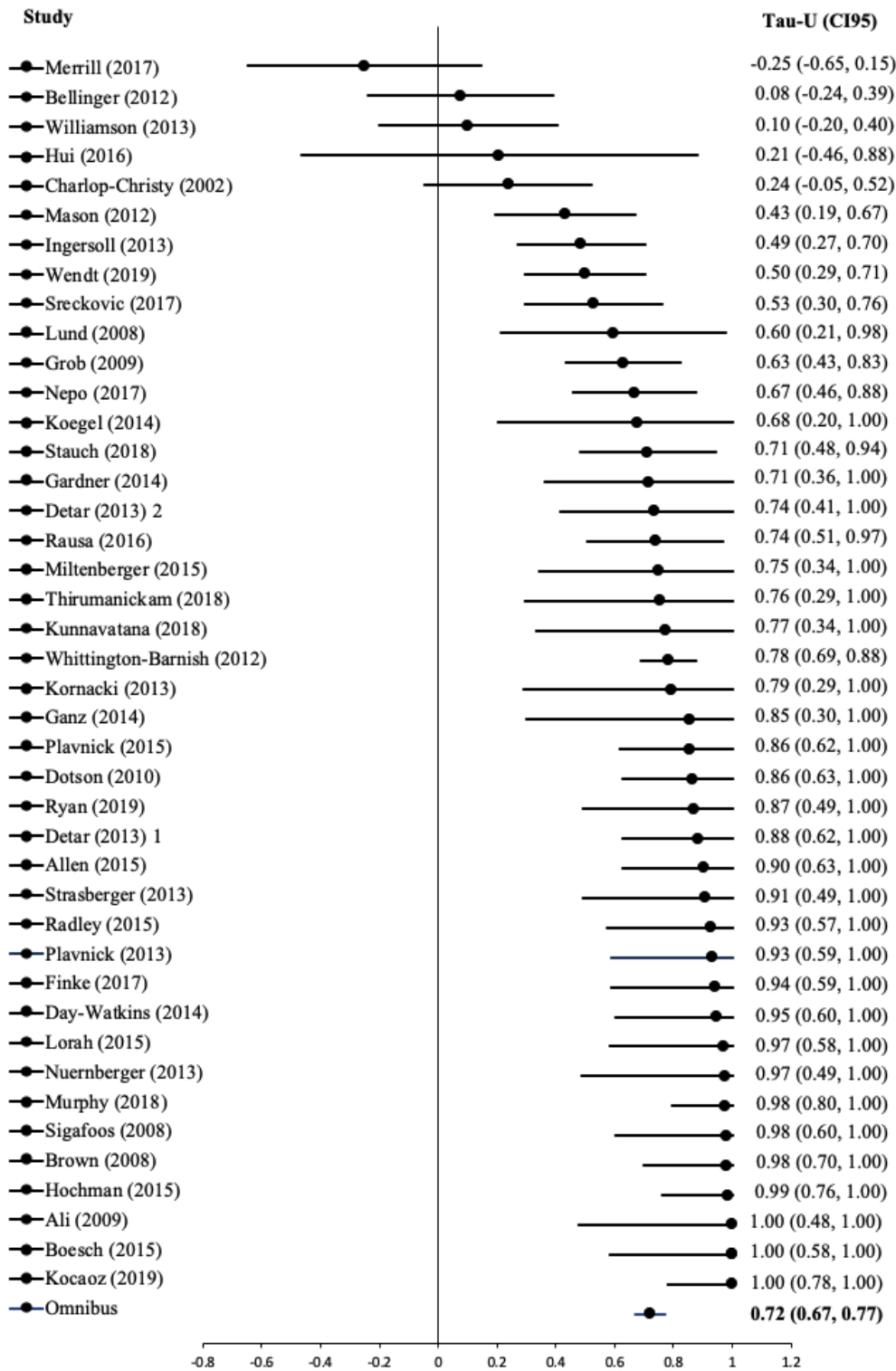


Figure 3
Forest Plot of Effect Size for Intervention Moderators

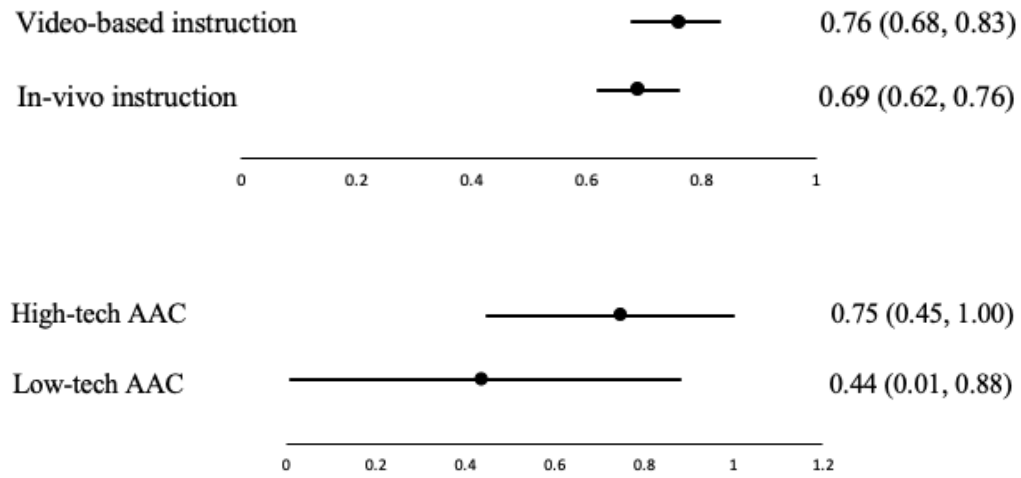


Figure 4
Forest Plot of Effect Size for Implementer Moderators

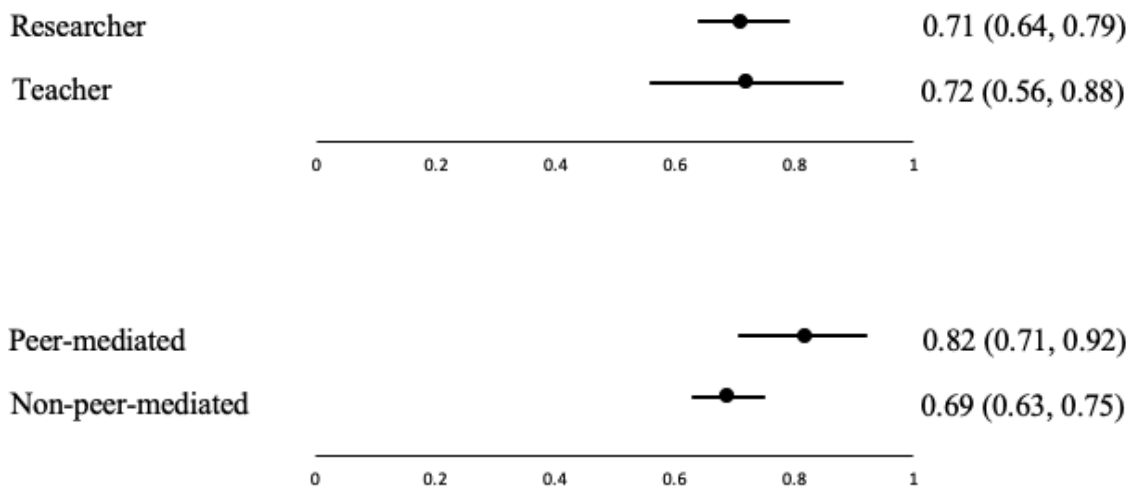


Figure 5
Forest Plot of Effect Size for Communicative Function Moderators

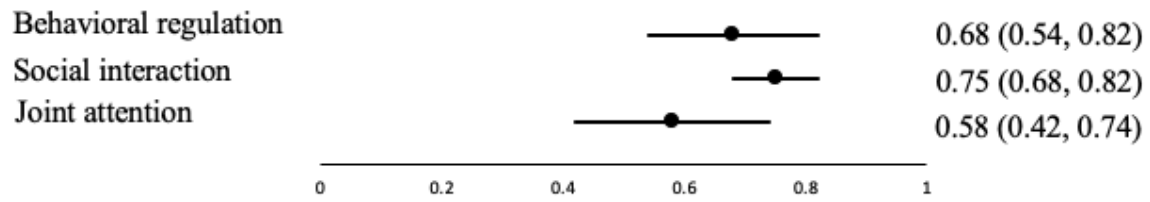


Figure 6
Forest Plot of Effect Size for Setting Moderators

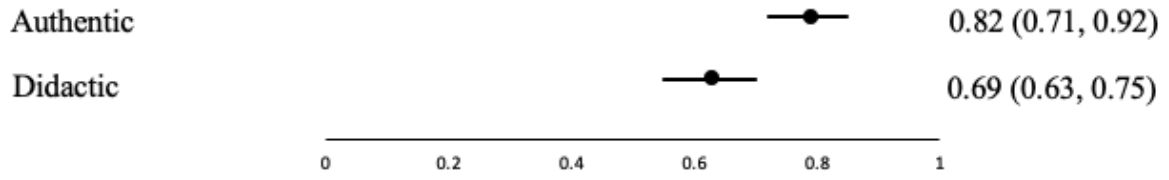


Figure 7
Publication Bias Funnel Plot

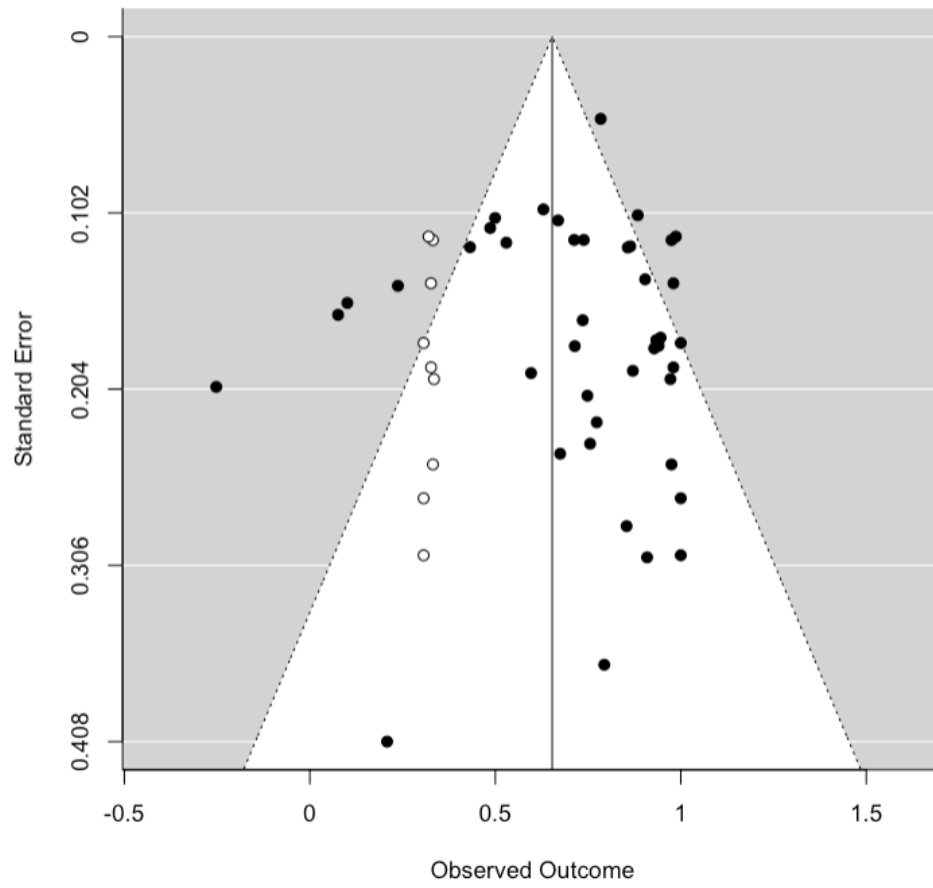


Table 1

Interpretive for Tau-U Values Based on Benchmarking from Included Documents' Effect Sizes

Tau-U values	Effect size interpretation	Percentile
0.98-1.00	Very large sized effect	90 th
0.89-0.97	Large sized effect	75 th
0.64-0.88	Moderate sized effect	50 th
0.21-0.63	Small sized effect	25 th
≤ 0.20	Very small sized effect	10 th

Table 2
Effect Size per Each Intervention

Intervention	Number of documents	Number of participants	Number of AB phases	Omnibus Tau- <i>U</i>	CI90
Video-based instruction	13	37	92	0.76	[0.68, 0.83]
In vivo instruction	28	61	116	0.69	[0.62, 0.76]
High-tech AAC	8	16	25	0.75	[0.45, 1.00]
Low-tech AAC	3	6	13	0.44	[0.01, 0.88]
Behavioral skill training	4	12	20	0.73	[0.54, 0.93]
Social skill training	4	8	19	0.60	[0.40, 0.79]

Table 3
Effect Size per Each Implementer

Implementers	Number of documents	Number of participants	Number of AB phases	Omnibus Tau- <i>U</i>	CI90
Researcher	27	52	123	0.714	[0.64, 0.79]
Teacher	8	18	22	0.720	[0.56, 0.88]
Peer-mediated	11	28	57	0.815	[0.71, 0.92]
Non-peer-mediated	30	70	151	0.691	[0.63, 0.75]

Table 4
Effect Size per Each Communicative Function

Implementers	Number of documents	Number of participants	Number of AB phases	Omnibus Tau- <i>U</i>	CI90
Behavior regulation	13	27	36	0.68	[0.54, 0.82]
Social Interaction	26	64	131	0.75	[0.68, 0.82]
Joint attention	10	29	27	0.58	[0.42, 0.74]

Table 5
Effect Size per Each Setting

Implementers	Number of documents	Number of participants	Number of AB phases	Omnibus Tau- <i>U</i>	CI90
Authentic	22	53	119	0.78	[0.72, 0.85]
Didactic	21	45	89	0.63	[0.55, 0.70]

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CHAPTER III

A QUALITY REVIEW OF SOCIAL-COMMUNICATION INTERVENTIONS FOR ADOLESCENTS AND ADULTS WITH ASD: MAINTENANCE, GENERALIZATION, AND SOCIAL VALIDITY

Individuals with autism spectrum disorder (ASD) prevalence estimates increased from 6.7 to 16.8 per 1,000 of all individuals who were aged 8 years old across the United States (Maenner et al., 2020) and reported a rising number of this population across worldwide (Davidovitch et al., 2013; Hansen et al., 2015; Neik et al., 2014). Eventually, this population will age and transition to adolescents and adults. Many individuals with ASD frequently reach adulthood with inadequate communication skills and they require instruction and strategies to improve their communication skills in their levels of age (Hong et al., 2019). Delayed speech and language skills are typical characteristics of ASD; about 40% of them do not use verbal communication (Centers for Disease Control and Prevention [CDC], 2018). There are lacking numbers of services and research to support transitioning adolescents with ASD in different areas including social and communication interventions (Ganz et al., 2017; U.S. Department of Health and Human Services, 2017). Educators and parents could prepare the strategies to support the growth of this population by knowing which interventions are the most effective and efficient. Also, this population could apply social and communication intervention/skills to their other daily living skills and employment skills in the future after improvement of communication skills.

