

A META-ANALYSIS OF SINGLE-CASE STUDIES ON
FUNCTIONAL COMMUNICATION TRAINING

A Dissertation

by

AMY KATHLEEN HEATH

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

May 2012

Major Subject: Educational Psychology

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ABSTRACT

A Meta-Analysis of Single-Case Studies on Functional Communication Training.

(May 2012)

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Functional Communication Training (FCT) is an intervention that involves teaching a communicative response to decrease the occurrence of challenging behavior in individuals with disabilities. FCT is a two step intervention in which the interventionist first determines the function, or purpose, of the challenging behavior and then teaches a communicative response that will provide the same function as the challenging behavior. This meta-analysis addressed the following questions: (a) Is FCT more effective with a complete or brief functional analysis? (b) Is FCT differentially more effective for one communication mode versus another (unaided augmentative and alternative communication, aided augmentative and alternative communication, or verbal)? (c) Is FCT more effective when implemented in natural or contrived contexts? (d) Is FCT more effective for different functions of challenging behavior (attention, tangible, escape and multiple)? (e) How effective is FCT with individuals with challenging behavior, across different age ranges? (f) How effective is FCT with individuals with challenging behavior, across different disability categories?

A thorough search was performed to find all articles related to FCT. The articles were then reviewed to ensure that they met the inclusion criteria. Data were extracted from the graphs within each study and then analyzed using Robust Improvement Rate Difference (IRD). Forest plots were also created to aid in visual analysis to determine statistical significance and consistency of the results. A variable was determined to moderate the effectiveness of FCT if there was a statistically significant difference between the levels within each variable.

Thirty nine studies were included in this meta-analysis. Over-all FCT has a Robust IRD score of .86 (confidence intervals = .85 - .87). Based on the findings of this meta-analysis FCT is most effective with brief functional analysis and verbal communication. FCT was equally effective in natural and contrived settings. FCT appears to be most effective when an individual's behavior serves as attention seeking or an attempt to gain access to a tangible item. FCT appears to be more effective with school age individuals rather than adults. Finally, FCT may be more effective with individuals with autism spectrum disorder than intellectual disabilities or other disabilities.

DEDICATION

I would like to dedicate this dissertation to my wonderful husband and son.

I could not have done this without you!

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I would like to thank my committee co-chairs, Dr. Mack Burke and Dr. Jennifer Ganz, as well as my committee members Dr. Mandy Rispoli, Dr. Richard Parker, and Dr. Kathryn McKenzie. Your help and encouragement throughout this process have been amazing.

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CHAPTER I

INTRODUCTION AND LITERATURE REVIEW

Managing severe and chronic problem behavior, which are exhibited by many students with disabilities, is a challenge faced by both teachers and parents. Challenging behavior can take many forms depending on the individual, the setting, and the function of the behavior (Machalicek et al., 2007). Behaviors such as aggression, self-injury, and noncompliance are common to individuals with autism spectrum disorders (ASD) (Baghdadli, Pascal, Grisli, & Aussiloux, 2003; Kiernan & Kiernan, 1994; McClintock, Hall, & Oliver, 2003; Murphy, Hall, Oliver, & Kissi-Debra, 1999). Likewise, individuals with intellectual disabilities (ID) and multiple disabilities often display challenging behavior in the form of self-injurious behavior (SIB) and stereotypy (Poppes, van der Putten & Vlaskamp, 2010), as well as aggression (Poppes et al., 2010).

If challenging behavior is not addressed, individuals with disabilities are at risk for poor academic achievement, adult mental health concerns, and peer rejection (Dunlap et al., 2006). Challenging behavior also puts individuals at higher risk for abuse, neglect, deprivation, (Emerson et al., 2001, Lowe et al., 2007) victimization (Crocker et al., 2006; Rusch et al., 1986), and incarceration (Lund, 1990; Crocker & Hoggins, 1997; Crocker et al., 2006). Many of these risks can be linked to the fact that social and