As children with ASD become adolescents, social environments and interactions with others become increasingly complicated (Davis et al., 2010). These populations had a difficult

time with participating in contact and building a relationship with their typical peers in school (Daniel & Billingsley, 2011). The communicative interaction in adolescents and adults require communication interventions in a more complex interaction than an intervention that is simple use with young children. Across all studies, there are gaps that should be addressed and suggested for future research studies related to knowledge of the quality of this literature base including generalization sessions, maintenance sessions, and social validity in the literature. To successfully implement social-communication skills to adolescents and adults with ASD, it is critical to maximize opportunities for generalization and maintenance across contexts, communicative partners, activities, and conversation topics to teach and expand new communication skills (Bellini et al., 2007; Holyfield et al., 2017; Hong et al., 2019). This population needs to develop new communication behaviors and expand their vocabulary of communication skills beyond their current levels in different generalization contexts (Hong et al., 2019).

Further, with regard to social validity, it is important to measure the feasibility and social significance of interventions from the points of view of participants, implementers and other stakeholders. Especially for adolescents and adults with ASD, social validity measures could be the tools that determined the meaningfulness of the teaching procedures, interventions, and targeted skills for them (Hood et al., 2017; McNeill, 2019). Then, the researcher would also use the results in the social validity to develop and evaluate interventions along with determining efficacy of a given approach under ideal circumstances (McNeill, 2019).

There are no prior syntheses of the state of the science on generalization, maintenance, and social validity as related to intervention for social communication deficits in adolescents and adults with ASD. Best practice suggests that researchers and interventionists should plan for

generalization of newly learned skills across contexts, people, and materials (Anthony, 2014; Bellini & Akullian, 2007; Holyfield et al., 2017; Kagohara et al., 2012; Nuernberger et al., 2013; Palman et al., 2012). Given the ubiquitous nature of communication, it is important to increase opportunities to practice communication skills in generalization contexts to successfully expand and develop the skills to daily life routines with natural settings, natural communicative partners, and natural communities (Dean et al., 2019). However, it is unclear what proportion of the research demonstrates effective interventions that address and impact generalization effectively and efficiently.

Furthermore, both research and practice activities during routines for this population needs maintenance sessions to confirm that specific interventions are worked overtime (Kagohara et al., 2012; Nuernberger et al., 2013; Holyfield et al., 2017). Outcomes in several studies showed effects of interventions but did not include generalization and/or maintenance sessions. Researchers also suggested to generalize the social communication interventions into the natural environment setting in their community and also generalize to different communication partners beside the implementer (Collins et al., 2019; Nuernberger et al., 2013; Palmen et al., 2012).

Determining what interventions are evidence-based practices (EBP) for adolescents and adults with ASD, is critical in providing support for improvement of social-communication deficits in this population. They need complex and more specific skills than when they were a child. Not many researchers and intervention have stated about specific interventions to support them. There is a substantial minority of studies that focused on social-communication skills for individuals with ASD aged 12 years and up (Wong et al., 2014). None of literature review

provides an overall literature review across all social-communication intervention types as an EBP for adolescents and adults with ASD (Lounds Taylor, 2012; Wong et al., 2014).

The growing numbers of adolescents and adults with ASD indicated that researchers and educators need substantial support. It will be helpful for educators and families of this population to know which interventions are the most effective. There are several reasons for evaluating for methodological standards of studies supporting the intervention including to emphasize the current need for conducting high-quality research and to inform the need that should be addressed in the future research (Kratochwill et al., 2010; Morin et al., 2018; Reichow et al., 2008). One of the most critical reasons to evaluate the quality review of research is the researcher could use the criteria of the methodological quality to determine if that particular intervention meets EBP criteria. To conduct high-quality and well-reported research confirms that the research is valid for parents and/or educators who implement EBPs to their child rather than implement invalid intervention from the poor-quality methodology study (Horner et al., 2005; NTACTION, 2018).

All studies were reviewed to evaluate whether or not they meet the basic design standards (WWC). The basic standard levels of design criteria were used to review in the full-text stage. Then, all studies that meet the basic standard or meet the standard with reservation were evaluated for the extended methodological standards (i.e., participant description, setting and materials description, implementer description, baseline and intervention description, generalization, maintenance, procedural integrity, and social validity). Then, all the documents that met the extended methodological standard were evaluated with an evidence of quality indicators protocol (NTACTION, 2018). This quality indicators protocol consists of 21 criteria (Honer et al., 2005) to examine if the document showed sound evidence-based methodology

related to the criteria. Then, to determine whether or not this particular social-communication intervention can be considered an EBP, the researcher evaluated from the criteria of whether that intervention (a) has at least five documents that pass quality indicator across at least 20 participants, (b) consist of documents that shows functional relation and positive effects, (c) are conducted by at least three different research team members and authorship (NTACT, 2018). The purpose of the quality review is to apply the WWC guidelines to the literature of social-communication interventions for individuals with ASD. The research questions of this quality review are: (a) does the body of literature on using social-communication interventions to adolescents and adults with ASD meet the criteria for WWC basic standard review as outlined by Kratochwill et al. (2014; 2018); and (b) does the literature meet extended methodological standards (i.e., participant description, setting and materials description, implementer description, baseline and intervention description, generalization, maintenance, procedural integrity, and social validity)? (c) how many maintenance sessions and how long is the latency between cessation of intervention and maintenance data sessions? (d) how many generalization sessions and what types of generalization are targeted? (e) what social validity criteria are targeted? (f) does this body of literature for particular interventions meet the criteria for EBPs for any interventions to improve communication in adolescents and adults with ASD (NTACT, 2018)?

Method

Document Identification

The literature search procedures for the title/abstract and full-text stage were the same procedures as in the description of the companion study (chapter 2, meta-analysis paper). This study used the WWC basic design standards and extended-methodological standards to evaluate

documents that meet the criterias on both standards review (U.S. Department of Education [USDE], 2019). The magnitude of social-communication intervention effect for adolescents and adults with ASD related to moderators (i.e., intervention categories, implementer, communication function) were provided in the companion study (chapter 2, meta-analysis) paper.

Literature Search

On September, 2019, the author and a research librarian searched the concepts of keywords terms through the different databases in EBSCO which are PsycINFO, Academic Search Ultimate, MEDLINE Complete, ERIC, Education Source, CINAHL Complete, Education Full Text (H.W. Wilson), Social Sciences Full Text (H.W. Wilson), Communication Source, Sociology Source Ultimate, SocINDEX with Full Text. The research librarian used keywords and thesaurus terms to search for the concept in each database. The concepts are ‘autism’, ‘social-communication intervention’, and ‘participants' age of adolescents and adults. Approximately 2,106 documents were found, including articles, dissertations, and books, book chapters.

Inclusion/exclusion Criteria

Title and Abstract Stage

All documents were reviewed for title/abstract criteria by following exclusion criteria. We excluded any documents if: (a) document did not include individuals with ASD, (b) document did not state one of the interventions that improve social-communication skills (i.e., behavioral interventions [video model, model, prompt, discrete trial training], naturalistic interventions [pivotal response treatment, milieu, natural environment teaching, incidental teaching, joint action routine, behavior chain interruption], peer and parent mediated, and

augmentative and alternative communication), (c) document is not a SCED, (d) document is not peer-reviewed document, (e) document did not include participant age 12 years old and up, and (f) document is not written in English. If the information in the title/abstract stage was not clear to support the excluded decision, we kept the document into full-text stage.

Full-text Stage

Any documents that were not excluded from the title/abstract review stage remained into the full-text stage. The full-text inclusion criteria were (a) including individuals with ASD age of adolescents and adults (12 years old and up), (b) including SCED experiment that have a line graph of time-series data with at least three different points in time, (c) including at least three data points minimum of 6 phases across baseline and intervention phases, (d) including contents of inter-observer agreement (IOA) minimum of 20% of sessions and have a minimum score of agreement of 80% or 0.60 kappa agreement, (e) including a social-communication intervention applied for the individuals with ASD (e.g., Behavioral interventions, Naturalistic interventions, Peer and parent mediated intervention, Augmentative and Alternative Communication), (f) including written in English. See Figure 1 for the PRISMA flow chart of each search at each stage. They were excluded if studies used qualitative design, is a literature review, book reviews, meta-analysis, an informative/descriptive article, or anything other than SCED.

Variables Coding

Documents from the literature search were coded following these variables: (a) intervention categories (video modeling, augmentative and alternative communication (AAC), Peer-mediated intervention, behavioral skills training, and social skills training); (b) implementer (researcher, parent, peer, educator, etc.); (c) communicative function (behavior regulations, social interaction, joint attention, mixed communicative function); (d) setting (place of

employment, home, school, clinical, community). The author did not calculate the magnitude of effect in this study.

Design Quality Standards

Basic Design Standards

WWC pilot single-case design standards were used to review for evaluating whether or not the documents meet the basic design standards and standard for multiple-probe design. All SCEDs documents were reviewed by using WWC (Kratochwill et al., 2010, 2014, 2018) in the full-text stage and excluded documents that did not meet the criteria. Following are the standard levels of design criteria; (a) meets design standards, (b) meets design standards with reservations, or (c) does not meet standards. The six basic design standards are: (a) the document indicate a systematically manipulated independent variable; (b) the document was measured inter-observer agreement (IOA); (c) IOA was collected for at least 20% of data points across baseline and intervention phase; (d) IOA scores were reported for at least 80% or .60 kappa; (e) At least three attempts data points by phases changes were measured; (f) At least three data points per baseline and intervention phases and at least four data per intervention phase for alternating treatment design.

Extended Methodological Standards

All documents that did not excluded from the full-text stage and basic design standards stage were continued to the extended methodological standards stage. The extended methodological standards were developed by combining standards from expert panels (e.g., Council for Exceptional Children [CEC], 2014; Horner et al., 2005; and Reichow et al., 2008). The additional extended methodological standards were reviewed for different reporting criteria, which are participants (e.g., assessment, age, diagnosis, education services, recruitment), settings

(e.g., presence of other individuals in the setting, dimension, familiarity of participants, other individuals in the setting, descriptions of the context), materials (e.g., qualities, descriptions, examples of materials), implementers (e.g., educational background, experiences, familiarity with participants), procedures in baseline and intervention (e.g., description that could followed, length of session), the dependent variable (e.g., description of observation, data collection, recording data), maintenance (e.g., data points, implementing period time from intervention session), generalization (e.g., data points across phases, types of generalizations), procedural fidelity (e.g., reporting of procedural fidelity), percentage of IOA), and social validity (e.g., social significant and benefit, authentic settings for participants, types of social validity surveys, cost efficiency, feasible of intervention) description. Then, the standard levels of design criteria were identified include (a) meets design standards, (b) meets design standards with reservations, or (c) does not meet standards. After the extended methodological standards, the documents that meet the standards and meet the standards with reservation were descriptively summarized, focusing on the details of generalization sessions, maintenance sessions, social validity information that each document provided.

NTACT Quality Indicators and Evidence-based Practice (EBP)

After coding each study for the basic design and extended methodological standards, the evidence was further evaluated if each social-communication intervention (video-based instruction, AAC, peer-mediated intervention, behavior skills training, and social skills training) to teach social communication skills to adolescents and adults with ASD were an EBP following the National Technical Assistance Center on Transition (NTACT, 2018). First, quality indicators according to the guidelines of NTACT were used to evaluate each document prior to determining an EBP. Checklists from NTACT are developed based on suggestions outlined by Horner et al.

(2005). There are 21 checklists for SCED which are (a) participants, (b) setting, (c) dependent variable and measures, (d) independent variable and intervention, (e) procedures in baseline, (f) results, graphs, and design, (g) external validity, and (h) social validity. Only high and acceptable quality documents were considered to be EBP. The document was deemed high quality if the document met all the criterias; and the document was deemed acceptable quality if it met each of the first 17 criteria and at least one of the criteria regarding social validity. Then, in order to determine the EBP eligibility, documents are evaluated based on the following criteria: (a) must have at least five documents that are high or acceptable quality indicators with more than 20 total participants across documents, (b) must demonstrate positive effects for all documents, or at least a 3 to1 ratio between documents showing positive effects and documents showing neutral effects, (c) must be conducted across three different research teams for all documents. If there are any documents in that intervention that demonstrate negative effects, that intervention cannot qualify to be evidence-based.

Interrater Agreement

The primary coder (first author) evaluated all the documents in coding procedures (title/abstract, full-text, extended methodological review) and another three raters were randomly selected documents for 100% in the title/abstract stage, at least 30% in the full-text stage, at least 30% of extended methodological review stages, and at least 44% of NTACTION quality indicators to establish interrater reliability agreement. Before the independent coding stage, the first author trained raters to code in each stage until the reliability of the raters scores met 90% agreement. Retraining was taken whenever the rating score fell below 90%. The first author independently reviewed and/or discussed the discrepancy's solutions among other raters. Interrater agreement scores were calculated each review stage by using percentage agreement. The agreement scores

for title/abstract, full-text, extended methodological review stage, and NTACTION quality indicators resulted in 93%, 93%, 91% (75%-100%), and 93% (82%-100%) respectively.

Results

This quality review aims to review and summarize the literature of social-communication interventions for adolescents and adults with ASD. All literature that meet the basic standard criteria in the full-text stage were included to review for extended methodological review. A total of 41 single-case experimental design documents were reviewed and analyzed, including 17 multiple baseline design documents, 12 multiple probe design documents, 3 reversal design documents, 2 alternating treatment design documents, and 1 changing criterion design. See Appendix 2 for the summary of participants, dependent variables, and independent variables for each document.

Extended Methodological Standard Review

A total of 41 single-case experimental design documents were reviewed for each category (i.e., participant description, setting and materials description, implementer description, baseline and intervention description, generalization, maintenance, procedural integrity, and social validity) by using the extended methodological standards. All documents met the standard for the dependent variable description except one document that met the standard with reservation (Ali et al., 2019). For the materials, baseline and intervention procedures description, all documents met the standard or met the standard with reservation. Regarding descriptions of participants, settings, implementers, maintenance, generalization, procedural integrity, and social validity, ratings were mixed between met the standard with or without reservation and did not meet standard. The participant and setting descriptions did not meet standard 37% and 34% of the documents. In particular, the descriptions of maintenance, generalization, and social validity

were consistently poorly addressed across the articles related to extended methodological standard. See Table 6, which presents the extended methodological quality standard ratings for each experiment and a summary of all standards. See Table 7 for a summary of overall documents of extended methodological quality standards. Given the high proportions of experiments that did not meet standards for maintenance, generalization, and social validity, we have focused on examining those areas in more detail below. See Table 8 for a summary of maintenance, generalization, and social validity substandard.

Maintenance Description

There were only 9 documents (22%) that met the extended methodological criteria. All 9 documents included all the extended methodological criteria which are there were at least 3 maintenance data points per level and were collected at least 4 weeks following the conclusion of intervention. A total of 14 documents (34%) met the extended methodological criteria with reservation, including maintenance data were collected after intervention was implemented, but there were fewer than 3 data points, and/or maintenance data were collected less than 4 weeks following the conclusion of intervention. A total of 17 documents (41%) did not meet the criteria for maintenance description or did not collect maintenance data.

From those 23 documents that met the criteria with or without reservation were reviewed for the details for maintenance to describe for more details on the number of maintenance sessions and how long is the latency between cessation of intervention and maintenance data sessions. The results showed 12 documents (52%) that collect maintenance data with more than 3 data points and 11 documents (48%) that collect maintenance data with only 1-2 data points. For the next criteria, the latency between cessation of intervention and maintenance data sessions displayed 16 documents (70%) that collect some maintenance data for more than 4 weeks. For

the IOA criteria, there are only 2 documents (8%) out of 23 did not collect IOA for maintenance data. See Appendix 3 for description for the maintenance details.

Generalization Description

There were only 5 documents (12%) that met the extended methodological criteria for generalization description. All 5 documents included all the extended methodological criteria that included collecting generalization data during on baseline and intervention phases and there are at least 3 generalization data points per phase per level. A total of only 16 documents (39%) met the extended methodological criteria with reservation. The criteria standard with reservation included collecting generalization data only after the intervention and/or there were fewer than 3 data points for generalization data. A total of 20 documents (49%) did not meet the criteria for generalization description or did not collect the generalization data.

From those 21 documents that met the criteria with or without reservation were reviewed for the details for generalization to describe for more details on the number of generalization sessions and the types of generalization were targeted in each document. There are 8 documents (28%) and 10 documents (48%) that collect generalization data for 3 or more data points in baseline and intervention, respectively. About half of the documents collected more than one type of generalization such as contexts and people or contexts and materials. Only 4 documents out of 21 showed the generalization probes were conducted without interventionists present. See Appendix 4 for description for the generalization details.

Social Validity

There were only 4 documents (10%) that met the extended methodological criteria for social validity description and a total of 6 documents (15%) met the extended methodological criteria with reservation. The criteria standard for social validity also provided in Table 5. A total

of 31 documents (75%) did not meet the criteria for social validity description or did not collect the social validity. Those 10 documents that met the criteria with or without reservation were reviewed for the details for social validity to describe for more details on the type of social validity materials used in the study. All 10 documents met the criteria of social significance of the dependent variable, significant intervention effects, and criteria of implementing the intervention in an authentic setting. There is not any document that met the criteria of the intervention that was efficient and cost effective. For the two criterias of procedures satisfaction and the appropriate contextual fit of intervention, 5 documents (50%) and 8 documents (80%) met these criterias, respectively. See Appendix 5 for description for the social validity details.

NTACT Quality Indicators and Evidence-based Practice

Forty-one documents of social-communication interventions were grouped by intervention categories before coding for EBP: (a) video modeling (13 articles with 37 participants), (b) AAC (11 articles with 22 participants), (c) peer-mediated intervention (4 articles with 12 participants), (d) behavior skills training (4 articles with 12 participants), and (e) social skills training (4 articles with 8 participants). Video modeling and AAC intervention were considered to review for evidence-based due to only these two interventions including more than 20 participants across all documents (NTACT, 2018).

A total of 13 articles of video modeling intervention were coded for NTACT quality indicator. No documents met all NTACT quality indicators to evaluate as a high quality (met all the 21 quality indicators). A total of six documents (46%) were evaluated as acceptable quality (Detar, 2013; Plavnick et al., 2013, 2015; Rausa et al., 2016; Stauch et al, 2018; Whittington-Barnish et al., 2012). Seven documents (54%) failed to meet acceptable quality; three documents did not meet all quality indicator from 1-17 such as definition of physical settings (Kacaoz et al.,

2019; Miltenberger et al., 2015; Thirumanickam et al., 2018) and four documents did not meet at least one of the indicators for social validity (Allen et al., 2015; Day-Watkins et al., 2014; Mason et al., 2012; Williamson et al., 2013). Regarding AAC intervention, a total of 11 articles were coded for NTACTION quality indicators. The results showed there are no documents that meet all NTACTION quality indicators to evaluate as a high quality. Only two documents (18%) were evaluated as acceptable quality (Strasberger et al., 2013; Wendt et al., 2019). Nine documents (82%) failed to meet acceptable quality; they did not meet at least one of the indicators for social validity.

Afterwards, for determining the level of EBP, those documents of video modeling intervention and AAC intervention with acceptable levels of quality were evaluated for minimum acceptable quality documents, minimum participants number, positive effects, and number of authors' research team. Video modeling has been established as an EBP following this criteria: (a) having six documents eligible as acceptable quality indicators with 26 participants; (b) demonstrating positive effects for all documents; (c) conducting across seven different research teams (NTACTION, 2018). For AAC intervention, it was rejected to be an EBP due to having only 2 documents that met the acceptable quality indicators (NTACTION, 2018).

Discussion

This quality review analyzed 41 single-case experimental design documents by using WWC basic standard review (Kratochwill et al., 2014; 2018) in the full-text stage and extended methodological standards that were developed from different standards (e.g., Council for Exceptional Children [CEC], 2014; Horner et al., 2005; and Reichow et al., 2008). As a result of the analysis, the results showed important issues that need to be considered and addressed in this field of social-communication interventions for adolescents and adults with ASD in related to the

quality of the SCED. All documents received a rating of not meet standard for at least one standard. In particular, three of the extended methodological criteria were consistently poorly addressed across most of the articles: maintenance, generalization, and social validity.

Regarding maintenance description, there were several studies that did not collect data on maintenance or meet minimum extended methodological standard thresholds. Due to a lack of available data, we are unable to confirm that those social communication interventions that are the focus of this review demonstrated an ability to encourage maintenance of learned skills over time. These findings indicated that there is a need for researchers and implementers to plan for long term acquisition and maintenance of skills, collect maintenance data to encourage social-communication over time, and provide further instruction if maintenance is not occurring (Hong et al., 2019; Miller et al., 2014). Further, it is important to emphasize maintenance of interventions, especially for adolescents and adults with ASD related to their opportunities to practice and maintain skills learned from other implementers in settings in which their parents are present (Volkmar et al., 2014). The findings from parent and caregiver-assisted interventions demonstrated their success encouraging maintenance of learned skills over time, while the same was not true for other implementers (Volkmar et al., 2014). However, few of the social-communication intervention studies reviewed incorporate a parent-mediated intervention (Laugeson et al., 2012; Volkmar et al., 2014).

Additionally, almost half of the documents in this quality review failed to meet minimum extended methodological standard thresholds in the inclusion of and description of generalization assessment and strategies. There are few documents demonstrating generalization across at least two types of generalization (e.g., contexts, examples, people, materials) and almost none of documents stated the interventionist was not present during the generalization probe. This

finding is similar to previous literature that demonstrated that most social-communication skills for individuals with ASD were taught in structured, in authentic settings and that participants tended to have difficulty generalizing skills to untaught contexts (Reichle et al., 2005; Hong et al., 2018). These results also emphasize that we need to plan for, assess, and implement interventions with generalization of skills in mind throughout instruction to support individuals with ASD, including adolescents and adults, to develop and expand their communication skills to different contexts, people, and materials (Cooper et al., 2007; Hong et al., 2019). Encouraging generalization could also promote more opportunities to practice and produce social-communication skills for this population. Additionally, generalization probes should not include interventionists in the room to confirm that individuals apply skills in different contexts and with different interventionists and communication partners.

Furthermore, social validity is a critical concern that is highlighted by the low number of the included documents in this review that meet that standard. More than half of all documents did not meet the criteria for the social validity description or did not conduct social validity assessments. It is important to survey social validity from the participants, implementers and other stakeholders to make sure that the overall intervention outcomes and procedures are meaningful for them. This issue could guarantee that the strategies were adopted and maintained for participants and stakeholders (Horner et al., 2005; McNeill, 2019). Furthermore, it is particularly important to assess social validity from the viewpoint of adolescents and adults to make sure those interventions are meaningful for them (Hood et al., 2017).

Regarding NTAECT EBP, video modeling intervention has been established as an EBP to improve social-communication skills for adolescents and adults with ASD. This finding is expanded on prior studies (Bellini & Akullian, 2007) that qualified video modeling as an

evidence-based intervention with students with ASD; we also found video modeling intervention qualified as an evidence-based intervention in particular adolescents and adults with ASD.

Although prior studies demonstrate AAC as an EBP (Morin et al., 2018), AAC was not qualified to be EBP in this study focusing on adolescents and adults due to the limited number of documents that meet the NTACTION criteria standard.

Limitations and Future Research

Some limitations in this review need to be considered and addressed for the future research. First, the number of documents that collected and reported data on maintenance, generalization, and social validity related to social communication interventions for adolescents and adults with ASD was limited. Therefore, the author would encourage the researchers to report and increase the quality of their studies with relation to maintenance, generalization, and social validity in SCED. Second, we reviewed the methodological quality related to description and implementation of generalization and maintenance data recording, but did not review the evidence demonstrating skills were maintained and generalized. Thus, in the future, if more studies were available that include more data for maintenance and generalization of these skills, we could compare effect sizes between baseline generalization data and intervention generalization data, to determine improvement in generalization contexts or between intervention data and maintenance data to see their effects over time. In addition, the researcher and practitioner should promote generalizations across all phases (e.g., baseline, intervention, and maintenance) with an efficient number of data points per phase. Third, although we collected interrater agreement data for each quality criterion and the scores overall are more than 80% in each category, the social validity category had the lowest reliability due to inadequate social validity descriptions reported in each document. Future researchers also need to collect data for

more details on what types of social validity assessments were used and who is involved in collecting the social validity data. To conduct social validity is very important to the field to indicate that the intervention would be feasible and socially significant for all involved participants and also implementers; if key stakeholders do not deem an intervention to be feasible or acceptable, even the most effective strategies will not be adopted or maintained (McNeille, 2019). These supports proved that they are needed for researchers and practitioners to more purposefully develop and consider the components of intervention that are suitable and easy for participants and stakeholders (McNeille, 2019). Fourth, only both video modeling and AAC intervention could be considered for evidence based due to the fact that this intervention has more than 20 participants across documents. Other interventions were excluded from this process due to having research on too few adolescents and adults with ASD. Therefore, once we have more studies and participants in the future, these interventions should be considered to be EBP for improving social communication for adolescents and adults with ASD.

Clinical and Research Implication

The implications for clinicians are they should be supporting adolescents and adults with ASD to use generalization and maintenance for any activities in their daily routines, especially with their natural partners. There is evidence that parents and caregivers with adolescents and adults with ASD could be effective to generalize and maintain social-communication skills with their child rather than other implementers (Volkmar et al., 2014). For social validity purposes, clinicians should also encourage implementers and adolescent and adult participants to give input during the activities to develop their social-communication interventions to make sure that activities are meaningful for them (McNeill, 2019).

Regarding research implications, there is an urgent need for conducting more social-communication intervention research focused on adolescents and adults with ASD. In particular, there need to be studies focusing on applying maintenance, generalization, and social validity to qualify with the methodological standard. While currently there are only video modeling interventions that are qualified for EBP in terms of number of participants, there are not enough participants in other types of interventions (e.g., peer-mediated intervention, BST, and SST) for them to qualify as EBP. Different researcher teams need to conduct more research in other types of interventions with more participants. Then, those interventions are more likely to qualify to evaluate for EBP.

Table 6
Extended Methodological Quality Standard Ratings by Experiment

First Author	Design	Quality Criteria										
		Participant desc	Setting desc	Materials desc	IM desc	DV desc	Baseline desc	IV desc	Main desc	Gen desc	PI desc	SV desc
Ali (2009)	MPD	0	0	2	2	1	1	1	2	1	2	0
Allen (2015)	MBD	1	1	2	2	2	1	1	0	0	1	0
Bellinger (2012)	MPD	1	0	N/A	1	2	1	2	2	0	1	0
Boesch (2015)	CCD	2	1	2	2	2	2	2	0	0	1	0
Brown (2008)	MBD	1	2	2	1	2	2	1	0	1	0	0
Charlop-Christy (2002)	MBD	1	2	2	1	2	1	2	0	0	0	0
Day-Watkins (2014)	MPD	0	0	2	1	2	2	2	1	2	2	0
Detar (2013)	MBD	0	0	1	1	2	2	2	1	1	2	0
Dotson (2010)	MPD	0	1	N/A	1	2	2	2	2	1	2	0
Finke (2017)	MPD	0	0	2	1	2	2	2	1	1	2	0
Ganz (2014)	ATD	1	1	2	1	2	1	1	0	1	2	0
Gardner (2014)	ABAB	2	1	2	2	2	2	2	0	0	0	1
Grob (2009)	MPD	1	1	1	2	2	2	2	0	1	2	0
Hochman (2015)	MPD	2	1	2	2	2	2	2	0	1	1	2
Ingersoll (2013)	MBD	2	1	2	1	2	2	2	0	1	2	0
Kocaoz (2019)	MPD	0	0	2	1	2	2	2	1	0	1	2
Koegel (2014)	MBD	1	0	2	1	2	2	2	1	1	0	1
Kornacki (2013)	MBD	0	1	N/A	1	2	2	2	1	0	1	0
Kunnavatana (2018)	ABAB	0	0	2	1	2	2	2	0	0	0	0
Lorah (2015)	MBD	1	1	2	2	2	1	1	0	0	2	0
Lund (2008)	MBD	1	0	2	2	2	2	2	0	0	0	0
Mason (2012)	MBD	0	1	2	2	2	2	2	1	0	0	0
Merrill (2017)	MBD	1	1	2	1	2	2	2	1	0	2	0
Miltenberger (2015)	MBD	1	0	2	1	2	1	1	1	1	1	0
Murphy (2018)	MPD	0	1	2	2	2	1	2	0	2	2	0
Nepo (2017)	MPD	2	0	2	2	2	2	2	0	1	2	0

Table 6
Continued

First Author	Design	Quality Criteria										
		Participant desc	Setting desc	Materials desc	IM desc	DV desc	Baseline desc	IV desc	Main desc	Gen desc	PI desc	SV desc
Hui (2016)	MBD	1	2	2	1	2	2	2	2	1	1	0
Nuernberger (2013)	MBD	1	2	N/A	2	2	2	2	2	0	0	0
Plavnick (2015)	MPD	2	2	2	2	2	2	2	2	1	1	0
Plavnick (2013)	MPD	0	2	2	1	2	2	2	0	0	1	1
Radley (2015)	MPD	1	1	2	1	2	1	2	2	2	1	0
Rausa (2016)	MPD	0	2	2	1	2	1	1	1	0	0	1
Ryan (2019)	MPD	2	0	N/A	2	2	2	2	2	0	1	1
Sigafoos (2008)	ABAB	0	1	2	1	2	2	2	0	0	2	0
Sreckovic (2017)	MPD	2	1	2	2	2	2	2	1	0	1	0
Stauch (2018)	MPD	2	2	2	2	2	2	2	0	1	1	1
Strasberger (2013)	MBD	0	1	2	2	2	2	2	1	1	2	2
Thirumanickam (2019)	ATD	2	0	2	2	2	1	2	1	2	2	0
Wendt (2019)	MBD	2	1	2	2	2	2	2	2	2	1	0
Whittington-Barnish (2012)	MBD	2	1	2	2	2	1	2	0	0	2	2
Williamson (2013)	MPD	0	0	N/A	0	2	2	2	1	0	0	0
Meet standard		12 (29%)	8 (20%)	33 (94%)	20 (49%)	40 (98%)	29 (71%)	34 (83%)	9 (22%)	8 (12%)	16 (39%)	4 (10%)
Meet standard with reservation		14 (34%)	19 (46%)	2 (5%)	20 (49%)	1 (2%)	12 (29%)	7 (17%)	14 (34%)	16 (39%)	15 (37%)	6 (15%)
Does not meet Standard		15 (37%)	14 (34%)	0 (0%)	1 (2%)	0 (0%)	0 (0%)	0 (0%)	18 (44%)	20 (49%)	10 (24%)	31 (75%)