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learning environments are restrictive to individuals that engage in challenging behavior (Buschbacher & Fox, 2003; Machalicek et al., 2007; Reichle, 1990). Individuals may be segregated or excluded either to institutions or specialized treatment centers due to behaviors such as property destruction, aggression, and sexual offenses (Lowe et al., 2007). Services within these more restrictive settings can be inconsistent and inadequate due to a higher rate of staff turnover in institutions (Lowe et al., 2007) and schools (Hastings & Brown, 2002, Machalicek et al., 2007). Lack of quality services at an early age can cause more intensive services to be required in the adolescent and adult years (Dunlap et al., 2006). To decrease the risk of segregation and serious emotional issues challenging behavior must be addressed using consistent implementation of evidence based practices.

Functional Communication Training

Functional Communication Training is an evidence based practice developed by Durand and Carr (1985). Prior to the mid-1980s, a majority of the research on behavioral interventions for challenging behavior focused on reactive approaches, for example, punishment or withholding reinforcement (Carr, 1985; Carr & Durand, 1985). Time-out (Zeilberger, Sampen, & Sloane, 1968), extinction (Lovaas, Freitag, Gold, & Kassorla, 1965), contingent restraint (Azrin, Besalel, & Wisotzck, 1982), and response cost (Iwata & Bailey, 1974) are examples of punishment or withholding reinforcement. While these types of interventions were often effective in decreasing challenging behavior, the interventions did not directly teach replacement behaviors, or more socially appropriate behaviors, (Carr & Durand, 1985).

A non-aversive alternative approach to addressing challenging problem behavior developed by Carr and Durand (1985) is FCT. FCT is built on the theory that challenging behavior could be a means of communicating one's needs (Mancil, 2006; Kurtz et al., 2011). By teaching socially-appropriate communicative responses that meet the same needs as the behaviors, the challenging behaviors may diminish (Carr & Durand, 1985). FCT therefore begins with an analysis of the individual's challenging behavior and then develops a communicative response to meet the same need as the challenging behavior (Durand, 1990).

FCT is different from other communication based interventions in that a direct link is made between the function of the behavior, and the communicative response (Durand, 1990). Researchers who focus primarily on communication and building a communication system (e.g. Bondy & Frost, 1994; Sundberg, 1993) are not using FCT although their interventions may have the side benefit of decreasing challenging behavior. Research that has a primary focus of building communication and determining the effectiveness of different types of communication may not meet the criteria for FCT if the researcher does not use the function of the challenging behavior to guide the selection of a communicative response. When implementing FCT, the interventionist focuses on one communicative response that directly fulfills the same function as the challenging behavior (Mancil & Boman, 2010). Whereas, communication focused interventions tend to focus on teaching a variety of words as quickly as possible to expand the individual's vocabulary or build generalization. FCT can even be used with individuals who all ready have functional communication skills. For this group, the

intervention will build on the established skills by teaching the individual to use their communication skills rather than challenging behavior to meet his/her needs (Durand, 1990; Mancil, 2006, Mancil & Boman, 2010). Communication is only one component of FCT. Determining the function of the behavior is the first step of FCT.

Functional analysis

According to Durand (1990) a functional analysis (FA) is the best method for determining the function of the behavior. FA was first designed by Iwata et al. (1982/1994) to assess the self-injurious behavior for nine individuals. FA is the process of manipulating “various antecedents and consequences that are presumed to be important and observing their effect on an individual’s challenging behavior” (Durand, 1990, p 66). There are four main functions of behavior that are assessed during an FA: (a) escape, (b) attention, (c) sensory and (d) tangible.

Escape. The task demand situation is used to assess if challenging behaviors may serve as a means of escape (Iwata et al, 1982/1994; Durand, 1990; Wacker et al. 1990). In this condition the individual is presented with task demands as appropriate for the individual, such as sorting items, naming pictures, and completing paper pencil tasks. The task demand is removed contingent on challenging behavior. For example, Lallie, Casey and Kates (1995) used instructional tasks identified in the student individual education plan to provide instructional prompts every 30 seconds. When challenging behavior was displayed the task was removed until the individual was no longer engaged in the challenging behavior. The task was then reintroduced with instructional prompts provided every 30 seconds. Escape from the task was provided contingent on

challenging behavior. This condition can be modified to assess whether the difficulty of the task demands affect the rate of challenging behaviors (Broussard & Northup, 1997; Ellis & Magee, 2004).