Notes: 2 = met the standard; 1 = met the standard with reservations; 0 = did not meet the standard

IM = Implementer, DV = Dependent Variable, IV = Intervention, Main = Maintenance, Gen = Generalization, PI = Procedural Integrity, SV = Social Validity

Table 7
Extended Methodological Quality Standard Ratings: Summary

Criteria	Number of documents
Documents that met all standard	0
Documents that met or met with reservations for all standards	0
Documents that at least one criteria did not meet the standard	41
Total of documents	41

Table 8
Maintenance, Generalization, and Social Validity Quality Substandard: Summary

Maintenance (23)				
	Maintenance Data Points per level	Latency between cessation of intervention and maintenance data sessions	IOA collected for % of Maintenance Data Points	IOA Min Thresholds
	>= 3 12 (52%)	Some collected >= 4 weeks 16 (70%)	>= 20% Disaggregated 4 (17%)	>= 20% Disaggregated 3 (13%)
	1-2 11 (48%)	<4 weeks 7 (30%)	>= 20% Aggregated 17 (74%) None collected 2 (8%)	>= 20% Aggregated 18 (78%) None collected 2 (8%)
Generalization (21)				
	Minimum Generalization Data Points per Level in Baseline	Minimum Generalization Data Points per Level in Intervention	Types of Generalization (Contexts, Exemplars, People, Materials, Other)	Was the interventionist present during generalization probes?
	>= 3 8 (38%)	>= 3 10 (48%)	Two types 10 (48%)	Yes 10 (48%)
	1-2 7 (33%)	1-2 9 (43%)	One type 11 (52%)	No 4 (19%)
	0 6 (29%)	0 2 (9%)		Unstated/ unknown 27 (33%)

Table 8
Continued

Social Validity (11)					
Social significance of the dependent variables (i.e. the target behaviors are beneficial to the participant and relevant to the context)	The change in behavior or intervention effects was clinically significant according to the criterion or goals set for individual studies (e.g., via checklist)	The intervention is implemented in authentic environments with persons who are authentic to the setting using materials normally found in the setting	The intervention was efficient and cost effective (e.g., as evaluated in a social validity checklist or report by implementer or other stakeholder)	All individuals involved, who were surveyed, are satisfied with the procedures and outcomes (e.g., via checklist)	The intervention was deemed be feasible, or to have an appropriate contextual fit for persons who are typically responsible for implementation and maintenance in authentic environments (by said implementers/key stakeholders)
Yes 11 (100%)	Yes 9 (82%)	Yes 11 (100%)	Yes 0 (0%)	Yes 5 (45%)	Yes 9 (82%)
No 0 (0%)	No 2 (18%)	No 0 (0%)	No 11 (100%)	No 6 (55%)	No 2 (18%)

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*Indicates studies included in the methodological quality review.

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CHAPTER IV

TELEPRACTICE PARENTS COACHING IN NATURALISTIC STRATEGIES TO INCREASE COMMUNICATION SKILLS FOR ADOLESCENTS AND ADULTS WITH AUTISM: SINGLE-CASE EXPERIMENTAL DESIGN

The reported autism spectrum disorder (ASD) prevalence shows the number has increased rapidly during the past decade across countries worldwide (Maenner et al., 2020; Davidovitch et al., 2013; Hansen et al., 2015; Neik et al., 2014). The prevalence of adolescents and adults with ASD has also markedly increased, and, as a result, the demand for services for this population are increasing, including social-communication skills instruction (Gerhardt et al., 2011; Hong et al., 2016).

Adolescents and any opportunities to rapidly improve their knowledge and skills to understand people and develop independence. However, there are some challenges such as the complexity of social- communication and more expectations for many adolescents especially individuals with ASD (Gates et al.,2017). All ages of individuals with ASD, especially adolescents, have social-communication difficulties and barriers to interact with others across a range of places and activities such as school, home, and community (American Psychiatric Association [APA], 2013; Ganz, 2015; Holyfield et al., 2017; Rao et al., 2008). These barriers can cause a lack of social skills and an increase in challenging behaviors. Adolescents and adults with ASD need more practice and expansion in complicated and involved language beyond typical communication for things that they need (Holyfield et al., 2017). There is a major dearth in the provision of and research on communication interventions, such as AAC, for individuals with ASD who are older than school-aged children (Cannella-Malone, 2018; Ganz et al., 2017).

Providing parents with evidence-based strategies, such as naturalistic strategies for increasing communication skills, are extremely important to the field. Many studies have shown that communication partners, including parents, can learn to implement naturalistic strategies effectively with their children with ASD across age ranges from preschool to high school levels (Franzone, 2009; Roberts & Kaiser, 2011). Parents and families have a crucial role in teaching communication with their children because they are more knowledgeable about their child and are present across communication contexts. However, there are few studies of parent coaching in any intervention for communication skills for individuals with ASD and IDD that include adolescents and adults with autism (Dogan et al., 2017; Hong, Ganz, Gilliland, & Ninci, 2014; Levinger, 2012).

Adolescents and adults with ASD require support in learning communication skills in their natural community setting (Palmen et al., 2012). Naturalistic strategies are evidence-based strategies on applied behavior analysis principles that parents could use to promote their child's communication skills in both verbal and non-verbal communication (Franzone, 2009; Hong et al., 2016; Wong et al., 2014). These strategies are designed to increase appropriate communication skills based on the children's interests by expanding their skills in their natural contexts and environments throughout the day within their occurring routines (Akamoglu & Dinnebeil, 2017; Wong et al., 2014). Many of the single-case experimental design studies often took place in the clinic or resource room that exclude participants from the natural settings, that could be the lack of teaching social skills (Nepo et al., 2017; Nuernberger et al., 2013). Thus, there remains a need for research on adolescents and adults with ASD, that is implemented in natural contexts.

Natural communication partners need to be involved as implementers in naturalistic strategies, to promote generalization and maintenance of skills (Hong et al, 2019). Generalization refers to how natural communication partners will provide strategies across different people, settings, and activities. Maintenance refers to how we will encourage the use of these strategies consistently over time (Hong et al., 2019). Parents of adolescents with ASD can learn and successfully teach naturalistic strategies in their home with the improvement of their children's communication and social skills (Kaiser & Roberts, 2013; Symon, 2005). Behavioral intervention skills that parents could implement in naturalistic environments include creating opportunities for their child to practice skills (Brown, 2016); modeling communication skills for their child to imitate; prompting new words by using verbal, visual, or physical guidance; prompt fading with time delay; and expanding language by adding new words to communicate (Schreibman et. al, 2016). Each of these strategies might be useful for parents to enhance and increase opportunities for individuals with autism to communicate.

Telepractice coaching is a tool used to increase parents' procedural fidelity for working with their children and decrease the gap between the available services and intervention requirements. Families of individuals with ASD often experience a discrepancy between the availability of services in their communities and their need for services (Kogan et al. 2008; Wainer & Ingersoll, 2015). The lack of services is often due to a lack of access in rural areas, or length of waitlists for services (Machalicek et al., 2016). In recent decades, the technology to support online meetings and the specialized services has developed rapidly (Ingersoll et al., 2016). Telepractice technology is used to exchange information between therapists and families through electronic communications and also to improve services to meet individuals' unique needs. Promotion of parent coaching via telepractice may decrease the inequitable discrepancy in

delivery of services across families of individuals with ASD. There are many studies that discussed effective coaching procedures for parents by using telepractice and reporting on children's behaviors (Bearss et al., 2018; Ingersoll & Wainer, 2013; Ingersoll et al., 2016; Vismara et al., 2018; Vismara et al., 2012; Wainer & Ingersoll, 2015), but few reported how well parents implemented intervention components (Wainer & Ingersoll, 2015). Although the strategies that we will use in this study have reported on effective ways of teaching individuals with ASD and their parents (Ingersoll et al., 2017; Ingersoll & Berger, 2015), there is a need for evaluating telepractice coaching with different ages, such as adolescents and adults, rather than focusing only on younger ages which are presented in most of the telepractice studies of coaching with caregivers (Wetterborg et al., 2019).

This study identified how educators could use telepractice intervention as a tool to implement naturalistic strategies for parents with adolescents with ASD at their homes. The conceptual orientation of this study is based on naturalistic strategies in applied behavior analysis and the principles of using telepractice tools. By individually coaching parents and giving them feedback via telepractice intervention, parents can increase the parents' behavioral skills and increase their children's communication skills. The purpose of this study is to evaluate the effects of a telepractice parent-coaching on naturalistic behavioral strategies used by parents of adolescents and adults with ASD. The research questions are: (a) Is there a functional relation between the telepractice parent-coaching intervention and parent strategy implementation to teach adolescents and adults with ASD to communicate?, and (b) Is there a correlation between the parent strategy implementation and the use of children's targeted communication skills?, and (c) what is the social validity for the parents with adolescents and adults with ASD for the intervention?

Method

Experimental Design

A single case experiment multiple probe design (Ledford & Gast, 2018) was conducted across five parent-child dyads. This design was used for the purpose of avoiding parent fatigue to record the videos during extended baseline phases. The three phases consist of baseline, intervention, and maintenance. The coach collected generalization at least 1 data point per phase across all dyads. Each dyad began the intervention session after a stable baseline and the increase of a child's behavior in intervention of the previous level. The coach used quality standards for single-case experimental design to develop the study (Council for Exceptional Children, 2014; Ganz & Ayres, 2018; Horner et al., 2005; Kratochwill et al., 2013; Reichow, Volkmar, & Cicchetti, 2008; USDE, 2019).

Participants

The study participants were recruited through Facebook, American social-media company, and the researcher's University's newsletter for possible participants who live in the U.S. Participants contacted the coach via email stating their interest in participating, with the coach contacting them back if they meet eligibility criteria. Five mothers from five families who had adolescents or adult children with ASD participated in the study. Inclusion criteria for parents included: (a) parent or guardian with children who were adolescent-aged or adults (12 years old and up) with a diagnosis of ASD; (b) parent with a high-speed internet and agreed to participate by using videoconference tool in weekly coaching sessions; (c) parent who is the main caregiver; (d) live in the United States (based on IRB requirement). Inclusion criteria for adolescents and adults with ASD included: (a) age 12 years and older; (b) have ASD screening tools that confirm the presence of their characteristic; (c) no physical impairments that could

prevent the individual who needs alternative and augmentative communication. Five parents applied to the project, however, after the second baseline sessions, two participants withdrew from the study. One participant gave the reason they do not think these strategies are helpful to their child, but the other parent did not give a reason. See Table 9 for the three parents and child demographics who continued and completed the study. Due to space restraints, the two dyads who dropped out are excluded from this report; however, one may contact the first author for this information.

Parents completed the assessments including: Autism Spectrum Rating Scale (ASRS) (Goldstein & Naglieri, 2009), assess in total symptoms, social communication, and peer and adult socialization domains; Social Communication Questionnaire (SCQ) (Rutter, Bailey, & Lord, 2003), a screener for children exhibiting symptoms of ASD; and Vineland Adaptive Behavior Scales, Second Edition, Interview Form (Vineland-III) (Sparrow, Balla, & Cicchetti, 2016), results are standardized into a V-scale score with percentiles and age equivalents and measures in communication, social interaction, and daily living skills. Dyad C was not required to complete this ASRS because he did not meet the age criteria for the assessment (more than 18 years old). See Table 10 for participant assessment scores.

Dyad A: Adora and Adrian

Adora, the mother of Adrian, received some parent-training sessions from the therapists several years ago when Adrian was in kindergarten. This family had a teenage girl, Adrian, who was diagnosed with ASD, ADHD, and specific learning disabilities. Adrian was able to communicate by answering questions but lacked two-way communication skills with another communicative partner. For generalization sessions, Adrian's younger sister participated in the conversation with Adora and Adrian. This family lived in Missouri.

Dyad B: Banita and Bane

Banita, the mother of Bane, never received any parent-training, behavioral instruction, or worked with other individuals with disabilities, prior to intervention. This family had a teenage boy, Bane, who was diagnosed with ASD and intellectual disability. Bane had speech sounds that are difficult to understand by those not familiar with the child. He could have said only one word “ha” for “hug”. He was unable to independently communicate for needs and wants. This family lived in Texas.

Dyad C: Carly and Camilo

Carly, the mother of Camilo, had received in-home parent-training from speech-therapist with picture-exchange when Camilo was in kindergarten school, but never received telepractice training before. They had an adult son, Camilo, who was diagnosed with ASD. Camilo was able to communicate by requesting and answering questions but delayed and lacked two-way communication skills. For generalization sessions, Camilo’s younger brother participated in the conversation with Carly and Camilo. This family lived in Michigan.

Settings, Materials, and Session Contexts

Parents participated in both online webinars and live synchronous individual coaching sessions in their homes via their computers or tablets. The coach provided treatment plans and individual feedback to parents via videoconference telepractice program. After parents received feedback of implementation from the coach, each parent practiced and implemented the skills during the week in their living room (Dyad A, B, and C), kitchen (Dyad A), and dining room (Dyad B). The coach encouraged parents to practice the skills during any activities as much as they could in their natural routines.

The varieties of toys and activities were chosen by parents and used during all data collection sessions while practicing communication skills. Dyad A used a child's preferred activities, for example, cooking and talking about her favorite things from school. Dyad B and C used their preferred toys such as balls, puzzles, movies, or games. The augmentative and alternative applications on tablet computers were used for Dyad B. This material was created and displayed on an iPad using the GoTalk NOW application (Attainment Company, 2012).

All parents completed the 1-hour online webinar. This session consisted of self-paced learning modules (e.g., pre- and post-test, verbal instruction, examples of how to implement the skills, and a handout) from the Coach to Communicate (C2C) project. The contents of the webinar are described below, in Procedures. Then, each parent was coached through the telepractice program (Zoom) from their computer or tablet on how to use behavioral intervention skills in their natural routines with their child.

Parents recorded and uploaded two 3-minute videos per week implementing their behavioral intervention to improve their children's targeted communication skills. The coach provided weekly feedback via the written sheet, graph, and verbal instructions while watching recorded videos with parents each week. The sessions of parent coaching were approximately 1 hour per meeting. The coach met parents via videoconference every one or two weeks, depending on their schedule.

Coach

The first author served as a parent coach. She was a third-year doctoral student in the special education program at the time of conducting the study. She had experience working in communication skills with individuals with ASD for eight years and received training in the Applied Behavior Analysis intervention components. She obtained a Bachelor of Education in

Early Childhood and Master of Science in Special Education. There is no prior relationship between the coach and all participants in the study.

Measures

Dependent Variables (DVs) and Measurement

The primary DV was parent strategy implementation (e.g., incentivizing communication, modeling, prompting, expanding) for use of any of the strategies during a recording interval. The secondary DVs were individuals' targeted communication skills (e.g, asking questions, requesting items, and expanding answers). We calculated and graphed any children's targeted communication skills (which included both prompted plus independent behaviors) and independent targeted communication skills. Both DVs were measured by using 10-second partial interval video recording for 3-minute lengths. The coach and the observers collected data from the recorded videos. The percentages were measured and calculated by dividing the interval of behaviors' occurrence with the total overall of 3 minutes interval (18 intervals), then this number was multiplied by 100 to calculate percentages. See Table 11 for operational behavioral definitions of parent and child behaviors.

Study Procedures

Parents received an online webinar session for 1 hour to learn about the basic information of communication strategies before enrollment in the study. The online webinar was self-paced learning that parents could access anytime at their convenience. The contents of the webinar included the strategies and examples of scenarios which parents could implement to their child at home (e.g., incentivizing communication, modeling, prompting, time-delay, expanding). The instructional activities were verbal instruction through slide handouts, scenarios examples, practice activities, and pre- and post-quiz assessments.

Baseline Phase

The coach did not give any implementing strategies, feedback, or any interventions to participants. The coach requested parents to record and upload two 3-minute videos per week before the coaching sessions began to show their usual communication with their child. For Dyad C, parents were allowed to provide communication devices that they usually used with the child.

Coaching Behavioral Intervention Phase

The coach created the written treatment plan and discussed the children's communication goals based on parents' priorities before starting the individual coaching sessions. The coach provided coaching sessions through videoconference program (i.e., Zoom) for approximately one hour per week per session for a total of 8 sessions. Each parent was coached behavior intervention strategies for improving communication which are incentivizing communication, modeling, prompting, time delay, and expanding. The coach provided written feedback regarding parents' performance in the previous video, highlighting pointers for how to better implement some of the strategy's steps. The coach also provided verbal instructions regarding the written feedback, models how to perform the skills highlighted in the feedback sheet, practiced role play how to perform the skills, and explained the graph to the parents in the easy way to understand. If the data of parents' behaviors and individuals' behaviors were improved compared to baseline increased in the last 3 coaching sessions, the coach will decided to start a maintenance session; however, if the coach and parent decided more coaching was needed due to minimal or no improvement, coaching was extended for 2 sessions prior to the maintenance phase.

Maintenance

Following the last session of the coaching session, the coach conducted maintenance sessions by receiving the 3-minutes recorded videos from parents for 2 data points at 3 and 6 weeks. Parents still implemented the behavioral intervention to their child without receiving any coaching sessions from the coach. However, the booster instructions session, same strategies as the coaching behavioral intervention session, were provided after the last maintenance session (week 6) if the data in maintenance sessions were decreased. The goals of communications in the maintenance phase were the same as the goals in the intervention.

Generalization

Each parent implemented behavioral intervention skills to their child across different activities and communicative partners based on their preference but different from coaching phases, selected in discussion between the parent and coach. The coach requested parents to implement and record 3-minutes videos across baseline, intervention, and maintenance phase for 1-3 sessions. For Dyad A and C, the parents implemented skills in the generalization phase with different communicative partners (i.e., father and sister for Dyad A, brother for Dyad C). For Dyad B, the parent implemented skills in the generalization phase with different activities and setting (dinner or snack time).

Inter-observer Agreement (IOA)

The coach measured IOA for at least 27% (27%-50%) of data points within each phase of baseline, coaching intervention, maintenance, and generalization phases or data for each participant. IOA were collected by three coders who were doctoral students in special education. Before each coder independently conducted IOA, they were trained on the definition operation of behaviors and skills by the coach (the first author) to obtain 80% or higher of IOA scores. IOA

scores of agreement were calculated by dividing the overall agreed number from both coders by the sum of agreement and disagreements, then multiplied by 100 to receive the percentage. See Table 12 for the average IOA score of each parent. Overall IOA score was greater than 80% for all parents' observation for each phase (e.g, baseline, intervention, maintenance).

Procedural Fidelity

All video conference meetings of baseline and intervention sessions were recorded during the coach implementing the skills to each parent. The videos were randomly chosen from each phase (baseline and intervention) by the coach for the procedural fidelity purpose. Two observers watched the videos and evaluated the coach's fidelity from the recorded videos. Both baseline and intervention phases were collected for procedural fidelity for at least 25% (25%-100%). All procedural integrity scores for each session found to be 100% accuracy across all participants. Procedural integrity IOA scores also collected for at least 30% of sessions and recorded 100% accuracy across all sessions. Procedural fidelity data were broken by each phase and participants. See Appendix 6 and Appendix 7 for procedural fidelity checklists for baseline and intervention.

Social Validity

There are two social validity anonymous parent surveys were collected to measure the feasibility and efficiency of the telepractice parents coaching in behavioral intervention via naturalistic intervention strategies intervention in families with adolescents and adults with ASD. The first survey, a short checklist and answer survey, were collected during the intervention sessions (every other intervention session per week). The short survey included 4 items that parents could response on 5-point Likert scale out of 5.00 (e.g., 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree) and three open-ended questions to ask parents about the feasibility of parent coaching intervention and their additional comments. The researcher

used the results score and comments from this weekly survey to adapt the followed intervention sessions. The second survey, a long checklist and answer survey, were collected after the last session of coaching intervention session. The long survey included 18 items and four open-ended questions. The short and the long survey were developed from the Treatment Evaluation Inventory Short Form (TEI-SF; Kelley, Heffer, Gresham, & Elliott, 1989) and Parent Satisfaction Survey (Washburn, 2012). See Appendix 8 and 9 for the social validity surveys.

Data Analysis

Visual Analysis

Data of both DVs, parent implementation of skills and individuals' behaviors, were graphed. The data were analyzed for level, trend, and variability of data points, across and within phases, including baseline, intervention, and maintenance.

Effect Size

The effect size calculation was chosen for evaluating the degree of the effects between baseline and intervention phases for each parent and child dependent variable while adjusting for undesirable baseline trends. Tau-*U* was used for calculating effect size with the range -1.0 to 1.0 for each parent implementation of each intervention component and each child's communication behaviors (Vannest, Parker, Gonen, & Adiguzel, 2016). Tau-*U* is a measure of the magnitude of effects of an intervention, which can adjust for baseline trends and control for unexpected baseline trends. Moreover, Tau-*U* is chosen because it is robust, defensible, and demonstrates strong correlations with visual analysis when calculating effect sizes (Parker, et al., 2011a; Zimmerman et al., 2018). A negative effect size score presents a decrease of both dependent variables, and a positive effect size score presents an increase of both dependent variables (Parker, Vannest, & Davis, 2011).

Correlation

Correlation data will be reported by using the Pearson's correlation coefficient (r) in STATA® (StataCorp, 2017) to determine the relationship between use of parent strategy implementation (e.g., incentivizing, modeling, prompting, and expanding) and children's target communication skills. Children's targeted communication skills variables are distal outcomes; therefore, we cannot make a decision regarding the presence of a functional relation between the coaching intervention and child outcomes; however, we report the correlation to provide insight on the appearance of the children's communication skills alongside the parents' use of targeted strategies for instruction of their children.

Results

The researcher established a functional relation between the intervention (i.e., telehealth parent-coaching) and parent strategy implementation (i.e., incentivizing, modeling, prompting, and expanding) with three demonstrations of effect (see Figure 8). Although there was some variability across all three participants, there was a positive level change for all three participants for use of any parent strategy implementation between baseline and intervention. All three parents' data seem to have fairly level trends in data compared to baseline to intervention phase. The omnibus Tau- U for use of parent strategy implementation was 1.00*, indicating the telepractice coaching intervention had a strong effect (see Table 13).

Figure 9 displays data for children, Adrian, Bane, and Camilo, on use of any children's targeted communication skills (prompted plus independent) and independent targeted communication skills. There was a positive level change and increasing trend for all three participants for targeted communication skills comparing baseline to intervention phases. For independent targeted communication skills in children, the overall omnibus Tau- U was 0.80*,

indicating 80% of all sessions displayed improvement between baseline phase and intervention and had a moderate to strong effect (Table 14).

Generalization probes conducted across different people and settings are also included across baseline and intervention sessions for all three dyads. The data for both parents and children in generalization probes in each phase are similar in level to the baseline, intervention, and maintenance phase data for the targeted contexts and people. The findings of correlation indicated a significant strong positive correlation between overall parent strategy implementation and their children's targeted communication skills.

Visual Analysis and Effect Size

Parent Strategy Implementation

Adora's used none of parent strategy implementation during baseline. Banita and Carly used some of the skills, but at low levels during baseline. During the intervention phase there was moderate variability and an increasing trend. For all three parents, there was an immediate positive level change between baseline to intervention and these levels are maintained from intervention to the maintenance phase. Overall, the data in all phases were variable, with the exception of their baseline. This was as anticipated, due to implementation by natural communication partners and the authentic contexts in which this intervention was implemented. Generalization data overall are similar to the primary dependent variable data in baseline, intervention, and maintenance phases. The overall Tau-*U* for use of parent strategy implementation was 1.00* with CI [0.60, 1.00]. The Tau-*U* for each participant; Adora, Banita, Carly; was all 1.00* with CI [0.36, 1.00], CI [0.47, 1.00], and CI [0.47, 1.00], respectively.

Children's Targeted Communication Skills

During the baseline phase, Adrain's and Camilo's independent communication skills showed at very low levels with stable trend and little variability. For Bane, there are no communication behaviors during baseline. During the intervention phase, there was an immediate positive level change between baseline to intervention and these levels are maintained from intervention to the maintenance phase for all three participants. For all participants, generalization data overall are similar to the primary dependent variable data in baseline, intervention, and maintenance phases with the exception of one generalization data point at 0% in the intervention phase for Adrain and Camilo. The effect size for Adrian, Bane, and Camilo demonstrated a moderate effect size of 0.58 [-0.07, 1.00] ($p = 0.14$) for asking questions, a high effect size with 0.82* [0.29, 1.00] for requesting items, and a high effect size with 0.96* [0.44, 1.00] for making a statement to expand his answer.

Correlation

The Pearson's correlation coefficient indicated a significant strong positive correlation between omnibus parent strategy implementation (i.e., incentivizing, modeling, prompting, and expanding) and their children's use of anytargeted communication skills (prompted plus independent) ($r = .786, p = .000$). Also, there was a moderate positive correlation between parent use of all behavior intervention skills and children's independent targeted communication skills ($r = .568, p = .000$). See details for the results of the correlational analysis in Table 15. See Figure 10 for a scatter plot of Pearson's correlation between parents' use of behavior intervention skills and children's targeted communication skills.

Social Validity

Parents provided overall positive feedback on the two parent surveys, indicating agreed

or strongly agreed on all items. An average score of 4.52 (range = 4.00 - 5.00) out of 5.00 was obtained for the short surveys across three parents, given at three different times during the intervention sessions. All three parents provided consistently positive feedback during the interventions (e.g., *“This is great fun and very helpful for my child!”*, *“Child asks many more independent questions than prior to intervention”*). There were no changes needed related to intervention procedures, based on parent comments during intervention.

The long survey collected at the end of the study had an average survey score of 4.50 and 4.76 (range between 4.00-5.00) out of 5.00 for the webinar sessions and individual coaching sessions, respectively, which indicated that parents agreed and strongly agreed to the benefits of the intervention. All parents rated the highest scores with strongly agreed related to the ease of intervention to use at home with their child, the helpfulness of coaching strategies to improve interactions with their children, and efficiency and cost-effectiveness of the telepractice parent coaching. Parents provided written feedback that indicated they were satisfied with the parent coaching intervention and there is nothing that they want to change. For example, parents mentioned *“I have more opportunity to talk to my son, it was very impressive”*, *“He can talk about what he is going to do or what he wants to do”*, *“Good experience that we can talk to each other.”*

Discussion

The overall results from this study indicated positive effects of using telepractice parent coaching in naturalistic strategies to teach parents of adolescents and adults with ASD in communication skills with their children. The findings demonstrated a clear functional relation between telepractice parent coaching to parent strategy implementation and showed an

improvement of their children's communication skills. The findings were consistent across all of the parent participants who completed the intervention. It is also notable that their children's increasingly independent use of communication skills as their parents increased their use of behavior components.

These findings are consistent with previous research which found that telepractice parent coaching are effective procedures for children ages 3-8 years (Bearss et al., 2018; Vismara et al., 2018; Wainer & Ingersoll, 2015). Furthermore, this work further demonstrates that parents with adolescents and adults can be successfully coached to implement communication skills to their children with a satisfactory degree of fidelity (Hong et al., 2019). Thus, the finding from the current study showed that a telepractice parent coaching procedure can also lead to an increase in social and communication behavior for adolescents and adults diagnosed with ASD. We also measured the distal child outcomes and assessed the correlation between parent implementation and child's communication skills. Further, there are few prior studies on the parent coaching in any intervention for communication skills for individuals with ASD and IDD that included adolescents and adults with autism (Dogan et al., 2017; Hong et al., 2014; Levinger, 2012).

This work makes a number of unique contributions to literature. One of the strengths of this work was the delivery of training on naturalistic strategies from a distance via videoconference, allowing for acceptability, saving time and money, and assistance for reimbursement from the insurance/services (Heitzman-Powell, 2014). Telepractice procedure has potential to support in-person coaching interventions and can help researchers and professionals to outreach to many families in rural areas without increasing time and cost (Akemoglu, 2019). Another unique point for this work was the collection of the social validity surveys during the intervention to determine the parents' understanding of the content and activities in the parent

coaching sessions. The survey also determined how feasibility and social significance affected their child at home every week during the intervention. The result of the survey allowed us to know if the parents were unsatisfied with the intervention. Moreover, social validity could be the tool that parents use to review themselves and how they implement the necessary skills throughout the intervention. Researchers should evaluate the social acceptance and feasibility of telepractice services; it can help researchers understand whether this mode of service delivery is acceptable or not (Akemoglu, 2019).

Implications for Practice and Research

Some implications of this work can be noted. Using the telepractice parent-coaching procedure could provide efficient and cost-effective services and save travel time for families to receive services (Benson et al., 2018; Heitzman-Powell, et al., 2014). There are very few services that focus on communication skills for adolescents and adults with autism. This intervention can help parents of this population to address their child's communication skills and implement services in their natural settings. Research suggests that naturalistic strategies have the potential to increase social and communication skills in adolescents and adults with autism (Ingersoll et al., 2013; Zeedyk et al., 2009). Lastly, it is very important to provide high-speed internet access to families of children with ASD to support their access to intervention services in rural areas at an acceptable price.

Limitations

There are some limitations in this study. First, the study reported both parents and child outcomes (distal targets); however, we are not able to implement a functional relation between telepractice parent coaching and their children's (distal) outcomes. Second, the data on parents implementation were highly variable, which was in our expectations because parents were

instructed to teach their child in authentic and natural environments; however, this makes visual analysis more challenging. Third, there were technical issues for one parent of recording and uploading the videos due to the size of the files and her phone's available space; this was resolved; however, is indicative of the limitations of this work given disparities in technology access for parents. Fourth, although we collected parents' social validity surveys during the intervention and at the end of the intervention, we did not collect social validity surveys for the child participants. Last, we cannot confirm how often the parents practiced parent strategy implementation during the week outside of the recorded video due to the fact that we requested only 3 minutes length for 2 videos per week. Also, we do not know if parents recorded several videos and uploaded the perfect videos in which parents used many parent strategies.