Attention. In the attention phase of the assessment the individual was presented with preferred materials but adult attention was withheld (Iwata et al, 1982/1994; Durand, 1990; Wacker et al. 1990). In this condition the adult would be present but ‘busy’ with something and therefore attention is withheld from the individual. For example, in Olive (2008) the mother was busy working on household chores while her child was engaged in an activity. If challenging behavior was displayed the adult provided attention, usually in the form of verbal redirection such as, “please don’t do that.” The attention was withdrawn once the challenging behavior stopped. The mother returned to work and then waited for challenging behaviors to return; this was repeated throughout the session. Attention from peers verses adults is an additional modification to this phase (Broussard & Northup, 1997; Ellis & Magee, 2004).

Sensory. In the sensory condition the individual was left alone in a room with nothing to interact with and no personnel present (Iwata et al., 1982/1994). In this condition, it was hypothesized that if the challenging behavior occurs it was most likely functioning as sensory stimulation or to relieve discomfort. For example in Iwata et al., (1982/1994) the individual was left in a small room with a one way mirror so that the individual was still under adult supervision. This phase is occasionally left out if challenging behaviors are not observed in baseline conditions, (Durand, 1990).

Tangible. Carr and Durand (1985) also suggest a tangible phase in which access to a tangible item was contingent on challenging behaviors. In this condition the same highly preferred item was used throughout the session. The item was then placed out of reach of the individual and was delivered contingent on challenging behavior. At the beginning of the session the individual was provided brief access to the item to “prime” the desire for the item. The item was then removed but kept in the individual’s eyesight. When challenging behaviors were displayed, the individual was provided brief access to the item and then the item was taken away once again (Carr & Durand, 1985). This procedure was repeated throughout the session. For example, in Braithwaite and Richdale (2000) small toys were held within view and provided contingent on challenging behavior being displayed by the participants.

Manipulation procedures. Manipulation procedures consist of directly observing the problem behavior during each of the conditions being manipulated (Iwata et al., 1982/1994). Each condition in a FA usually lasts five minutes. Data are collected on a partial interval recording system in which each interval is 10 – 30 seconds in length depending on the behavior being measured. Target behaviors must be clearly defined to ensure reliability with data collection. It is also necessary to track each behavior separately to determine if different behaviors serve different communicative functions (Durand, 1990).

In each FA condition, the percent of intervals with challenging behavior is graphed and analyzed to determine what situation led to the highest rates of challenging behavior. The condition that elicits the highest rate of challenging behavior is then

hypothesized to be the function of the behavior (Carr, 1985; Carr & Durand, 1985; Durand, 1990; Ellis & Magee, 2004). Some researchers use pre-assessment strategies to determine hypothesized functions of the behavior and then limit the analogue functional analysis to a baseline condition and the hypothesized function (Durand, 1990; Durand & Carr, 1991; Durand & Merges, 2001). This process is known as a brief FA.

Brief Functional Analysis. Durand (1990) suggests that a brief FA can also be used to determine the function of a behavior. Prior to conducting a brief FA, a functional assessment inventory, or checklist, may be used to determine the hypothesized function of the behavior, thus narrowing the conditions that may be tested via the brief FA. These assessment inventories ask a variety of questions to determine what situations and settings the challenging behavior occurs in most frequently. The Motivation Assessment Scale (Durand & Crimmins, 2001), a highly preferred functional assessment inventory, included questions such as, “does the behavior seem to occur following a request to perform a difficult task,” “does the behavior occur when you take away a favorite food, toy or activity,” and “does it appear to you that the person enjoys doing the behavior (it feels, tastes, looks, smells and sounds pleasing)?” The questions are varied and each function is probed in a variety of ways to ensure reliable responses. The responses on the questionnaire guide the interventionist to hypothesize what function the behavior may be serving. An FA is then used to test the hypothesis. In this case only the hypothesized function and a baseline condition would be tested rather than testing all possible conditions. A brief FA preceded by a functional assessment inventory was utilized in

studies such as Durand, (1993), Lalli, Casey and Kates (1995), and Olive, Lang and Davis (2008).

Another method for a brief FA is to probe each condition once (Derby et al., 1992; Ishuin, 2009). The condition that has the highest rate of challenging behavior is probed a second time to ensure that the results will remain higher than the other conditions. A brief FA is easier to use within the school setting because it is less time intensive (Derby et al., 1992; Ishuin, 2009; Tincani, Castrogiovanni & Axelrod, 1999). The results from this form of brief FA are reliable and potentially more accurate than a complete FA (Ishuin, 2009).

Either a brief or complete FA may be used to develop FCT interventions (Durand, 1990; Hanley, Iwata & McCord, 2003; Wacker et al., 2005). While a brief FA has been demonstrated to be effective at determining the function of a behavior (Derby et al., 1992; Durand, 1990) there is no research at this point to determine that a brief FA is as effective as a complete FA when combined with FCT. A brief FA saves practitioners time during the intervention, making this two-step intervention process easier to implement (Durand, 1990).

Steps in Determining a Communicative Response

Once an FA has been completed, and the function of the behavior has been hypothesized, an appropriate communicative response can be developed (Durand, 1990; Mancil, 2006, Mancil & Boman, 2010). The communicative response is aimed at either allowing the individual to gain access to attention from another person, access to a tangible item, avoid or escape a task demand, or allow time for self-stimulatory

behaviors (Durand, 1990). FCT has been used with all functions of behavior (Durand, 1990; Mancil & Boman, 2010). Determining if FCT is more effective for specific functions could guide interventionists when developing intervention plans for individuals with challenging behavior. More research is needed to ascertain FCT's effectiveness across all functions of behaviors and whether it can be equally applied to all functions.

Determining a Communicative Response

Once the function of the behavior has been hypothesized the next step in FCT is determining an appropriate communicative response (Durand, 1990). The response mode can be verbal, sign language, pictorial, or utilize a speech generating device (Durand, 1990). There are four variables to address when choosing a mode of communication: (a) effort to use the communicative response, (b) the novelty of the request, (c) previous history of a relationship between communication and challenging behavior, and (d) a preference for certain types of communicative responses (Ringdahl et al., 2009).

Effort to use the response. Researchers have investigated if the amount of effort needed to use a communicative response will differentially impact the effectiveness of FCT (Bailey, McComas, Benavidas, & Lovasz, 2002; Buckley & Newchok, 2005; Horner & Day, 1991; Richman, Wacker & Winborn, 2001). For instance, pointing to a picture may be perceived as requiring less effort than spelling a phrase using an array of letters (Bailey et al., 2002). The length of the communication phrase may also impact the effort needed. For example, Horner and Day (1991) found that individuals preferred to sign "break" rather than signing "I want to go please." The longer sentence took more

effort and was therefore less effective than the single word response. Less effort in the communication mode leads to more effective interventions. (Bailey et al., 2002; Buckley & Newchok, 2005; Horner & Day, 1991; Richman et al., 2001; Ringdahl et al., 2009).

Novelty of the response. Novelty may increase the likelihood that the intervention will be successful (Winborn et al., 2002; Winborn-Kemmerer et al., 2009; Winborn-Kemmerer, Wacker, & Harding, 2010). Novelty of the mand is determined by selecting a different mode of response (e.g., verbal, pictorial, gestural) or a new response within the same mode that will be perceived as new and different from how the student usually communicates (Winborn et al., 2002; Winborn-Kemmerer et al., 2009). For instance, an individual whose primary communication is verbal may also be given the option to use a picture to communicate (Winborn-Kemmerer et al., 2010). Individuals within the study were more likely to use the novel request (a picture card) rather than the existing communicative response (verbal responses, Winborn-Kemmerer et al., 2010). Interventionists may need to provide the individual the opportunities to use novel modes of communication to increase the likelihood that the response will be used.