Future Research

This study suggests several areas for future research. First, the results of this study showed that educators could use telepractice coaching intervention for parents with adolescents and adults with ASD to implement naturalistic strategies in social communication skills; however, researchers could extend telepractice coaching to different skills such as conducting functional analyses of problem behavior or conducting in-home functional communication training to teach adolescents and adults, specifically (Suess et al., 2014; Wacker et al., 2014). Second, a further parent coaching study is needed in order to develop efficient and acceptable interventions to solve the barriers that parents with adolescents and adults with ASD met during the telepractice intervention procedure. Researchers also needed to find out the best strategies for educators to provide telepractice coaching to parents. Third, we conducted generalization sessions in this study with only one type of either different activities or different people. Further studies need to conduct generalization sessions in many types of contexts, materials, activities,

and people to expand the communication behaviors of adolescents and adults with ASD. Fourth, not only parent participants should provide feedback on the social validity surveys, but also adolescent and adult participants should have opportunities to complete the surveys to determine whether or not the parent coaching intervention was considered socially acceptable.

Conclusion

This current study extends prior research by including parents with adolescents and adults with ASD and examining the effects of telepractice parent coaching in naturalistics strategies intervention in communication skills for their children. Overall, findings from this study showed that parents of adolescents and adults with ASD were able to be coached and maintain the use of communication skills for their children after the intervention. This shows that parents are able to be an effective coach for their adolescents and adults with ASD.

Figure 8
Any Use of Parent Strategy Implementation (e.g., Incentivizing, Modeling, Prompting, and Expanding)

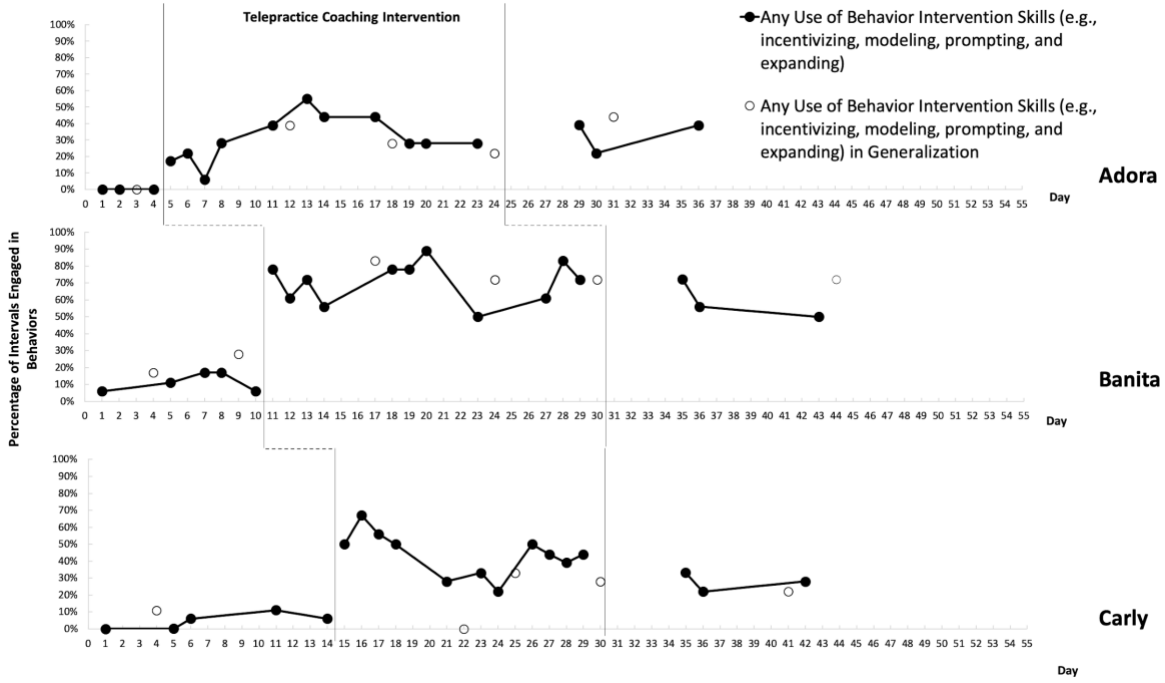


Figure 9
Children Targeted Communication Skills

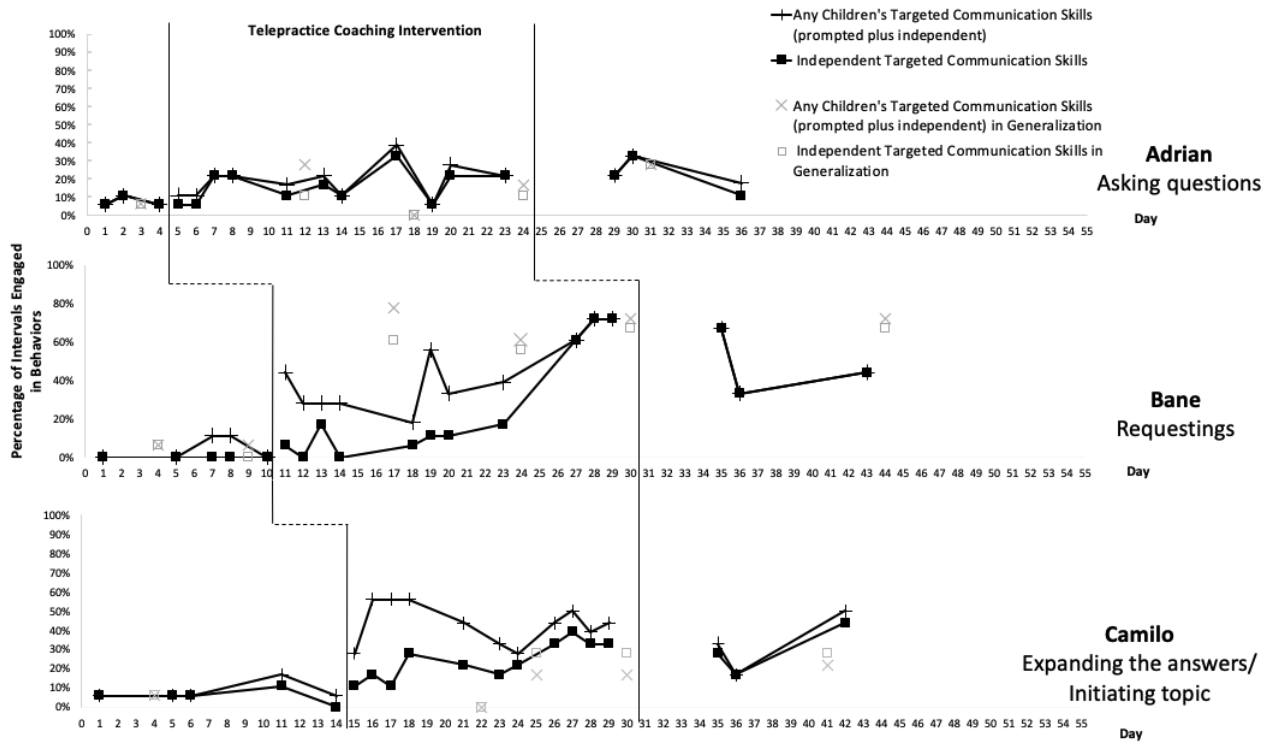
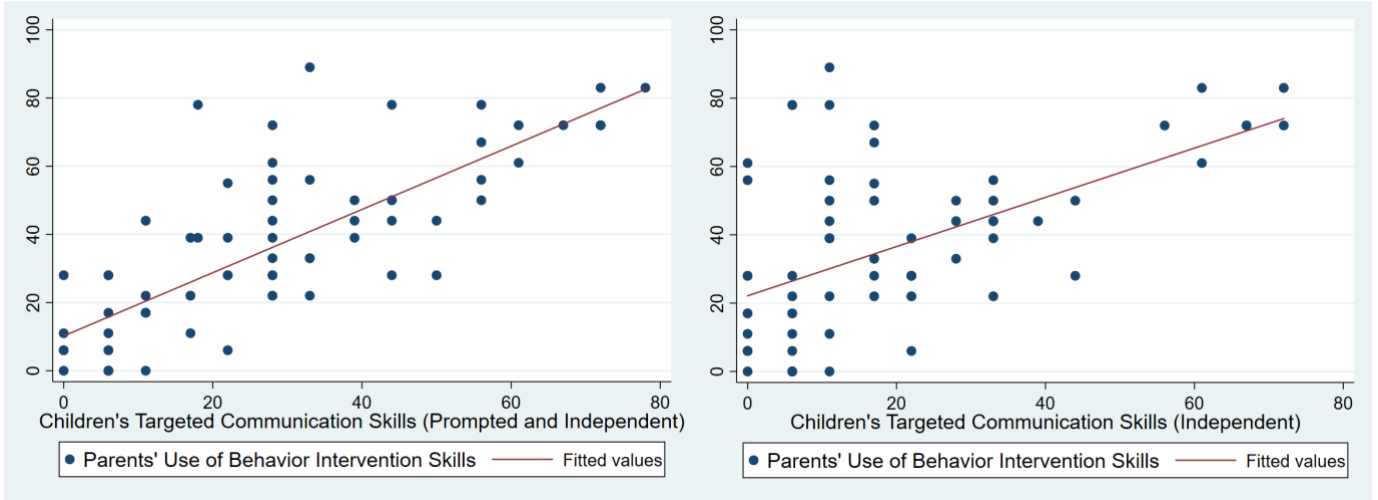


Figure 10

Scatter Plot of Pearson's Correlation between Parents' Use of Behavior Intervention Skills and Children's Targeted Communication Skills with Prompted and Independent (Left Graph) and Independent (Right Graph)



($r = .786^{***}$)

($r = .568^{***}$)

Table 9
Parents and Children Demographics

	Types of Participant	Name	Gender	Age	Race	Education Background	Previous Online Training
Dyad A	Parent	Adora	Female	44	Caucasian	High school	Yes
	Child	Adrian	Female	13	Caucasian	Middle school	
Dyad B	Parent	Banita	Female	45	Asian	Master's	No
	Child	Bane	Male	15	Asian	High school	
Dyad C	Parent	Carly	Female	60	Asian	Doctorate	No
	Child	Camilo	Male	26	Asian	High school	

Note. Previous Training = Previous training in behavior therapy or working with individuals with ASD.

Table 10
Summary of Formal Assessment Results for Participants

Parent Participants		Adora (age 44)			Banita (age 45)			Carly (age 60)		
Gender		Female			Female			Female		
Race		Caucasian			Asian			Asian		
Education Background		High school			Master's			Doctorate		
Child Participants		Adrian (age 13)			Bane (age 15)			Camilo (age 25)		
Gender		Female			Male			Male		
Race		Caucasian			Asian			Asian		
Education Background		Middle school			High school			High school		
Test& Domain	Standard Scores_a	%tile	Descriptor	Standard Scores_a	%tile	Descriptor	Standard Scores_a	%tile	Descriptor	
ASRS _b Total	74	99	very elevated	73	99	very elevated	n/a	n/a	n/a	
ASRS Social Communication	61	86	Slightly elevated	82	99	very elevated	n/a	n/a	n/a	
Vineland-3 _c Communication	76	5	Moderately Low	28	<1	Low	57	<1	Low	
Vineland-3 Socialization	77	6	Moderately Low	34	<1	Low	38	<1	Low	
SCQ _d Total	15	-	ASD cut-off	21	-	> ASD cut-off	17	-	> ASD cut-off	

^aScores on the ASRS are T-scores; ^bASRS- Autism Spectrum Rating Scale (Goldstein & Naglieri, 2009); ^cVineland Adaptive Behavior Scales-3 (Sparrow, Cicchetti, & Saulnier, 2016), ^dSCQ- Social Communication Questionnaire (Rutter, Bailey, & Lord, 2003)

Table 11

Definitions of Operational Behavior for Each Parent and Child

	Parent behavior	Children Behaviors, Settings, Materials, and Generalization Details
Dyad A (Adora and Adrian)	<p>Incentivizing Communication</p> <ul style="list-style-type: none"> · Introduce news items or news topic to practice communication skills · Give a child social praise when a child asks the questions <p>Modeling</p> <ul style="list-style-type: none"> · Verbally model questions to the child <p>Prompting</p> <ul style="list-style-type: none"> · Verbally prompt the child to ask questions (e.g., “Ask me ___”, “Say ___”) <p>Expanding</p> <ul style="list-style-type: none"> · Model or prompt for longer questions or different types of questions. 	<p>Asking questions goals</p> <ul style="list-style-type: none"> · The child asks context-appropriate questions to communication partners. <p>Setting</p> <ul style="list-style-type: none"> · Natural setting inside the house (i.e., living room, kitchen, and dining area). <p>Materials</p> <ul style="list-style-type: none"> · The child’s preferred items or activities (i.e., cooking, talking about her favorite items). <p>Generalization</p> <ul style="list-style-type: none"> · Having a conversation with her sister and dad.
Dyad B (Banita and Bane)	<p>Incentivizing Communication</p> <ul style="list-style-type: none"> · Introduce news items or news toys to practice communication skills · Give a child social praise when a child requests item <p>Modeling</p> <ul style="list-style-type: none"> · Verbally model requesting items or model how to use AAC (i.e. pressing the icon on the tablet) <p>Prompting</p> <ul style="list-style-type: none"> · Verbally prompt the child to request items (e.g., “Say___”, pointing to the icon on the tablet) <p>Expanding</p> <ul style="list-style-type: none"> · Model or prompt for longer words requesting 	<p>Requesting items verbally or using AAC device</p> <ul style="list-style-type: none"> · The child requests by using at least one word verbally or by using AAC for the item he wants. <p>Setting</p> <ul style="list-style-type: none"> · Natural setting inside the house (i.e., living room bedroom, and dining area for generalization session). <p>Materials</p> <ul style="list-style-type: none"> · The child’s preferred items (i.e., ball, puzzle, flashcards). · Tablet with the AAC application (Go Talk Now) <p>Generalization</p> <ul style="list-style-type: none"> · Requesting items in different activities (e.g., dinner time)
Dyad C (Carly and Camilo)	<p>Incentivizing Communication</p> <ul style="list-style-type: none"> · Introduce news items or news topic to practice communication skills · Give a child social praise when a child expand his answer or initiating topic <p>Modeling</p> <ul style="list-style-type: none"> · Verbally model sentences to the child <p>Prompting</p> <ul style="list-style-type: none"> · Verbally prompt the child to expand his answers (i.e., “Say___”, “Tell me more about him”) <p>Expanding</p> <ul style="list-style-type: none"> · Model or prompt the child for a longer sentence 	<p>Expanding his answer or initiating topic</p> <ul style="list-style-type: none"> · After communication partners ask questions to the child, the child verbally answers the question and also makes a statement to expand his answer or initiating topic with his communication partners. <p>Setting</p> <ul style="list-style-type: none"> · Natural setting inside the house (i.e., living room and bedroom). <p>Materials</p> <ul style="list-style-type: none"> · The child’s preferred items and activities (i.e., games, movies). <p>Generalization</p> <ul style="list-style-type: none"> · Having a conversation with his brother.