Previous history with the response. When given the choice to use an existing communicative response or a novel response, the individual is more likely to use the existing response (Winborn et al., 2002). In this case the existing response is used more frequently but the rate of challenging behavior does not decrease. Existing requests may be ineffective in decreasing challenging behavior because of the pre-established relationship between the mode of communication and challenging behavior. For instance the student may have already tried to use a picture to request breaks but the request were

ignored. The individual may assume that all future requests will be ignored. An interventionist may need to assess if challenging behavior has previously been linked with the communicative response (Winborn et al., 2002).

Proficiency with the response. The final variable in determining a mode of communication is how proficient the individual is at using the response. Ringdahl et al. (2009) defined proficiency as how effectively the individual is able to use the response. Highly proficient communicative modes are more likely to be used by the individual and can be more effective at changing challenging behavior (Ringdahl et al., 2009). For example Ringahl et al. (2009) assessed each participant's proficiency with three different modes of communications prior to implementing FCT. During FCT each mode was assessed individually to determine the effect of proficiency in decreasing challenging behavior. Higher effects were found with the mode of communication that the individual was the most proficient in using during the pre-assessment.

To save time assessments can be used to determine what mode of communication the student is most proficient in using (Durand, 1990). Durand (1990) created the "Communicative Response Modality Checklist" (p. 179) that leads the interventionist through the process of selecting a modality of communication based on the responses to each question on the checklist. While mode of communication is linked directly to proficiency, no research has looked at determining whether a specific mode of communication leads to more effective results than other forms.

FCT and Reinforcement

Another component of FCT is determining the effective rate of reinforcement after the behavior is displayed (Carr, 1988; Richman et al., 2001). For FCT to be effective the communicative response must be reinforced at a higher rate than the challenging behavior was reinforced (Carr, 1988; Durand, 1990; Wacker et al., 1990). Researchers have attempted to determine if FCT alone can provide enough reinforcement or if a secondary intervention is necessary. Studies have utilized FCT alone (e.g., Casey & Merical, 2006; Durand & Carr, 1987; Fisher 1993; Mehta Albin, 2005) as well as combining FCT with extinction (e.g., Braithwaite & Richdale, 2000; Hagopian et al., 2004; Hagopian, Kuhn, Long & Rush, 2005; Kelley, Lerman & VanCamp, 2002; O'Neill, 2001; Worsdell, et al., 2000). FCT has also been combined with punishment (Hanley et al., 2005) and non-contingent reinforcement (Hagopian, Wilson & Wilder, 2001).

Extinction is the process of withholding reinforcement contingent on behavior being displayed (Lovaas et al, 1965). When combining FCT with extinction the researcher only provides reinforcement for the replacement behavior, and withholds reinforcement for challenging behavior (Kelley et al., 2002; Shirley et al., 1997, Worsdell et al., 2000). FCT combined with extinction is more effective than FCT on its own. In Worsdell et al., (2000) challenging behavior decreased even when extinction was reinforced intermittently.

Impact of Environment on FCT

Researchers have utilized FCT in both contrived and natural settings. Much of the original research on FCT was conducted in contrived settings (Carr, 1985; Carr & Durand, 1985). Researchers have also investigated whether FCT could be taught and used in the natural environment (e.g. Casey & Merical, 2006; Durand, 1991; 1993; Franco, 2009; Gibson et al., 2010; Harding et al., 2009A, 2009B; Mancil et al., 2009; O'Neill, 2001; Wacker, 2005). In each of these studies the environment, usually the classroom or the individual's home, was left unchanged and service providers were trained to implement FCT, with the exception of Franco (2009), in which the researcher provided the intervention in the natural environment. According to the results of these studies, FCT can be effectively implemented in natural environments with service providers as implementers. There is currently no study that compares the effectiveness of FCT between contrived and natural environments to determine if one environment leads to higher effects. This meta-analysis evaluated the results of all studies involving FCT to determine if FCT can be used as effectively in natural settings as contrived settings and therefore be more relevant to the field.