Table 12

Inter-observer Agreement: Average Percent Agreement of Each Dyad

	Dependent Variables	Sessions	Adora-Adrian Mean (range)	Banita-Bane Mean (range)	Carly-Camilo Mean (range)
Parent Strategy Implementation	Incentivizing Communication	Baseline	83	100	100
		Intervention	96 (89-100)	85 (78-89)	88 (78-94)
	Model	Maintenance	94	83	94
		Baseline	100	100	100
Children's communication skills	Independent communication skills	Intervention	96 (89-100)	95 (89-100)	90 (83-94)
		Maintenance	94	94	89
	Any communication skills (prompted plus independent)	Baseline	100	94	100
		Intervention	96 (89-100)	91 (78-100)	85 (72-94)
		Maintenance	100	100	100

Table 13
Effects on Parent Strategy Implementation Intervention Skills

		Tau-U	LL CI 90%	UL CI 90%
Any Components of Parent Strategy Implementation	Adora	1.00*	0.36	1.00
	Banita	1.00*	0.47	1.00
	Carly	1.00*	0.47	1.00
	Omnibus Effects	1.00*	0.60	1.00
Incentivizing Communication	Adora	0.82*	0.18	1.00
	Banita	1.00*	0.47	1.00
	Carly	0.98*	0.45	1.00
	Omnibus Effects	0.94*	0.55	1.00
Modeling	Adora	0.45	-0.19	1.00
	Banita	0.98*	0.45	1.00
	Carly	0.47	-0.06	0.96
	Omnibus Effects	0.65*	0.26	1.00
Prompting	Adora	0.82*	0.18	1.00
	Banita	0.65*	0.13	1.00
	Carly	0.47	-0.06	1.00
	Omnibus Effects	0.64*	0.25	1.00

Table 13
Continued

		Tau-U	LL CI 90%	UL CI 90%
Expanding	Adora	0.64	-0.004	1.00
	Banita	0.55*	0.02	1.00
	Carly	0.98*	0.45	1.00
	Omnibus Effects	0.73*	0.34	1.00

Note. LL = Lower limit; UL = Upper limit; Com. = Communication; No effect sizes are provided for Dyad B due to early withdrawal from the study.

* $p < .05$.

Table 14
Effects of Intervention on Independent Target Behaviors in Children

		Tau-U	LL CI 90%	UL CI 90%
Adrain	Asking Question	0.58	-0.07	1.00
Bane	Requesting	0.82*	0.29	1.00
Camilo	Expanding answer/ Initiating topic	0.96*	0.44	1.00
All Participants	Omnibus Effects	0.80*	0.41	1.00

Note. LL = Lower limit, UL = Upper limit
 * $p < .001$.

Table 15

Pearson's Correlations between Parent Strategy Implementation Use of Behavior Intervention Skills and the Children's Targeted Communication Skills (Prompted plus Independent)

Parent Strategy Implementation Use of Behavior Interventions Skills	Children's Targeted Communication Skills (Prompted plus Independent)	Children's Targeted Communication Skill (Independent)
Any component used (Incentivizing, modeling, prompting, expanding)	.786***	.568***

* $p < .05$.

** $p < .01$.

*** $p < .001$.

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CHAPTER V

SUMMARY AND CONCLUSIONS

This dissertation included three studies that aimed to investigate the effects of social-communication interventions for adolescents and adults with autism spectrum disorders (ASD). The first study consisted of meta-analysis procedures to investigate the overall effects of social-communication skills. The second study reported the outcomes of the quality review of social-communication interventions and identified which social-communication interventions for this population could be considered evidence-based practice (EBP). The third study conducted single-case experimental designs to investigate the effects of telepractice parent coaching on naturalistic strategies to improve communication skills for adolescents and adults with ASD.

The first study consisted of meta-analysis procedures which reported the overall effect size and effect sizes of each intervention type in improving social-communication skills for adolescents and adults with ASD. This study included single-case experimental designs (SCEDs). The findings of Tau-*U* analyses (Parker et al., 2011) from this study indicated that each social-communication intervention (i.e., video-based instruction, in-vivo instruction, high-tech augmentative and alternative communication (AAC), low-tech AAC, behavioral skills training, and social skills training) are moderately effective on improving social-communication skills for adolescents and adults with ASD. Moderator analyses also revealed and found there was a statistically significant difference in social-communication outcomes across some moderators (i.e., between peer-mediated and non-peer-mediated without peer implementer, between social interaction and joint attention communicative functions, and between authentic and didactic settings).

The second study conducted the quality review of social-communication interventions for adolescents and adults with ASD. This study also identified which social-communication interventions for this population could be considered EBP by using NTACTION indicators (NTACT, 2018). The findings showed important issues that need to be considered in this field of social-communication interventions for adolescents and adults with ASD in related to the quality of the SCED. Three of the extended methodological criteria were found poorly addressed across most of the articles: maintenance, generalization, and social validity. After reviewing a quality review to meet EBP standard (NTACT, 2018); only video modeling intervention has been established as an EBP.

The third study was a single-case experimental design (SCED). The author used multiple-probe design across three participants to conduct the effects of telepractice parent coaching on naturalistic strategies to improve communication skills for adolescents and adults with ASD. This study identified how telepractice intervention could be a tool for educators to implement naturalistic strategies for families with adolescents and adults with autism at their natural settings. The results in visual and effect size analysis demonstrated a functional relation between the telepractice parents coaching and parent strategy implementation with a strong effect for all three participants. These results also revealed that parents of adolescents and adults with ASD were able to practice and maintain the use of communication skills for their children.

Implications for Practice

The findings of these three studies showed several implications for practice. First, peer-mediated was found to be more effective than interventions that implement without peers for adolescents and adults with ASD. Second, educators and parents should be encouraging adolescents and adults with ASD to use generalization and maintenance for any social-

communication activities in their authentic settings and with their natural partners, especially their parents and peers. Although there is only one document of parent-mediated in this study, it reported a strong effect in using parents-mediated intervention for this population. Third, parents and families with adolescents and adults with ASD could be the potential role who can practice the social-communication skills for their child at home. Fourth, high-tech AAC is an effective intervention for increasing social-communication skills in different goals (i.e., requesting items, exchanging information) for adolescents and adults with ASD. Lastly, the findings from a single-case experimental design study also revealed and confirmed the effectiveness of using both parents-mediated intervention and high-tech AAC for adolescents and adults with ASD.

Limitations

There are some limitations in these three studies that should be considered. For the first study, a meta-analysis, the results of Tau-*U* calculation are over 1.0 in some cases due to corrected baseline strategy. Additionally, we are unable to analyze some of the moderator variables due to the small number of documents. Some potential documents might be missing due to the key words of searching. For the second study, a quality review, the number of documents that collected all three maintenance, generalization, and social validity criteria was also limited. Reliability in social validity criteria reported in the lowest scores because of inadequate descriptions in each article. Lastly, several interventions had too few adolescents and adults participants which is the reason that intervention was excluded and not considered to be EBP. The third study, a single-case experimental design, is not able to demonstrate a functional relation between telepractice parent coaching and their children's (distal) outcomes. Parent's implementation data varied due to the interventions being implemented in natural settings. Social validity for the child participants was not conducted. Additionally, the researcher was not able to

control parents' fidelity for each participant; we are not able to confirm how often the parents practiced the skills outside of the recorded video.

Future Research

This dissertation included several areas to support further research in this field of social-communication interventions for adolescents and adults with ASD. In meta-analysis study, we encourage future study to expand each intervention to look in more detail for this population such as differences between high-tech and low-tech AAC intervention across all adolescents and adults with other disabilities. There is also a need for conducting more social-communication interventions such as behavior skills training and social skill training focused on adolescents and adults with ASD. Additionally, researchers should focus more on conducting research for this population with their natural communicative partners to generalize social-communication skills across authentic settings. In quality-review study, more studies need to be conducted focusing on applying maintenance, generalization, and social validity to qualify with the methodological standard. Furthermore, researchers could compare the effect size data between baseline generalization data and intervention generalization data and between intervention and maintenance data. For SCED study, researchers could extend telepractice parent coaching to different skills such as in-home functional communication training or more details on how to use high-tech AAC to teach adolescents and adults with ASD and other disabilities. Moreover, adolescent and adult participants should be encouraged to complete the social validity surveys to determine their feedback regarding whether or not the intervention was considered socially acceptable for them.

APPENDIX 1

MODERATOR CODING AND OPERATIONAL DEFINITIONS

Moderator coding	Operational Definition
Intervention Categories	
<ul style="list-style-type: none"> • Video-based instruction • In-vivo instruction • High-tech-AAC • Low-tech AAC • Behavior skills training • Social skills training 	<ul style="list-style-type: none"> • A video as an instructor to teach participants • A person to lead the intervention • An application of a graphic communication mode. High tech applications involve the use of electrical. • A graphic communication mode that does not require electrical power to operate. • Named the intervention that explicit in the documents • Named the interventions that explicit in the documents
Implementer	
<ul style="list-style-type: none"> • Researcher • Parent • Peer • Teacher 	<ul style="list-style-type: none"> • First author, researcher, graduate assistant, graduate student • Parent/caregiver of the participant • Peer/communicative partner who are same age or class with the participants • Educators who works in the classroom with participants such as paraprofessional, pre-service teacher, and in-service teacher
Communicative function	
<ul style="list-style-type: none"> • Behavioral regulation • Social interaction • Joint attention 	<ul style="list-style-type: none"> • Expression of needs and wants communicative to obtain access to an object, activity or person; or to escape or avoid contact with an object, activity, or person. • Taking turn conversation: any conversation, greeting, answering questions • Get attention from partners/initiating topic/naming objects in the environment/ requesting information
Setting	
<ul style="list-style-type: none"> • Authentic settings • Didactic settings 	<ul style="list-style-type: none"> • The natural environment that participant would occur in every life (i.e., home, group home, classroom, self-contained classroom, community, gym, playground, store, mall, place of employment) • The place that exclude participants from the authentic environment and distract were minimize (i.e, clinic, private room, room with the fake mirror)

APPENDIX 2

SUMMARY OF CHARACTERISTICS OF PARTICIPANT AND INTERVENTION

First Author	Research Design	Adolescent and adult participants	Child's communication mode	Interventions	Communicative function
Ali (2009)	MPD	#2 w/ ASD, ADHD, visual impairment, orthopedic impairment Age: 13, 14	Speech/Verbalization/ Vocalization (2)	Low-tech aided AAC	Social interaction
Allen (2015)	MBD	#3 w/ ASD, IDD Age: 17 (3)	Speech/Verbalization /Vocalization (3)	Video modeling Parent-mediation strategy	Behavioral regulation Social interaction
Bellinger (2012)	MPD	#1 w/ ASD Age: 12	Speech/Verbalization /Vocalization	Social skills training	Behavioral regulation Social interaction Join attention
Boesch (2015)	CCD	#1 w/ ASD Age: 14	Speech/Verbalization /Vocalization, Gesture/Body language Sign language	Functional Communication Training (FCT) Sign AAC	Behavioral regulation
Brown (2008)	MBD	#1 w/ ASD Age: 13	Speech/Verbalization /Vocalization	Script fading	Social interaction
Charlop-Christy (2002)	MBD	#1 w/ ASD Age: 12	Speech/Verbalization /Vocalization Gesture/Body language	Low-tech aided AAC	Behavioral regulation Join attention
Day-Watkins (2014)	MPD	#3 w/ ASD Age: 13-18	Speech/Verbalization /Vocalization	Video modeling	Social interaction
Detar (2013)	MBD	#3 w/ ASD Age: 18, 20, 22	Speech/Verbalization /Vocalization	Video modeling	Social interaction

Dotson (2010)	MPD	#4 w/ ASD, ADHD, CP, Dyslexia Age: 13, 17(2), 18	Speech/Verbalization /Vocalization	Peer-mediated intervention/Peer support	Social interaction
Finke (2017)	MPD	#3 w/ ASD Age: 12 (2), 13	Speech/Verbalization /Vocalization (1) Gesture/Body language (2) Sign Language (1) Low-tech aided AAC (3)	Mid-to-high-tech aided AAC	Social interaction
Ganz (2014)	ATD	#1 w/ ASD Age: 14	Speech/Verbalization /Vocalization	Mid-to-high-tech aided AAC	Social interaction
Gardner (2014)	ABAB	#1 w/ ASD, ADHD, oppositional defiant disorder Age: 18	Speech/Verbalization /Vocalization	Peer-mediated intervention/Peer support	Social interaction
Grob (2019)	MBD	#3 w/ ASD (3), ADHD (1) disorder Age: 19 (2), 27	Speech/Verbalization /Vocalization Not reported (2)	Behavioral skills training	Behavioral regulation Social interaction
Hochman (2015)	MPD	#4 w/ ASD, IDD (4) Age: 15 (3), 17 (1)	Speech/Verbalization /Vocalization	Peer-mediated intervention/Peer support	Social interaction
Ingersoll (2013)	MBD	#4 w/ ASD, IDD (4) Age: 13 (2), 15, 16	Not reported (4)	Reciprocal Imitation Training	Join attention
Kocaoz (2019)	MPD	#3 w/ ASD Age: 14 (2), 13	Speech/Verbalization /Vocalization (3)	Video modeling	Social interaction and Join attention
Koegel (2014)	MBD	#1 w/ ASD Age: 14	Speech/Verbalization /Vocalization	Self-Management	Social interaction
Kornacki (2013)	MBD	#1 w/ ASD, IDD Age: 21	Speech/Verbalization /Vocalization	Behavioral skills training	Social interaction

Kunnavatana (2018)	ABAB	#2 w/ ASD Age: 26, 39	Sign language Low-tech AAC	Mid-to-high-tech aided AAC	Behavioral regulation
Lorah (2015)	MBD	#1 w/ ASD Age: 12	Gesture/Body language Mid-to-high-tech aided AAC	Mid-to-high-tech aided AAC	Social interaction
Lund (2008)	MBD	#3 w/ ASD, cognitive delay, visual impairment, speech and language impairment (3) Age: 12, 13, 17	Speech/Verbalization /Vocalization (1) Low-tech AAC (3)	Low-tech aided AAC	Behavioral regulation
Mason (2012)	MBD	#2 w/ ASD Age: 19, 26	Speech/Verbalization /Vocalization	Video modeling	Social interaction Join attention
Merrill (2017)	MBD	#3 w/ ASD Age: 14, 15, 17	Speech/Verbalization /Vocalization	Social skill training	Social interaction
Miltenberger (2015)	MBD	#1 w/ ASD Age: 12	Speech/Verbalization /Vocalization	Video modeling	Social interaction
Murphy (2018)	MPD	#3 w/ ASD Age: 12, 13, 14	Not reported	Social skill training	Behavioral regulation Social interaction Join attention
Nepo (2017)	MPD	#3 w/ ASD Age: 31, 33, 24	Speech/Verbalization /Vocalization (1) Gesture/Body language (3) Sign language (2)	Mid-to-high-tech aided AAC	Behavioral regulation
Ng (2016)	MBD	#1 w/ ASD, IDD Age: 14	Speech/Verbalization /Vocalization	Teaching Interaction Procedure	Join attention