Age of Implementation

FCT has been used with individuals at all ages including individuals in preschool (e.g. Durand, 1993; Durand & Carr, 1987; Gibson et al., 2010; Mancil et al., 2009) elementary school (e.g. Braithwaite & Richdale, 2000; Durand, 1991; Franco, 2009; Sigafos, 1996), secondary school (e.g. Carr & Durand, 1985; Durand, 1993; Fisher et al., 2005), and adults (e.g. Kahng et al., 1997; Shirley et al., 1997; Worsdell, 2000). To

date no study has examined the relative effectiveness across age groups. This meta-analysis analyzed the data according to age groups to help determine if FCT is equally effective across all age ranges. This information will help interventionists determine if, based on the age of the participant, FCT may be an appropriate intervention.

Disability Categories

While age is of interest, it is also important to determine if an individual's disability has an impact on the effectiveness of FCT. Disabilities that impair communication may be more likely to cause challenging behavior due to the individual's inability to communicate his or her needs (Carr, 1985; Carr & Durand, 1985; Neel et al., 1983; Reichle & Yoder, 1979). While typically-developing children learn to use spoken words to communicate their needs as they get older, individuals with ASD may continue to use challenging behaviors such as crying, screaming, or hitting to communicate as older children, adolescents, and adults (Buschbacher & Fox, 2003; Carr & Durand, 1985; Durand, 1990; Heflin & Alaimo, 2007). If they learn to effectively communicate their needs, verbally or via augmentative and alternative communication, challenging behaviors may become unnecessary. Effective and efficient conventional communication alleviates the need for the challenging behavior and provides more efficient access to reinforcement (Buschbacher & Fox, 2003; Carr & Durand, 1985; Heflin & Alaimo, 2007). Communicative hypothesis is a term used to refer to this relationship between behavior and communication (Carr, 1985; Carr & Durand, 1985; Neel et al., 1983; Reichle & Yoder, 1979).

There is a high prevalence rate of communication disorders in individuals with ASD as well as intellectual disabilities (ID, Pinborough-Zimmerman et al., 2007). It is likely that FCT would be effective with any disability that impacts an individual's ability to communicate effectively; therefore FCT should be equally effective for individuals with ASD and ID. FCT has also been implemented with individuals with ASD and ID as well as numerous other disabilities (e.g., hydrocephaly, Hagopian et al., 2004; cerebral palsy, Durand, 1993; Kuhn, 2010; and developmental disorders, Peck Peterson, et al., 2005; Volkert et al., 2009). There is currently no research investigating the effectiveness of FCT across disability categories.

Rationale for Conducting a Meta-Analysis on FCT

The No Child Left Behind Act (NCLB, 2001) and the Individuals with Disabilities Education Act (IDEA 2004) emphasize evidence-based practices (Reichow, Volkmar, & Cicchetti, 2008; Simpson, 2005, 2008; Simpson, McKee, Teeter, & Beytien, 2007). FCT is considered an evidence-based practice (EBP) by the National Professional Development Center on Autism Spectrum Disorders (NPDC-ASD, 2009). The NPDC-ASD proposed that evidence-based practices should meet one of the following three criteria: (a) at least five single-case studies conducted by at least three different research groups or investigators, (b) two high quality group studies, or (c) one group study and three single-case studies (NPDC-ASD, 2009).

Traditionally, single-case research uses direct and systematic replication to establish the external validity of a particular practice (Horner et al., 2005). However, meta-analysis can also serve as an important indicator of evidence-based practices. In a

meta-analysis the researcher compiles all of the studies utilizing the intervention of interest. Meta-analyses have the following four purposes: (a) identification of variables that may have an influence on outcome variables, (b) summarizing the overall effectiveness of the treatment being examined, (c) describing the body of research as a whole, and (d) providing quantification for the effectiveness of an intervention (Blimling, 1988; Busk & Serline, 1992; Busse, Kratochwill, & Elliot, 1995).