Nuernberger (2013)	MBD	#3 w/ ASD Age: 19 (2), 23	Speech/Verbalization /Vocalization	Behavioral skills training	Social interaction and Join attention
Plavnick (2013)	MPD	#2 w/ ASD (2), IDD, obsessive compulsive disorder (1) Age: 14, 16	Speech/Verbalization /Vocalization	Video modeling	Social interaction Join attention
Plavnick (2015)	MPD	#3 w/ ASD, IDD Age: 14, 15, 17	Speech/Verbalization /Vocalization	Video modeling	Behavioral regulation and Social interaction Join attention
Radley (2015)	MPD	#1 w/ ASD, IDD Age: 12	Not reported	Social skills training	Behavioral regulation and Social interaction Social interaction Social interaction and Join attention
Rausa (2016)	MPD	#1 w/ ASD Age: 23	Speech/Verbalization /Vocalization	Video modeling	Social interaction
Ryan (2019)	MPD	#5 w/ ASD, IDD Age: 19 (3), 20 (2)	Speech/Verbalization /Vocalization	Behavioral skills training	Social interaction
Sigafoos (2008)	ABAB	#1 w/ ASD Age: 12	Speech/Verbalization /Vocalization Gesture/Body language Sign Language Mid-to-high-tech aided AAC	Mid-to-high-tech aided AAC	Behavioral regulation
Sreckovic (2017)	MPD	#3 w/ ASD Age: 15 (3)	Not reported (3)	Peer-mediated intervention/Peer support	Social interaction Join attention
Stauch (2018)	MPD	#3 w/ ASD (3), IDD (2)	Speech/Verbalization /Vocalization	Video modeling	Social interaction

Age: 15, 16, 17

Strasberger (2013)	MBD	#1 w/ ASD Age: 12	Low-tech aided AAC	Mid-to-high-tech aided AAC	Behavioral regulation
Thirumanickam (2018)	ATD	#1 w/ ASD Age: 18	Speech/Verbalization /Vocalization Mid-to-high-tech aided AAC	Video modeling	Social interaction
Wendt (2019)	MBD	#3 w/ ASD (3), IDD (1), obsessive– compulsive disorder (1) Age: 14, 16, 23	Sign language	Mid-to-high-tech aided AAC	Behavioral regulation Join attention
Whittington-Barnish (2012)	MBD	#9 w/ ASD (9), IDD (1), ADHD (2), mild hearing loss (1) Age: 14, 15 (6), 17, 18	Speech/Verbalization /Vocalization	Video modeling	Social interaction
Williamson (2013)	MPD	#3 w/ ASD (3) Age: 12 (2), 14	Speech/Verbalization /Vocalization (2) Gesture/Body language (2) Mid-to-high-tech aided AAC (1)	Video modeling	Social interaction

MPD = Multiple probe design, MBD = Multiple baseline design, CCD = Changing criteria design, ATD = Alternating treatment design, ABAB = withdrawal design, ASD = Autism spectrum disorder, IDD = Intellectual developmental disabilities, ADHD = Attention-deficit/hyperactivity disorder, AAC = Augmentative and alternative communication

APPENDIX 3

DESCRIPTION FOR THE MAINTENANCE DETAILS

First Author	Maintenance Data Points per level	Latency between cessation of intervention and maintenance data sessions	IOA collected for % of Maintenance Data Points	IOA Min Thresholds
<i>Meet overall extended methodological standards (9)</i>				
Ali (2009)	>= 3	Some collected >= 4 weeks	>= 20% Aggregated	>= 80% Aggregated
Bellinger (2012)	>= 3	Some collected >= 4 weeks	>= 20% Aggregated	>= 80% Aggregated
Dotson (2010)	>= 3	Some collected >= 4 weeks	>= 20% Aggregated	>= 80% Aggregated
Ng (2016)	>= 3	Some collected >= 4 weeks	>= 20% Aggregated	>= 80% Aggregated
Nuernberger (2013)	>= 3	Some collected >= 4 weeks	>= 20% Aggregated	>= 80% Aggregated
Plavnick (2015)	>= 3	Some collected >= 4 weeks	>= 20% Aggregated	>= 80% Aggregated
Radley (2015)	>= 3	Some collected >= 4 weeks	>= 20% Aggregated	>= 80% Aggregated
Ryan (2019)	>= 3	Some collected >= 4 weeks	>= 20% Aggregated	>= 80% Aggregated
Wendt (2019)	>= 3	Some collected >= 4 weeks	>= 20% Aggregated	>= 80% Aggregated
<i>Meet overall extended methodological standards with reservation (14)</i>				
Day-Watkins (2014)	1-2	Some collected >= 4 weeks	>= 20% Disaggregated	>= 80% Aggregated
Detar (2013)	1-2	Some collected >= 4 weeks	>= 20% Aggregated	>= 80% Aggregated
Finke (2017)	1-2	Some collected >= 4 weeks	>= 20% Aggregated	>= 80% Aggregated
Kocaoz (2019)	1-2	<4 weeks	>= 20% Disaggregated	>= 80% Disaggregated
Koegel (2014)	1-2	Some collected >= 4 weeks	>= 20% Aggregated	>= 80% Aggregated
Kornacki (2013)	1-2	<4 weeks	>= 20% Aggregated	>= 80% Aggregated

First Author	Maintenance Data Points per level	Latency between cessation of intervention and maintenance data sessions	IOA collected for % of Maintenance Data Points	First Author
Mason et al. (2012)	>= 3	<4 weeks	>= 20% Aggregated	>= 80% Aggregated
Merrill et al. (2017)	>= 3	<4 weeks	>= 20% Aggregated	>= 80% Aggregated
Miltenberger et al. (2015)	1-2	Some collected >= 4 weeks	>= 20% Disaggregated	>= 80% Disaggregated
Rausa et al. (2016)	1-2	Some collected >= 4 weeks	None collected	None collected
Sreckovic et al. (2019)	>= 3	<4 weeks	>= 20% Disaggregated	>= 80% Disaggregated
Strasberger et al. (2013)	1-2	Some collected >= 4 weeks	None collected	None collected
Thirumanickam	1-2	<4 weeks	>= 20% Aggregated	>= 80% Aggregated
Williamson et al. (2013)	1-2	<4 weeks	>= 20% Aggregated	>= 80% Aggregated
Summary Documents (%)	>= 3 12 (52%)	Some collected >= 4 weeks 16 (70%)	>= 20% Disaggregated 4 (17%)	>= 20% Disaggregated 3 (13%)
	1-2 11 (48%)	<4 weeks 7 (30%)	>= 20% Aggregated 17 (74%)	>= 20% Aggregated 18 (78%)
			None collected 2 (8%)	None collected 2 (8%)

APPENDIX 4

DESCRIPTION FOR THE GENERALIZATION DETAILS

First Author	Minimum Generalization Data Points per Level in Baseline	Minimum Generalization Data Points per Level in Intervention	Types of Generalization	Was the interventionist present during generalization probes?
<i>Meet overall extended methodological standards</i>				
Day-Watkins (2014)	>/= 3	>/= 3	Contexts, Exemplars	Unstated/ unknown
Murphy (2018)	>/= 3	>/= 3	Contexts, People	No
Radley (2015)	>/= 3	>/= 3	Contexts, People	Unstated/ unknown
Thirumanickam (2019)	>/= 3	>/= 3	Exemplars, Other	Unstated/ unknown
Wendt (2019)	>/=3	>/= 3	Materials	Yes
<i>Meet overall extended methodological standards with reservation</i>				
Ali (2009)	0	>/= 3	Contexts	Unstated/ unknown
Brown (2008)	1-2	>/= 3	Materials	Yes
Detar (2013)	1-2	1-2	Contexts, People	Unstated/ unknown
Dotson (2010)	1-2	0	People	No
Finke (2017)	1-2	1-2	Materials, Other	Yes
Ganz (2014)	1-2	1-2	People	No
Grob et al. (2009)	>/= 3	0	Contexts, People	Unstated/ unknown
Hochman (2015)	0	>/= 3	Contexts	Yes
Ingersoll et al. (2013)	0	1-2	Contexts, People	Unstated/ unknown
Koegel et al. (2014)	0	1-2	Contexts	No

Miltenberger et al. (2015)	1-2	1-2	Contexts, People	Yes
Nepo et al. (2017)	0	>= 3	Contexts	Yes
Ng (2016)	>= 3	1-2	Contexts, People	Yes
Plavnick et al. (2015)	1-2	>= 3	Contexts	Yes
Stauch et al. (2018)	>= 3	1-2	Contexts	Yes
Strasberger et al. (2013)	0	1-2	Contexts	Yes
Summary Documents (%)	>= 3 8 (38%)	>= 3 10 (48%)	Multiple types 10 (48%)	Yes 10 (48%)
	1-2 7 (33%)	1-2 9 (43%)	One type 11 (52%)	No 4 (19%)
	0 6 (29%)	0 2 (9%)		Unstated/ unknown 27 (33%)

APPENDIX 5

DESCRIPTION FOR THE SOCIAL VALIDITY DETAILS

First Author	Social significance of the dependent variables (i.e. the target behaviors are beneficial to the participant and relevant to the context)	The change in behavior or intervention effects was clinically significant according to the criterion or goals set for individual studies (e.g., via checklist)	The intervention is implemented in authentic environments with persons who are authentic to the setting using materials normally found in the setting	The intervention was efficient and cost effective (e.g., as evaluated in a social validity checklist or report by implementer or other stakeholder)	All individuals involved, who were surveyed, are satisfied with the procedures and outcomes (e.g., via checklist)	The intervention was deemed be feasible, or to have an appropriate contextual fit for persons who are typically responsible for implementation and maintenance in authentic environments (by said implementers/key stakeholders)
<i>Meet overall extended methodological standards (4)</i>						
Hochman (2015)	Yes	Yes	Yes	No	Yes	Yes
Kocaoz (2019)	Yes	Yes	Yes	No	Yes	Yes
Strasberger (2013)	Yes	Yes	Yes	No	Yes	Yes
Whittington-Barnish (2012)	Yes	Yes	Yes	No	Yes	Yes
<i>Meet overall extended methodological standards with reservation (6)</i>						
Garder et al. (2014)	Yes	Yes	Yes	No	No	Yes
Keogel et al. (2014)	Yes	Yes	Yes	No	No	No
Plavnick (2013)	Yes	Yes	Yes	No	No	Yes
Rausa (2016)	Yes	Yes	Yes	No	No	Yes
Ryan et al. (2019)	Yes	Yes	Yes	No	Yes	No
Stauch (2018)	Yes	Yes	Yes	No	No	Yes
Summary Documents (%)	Yes 10 (100%) No 0 (0%)	Yes 10 (100%) No 0 (18%)	Yes 10 (100%) No 0 (0%)	Yes 0 (0%) No 10 (100%)	Yes 5 (50%) No 5 (50%)	Yes 8 (80%) No 2 (20%)

APPENDIX 6

PROCEDURAL INTEGRITY CHECKLIST (BASELINE SESSION)

Implementer:

Participant (initials):

Reviewer:

Date:

Session # (if multiple recorded): BL

Criteria	Yes(+)/No(-)/Not Applicable(N/A)
All Videos: Do not teach or provide any instructions or feedback regarding performance to caregivers.	
Explain the meeting schedule to parents.	
Required for baseline video:	
Tell parents to record the baseline video for 3:00-3:30 minutes and upload in the folder.	
Tell parents to have a conversation with their child about his preferred topic in the way they usually do.	
Required for generalization video:	
Tell parents to record the generalization video for 3:00-3:30 minutes.	
Tell parents to have a conversation with a child and another partner (e.g., sister, dad, or neighbors)	

Total number of yes (+):

Percentage (%):

APPENDIX 7

PROCEDURAL INTEGRITY CHECKLIST (INTERVENTION SESSION)

Implementer:

Participant (initials):

Reviewer:

Date:

Session # (if multiple recorded): IV

Criteria	Yes(+)/No(-)/Not Applicable(N/A)
Intervention session	
Provide written feedback regarding performance on last session/video, highlighting pointers for how to better implement some/all of the protocol steps (incentivizing communication, model, errorless learning, time delay, expand)	
Give verbal instructions regarding the written feedback.	
Model how to perform the skills highlighted in feedback.	
Role play how to perform the skills.	
Provide performance feedback during the role play, if needed.	
Provide graph to the parent (at the end of the meeting)	

Total number of yes (+):

Percentage (%):

APPENDIX 8

PARENT COACHING SHORT SURVEY

Thank you for participating in the Project Possible-Parent Coaching. Your feedback on this survey can help us understanding your learning during coaching sessions and improve it. Please answer questions indicate your views and offer your views and comments. Your feedback is very important to us. All responses will be treated in confidence.

Webinar	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The content and activity in the parent coaching sessions were easy to use at home with my child.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The content and activity in the parent coaching sessions were based on my priorities for my child's communication.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I understood the content, feedback, and discussion in the parent coaching session.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My child was cooperating with me when I practice the skills.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Besides video recording, please approximately how much time did you spend using learned skills/strategies with your child since the last parent coaching sessions? (last 2 weeks)
 0-3 hours/ 4-6 hours/ 7-9 hours/ More than 10 hours

Based on the video’s sessions, what did you think you did very well this week?

What is your goal for next week? After the coaching session, I will...

Please let us know how your child practices the skills beside the recorded in videos?

Please let us know if you have any other comments or anything that we needed to improve.

APPENDIX 9

PARENT COACHING LONG SURVEY

Thank you for participating in the study. The team members aim to provide high-quality coaching to meet different needs of families. Your evaluation of this survey can help us make this. Please tick the appropriate box for each question indicate your views and offer your views and comments. Your feedback is very important to us. All responses will be treated in confidence.

Webinar	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The information/knowledge I learned from the webinar was easy to understand.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel the length of the webinar sessions (2 hours) was enough to learn about the basic information and knowledge of communication strategies.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Individual Parent Coaching	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
The strategies/skills I learned in this project were easy to use at home with my child.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have received sufficient guidance, feedback, and suggestions on each strategy from my therapist.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The strategies/skills I learned in this project helped me to interact better with my child.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I find the procedures and the treatment used in this project to be an acceptable way of improving my child's communication skills.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

My child is satisfied with the coaching procedures and outcomes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am satisfied with the coaching procedures and outcomes.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel my behavior components (incentivizing, modeling, prompting, expanding) are beneficial and could help me to improve his/her communication skills.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel the telepractice parent coaching intervention (project possible) was efficient and cost effective.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe it would be acceptable to use the treatment with individuals who cannot choose treatments for themselves.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I will be willing to continue to use these strategies/skills if I want to improve his/her communication skills	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel the length of the individual coaching sessions (1 hour) was enough to learn about and practice the strategies.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel the total sessions I received were enough to learn about, practice, and receive feedback on the use of the strategies.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel most of the sessions that I taught communication skills to my child is present in the natural settings.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Overall, I have received good opportunities and experience to learn about different strategies/skills to work with my child through this project.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall, I feel using these strategies/skills I learned in this project had a positive impact and improvement on my child's and my behaviors.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall, I have a positive reaction to this project.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please give the scale of your stress level related to your child's communication skills. - Before participating the coaching session (1-100)

Please give the scale of your stress level related to your child's communication skills. - After participating the coaching session (1-100)

How much time did you spend using learned skills/strategies with your child per week?
0-3 hours/ 4-6 hours/ 7-9 hours/ More than 10 hours

I would like to learn more about communication strategies to work with my child. Please let me know if any spots are still available.

- Yes
- Maybe
- No

What did you like most about the parent coaching?

Please give some examples of your child's improvement of the communication that you would like to share (i.e., any experiences/situations that your child make an improvement of the communication skills)

What aspects of the parent coaching could be improved?

Please let us know if any other comments you would like to make.