Previous Reviews of FCT

As of this date there are no published meta-analyses assessing the overall effectiveness of FCT. There are three meta-analyses that investigated function based interventions and therefore included studies utilizing FCT (Goh & Bambara, 2010; Gresham et al., 2003; Marquis et al., 2000). Goh and Bambara (2010) and Gresham et al., (2003) investigated studies in which a functional behavioral assessment (FBA) was used prior to implementing an intervention. While Goh and Bambara found FBA based interventions to have a moderate effect at decreasing challenging behavior, Gresham et al. found that FBA based interventions are not more effective than non-FBA based interventions. FBA based interventions produce moderate effects but non-FBA based interventions had higher rates of behavioral change (Gresham et al.). The primary focus of Marquis et al. was positive behavioral supports. FBA was included as one potential moderating variable. Positive behavioral supports are most effective when they are preceded by an FBA (Marquis et al.). All three meta-analyses found that FBA-based interventions can produce positive behavioral changes. Studies utilizing FCT were

included within these meta-analyses but to date no meta-analyses have investigated the variables that impact the effectiveness of FCT.

There are currently two literature reviews on FCT (Mancil, 2006; Kurtz et al., 2011). First, Mancil (2006) conducted a literature review to determine what participants, environments, research designs, and behaviors utilize FCT for individuals with autism. Eight studies were included in the literature review. FCT was primarily utilized with males between the ages of 2.7 to 13 years of age. Only one study was conducted in a natural setting with interventionists other than researchers (Wacker et al., 2005). A majority of the participants used challenging behavior to escape a situation or task (55%; Mancil, 2006). Behavior that served the function of gaining attention (36%) and access to tangible (18%) items were also represented in the research on FCT with individuals with autism. Four different communication responses were utilized in the research; verbal, sign language, picture based and augmentative devices. Mancil (2006) was limited in the number of studies because of the focus on autism spectrum disorder.

Second, Kurtz et al. (2011) conducted a literature review of FCT with individuals with ID. Over half of the participants included in this literature also had dual diagnoses of ID and AU and therefore overlapped with Mancil (2006). Kurtz et al. (2011) wished to determine the empirical support for FCT in regards to eight different variables; (a) function of behavior, (b) age, (c) primary disability, (d) FCT alone verses combined with other interventions, (e) setting, (f) therapist, and (g) type of FA (Kurtz et al., 2011). Empirical support was determined based on the criteria in Divisions 12 and 16 of the APA guidelines. This system divides interventions into three categories (*well-*

established, probably efficacious, and experimental) based on the number of high quality interventions that found positive effects when using the intervention. FCT was determined to be a *well-established* intervention overall. FCT was also a *well-established* treatment for a variety of challenging behaviors, and all functions of behavior, except sensory. FCT was *well-established* for children and adolescents with ID and AU. FCT combined with extinction was also *well-established* but FCT with punishment was determined to be *probably efficacious*.

Both literature reviews (Kurtz et al., 2011; Mancil, 2006) examined the FCT research literature by counting the number of participants or studies for each variable of interest. While the FCT studies were evaluated to determine the quality of the research, no additional analysis of effectiveness was performed on the data. Unfortunately, literature reviews may lead to conclusions about effectiveness that are subjective rather than objective and therefore may be misleading (Kavale, 2001; White, 1985).

Purpose and Research Questions

The purpose of the current study is to quantitatively determine the overall effectiveness of FCT as well as what moderators are likely to influence its effectiveness. Based on the variables of interest found in the literature reviews, the following six moderator variables were analyzed for this meta-analysis: (a) type of functional analysis, (b) mode of communicative response, (c) location of implementation, (d) function of the behavior, (e) participant age, and (f) disability category. All six potential moderator variables were used to answer the following questions. (a) Is FCT more effective with a complete or brief functional analysis? (b) Is FCT differentially more effective for one

communication mode versus another (unaided augmentative and alternative communication, aided augmentative and alternative communication, or verbal)? (c) Is FCT more effective when implemented in natural or contrived contexts? (d) Is FCT more effective for different functions of challenging behavior (attention, tangible, escape and multiple)? (e) How effective is FCT with individuals with challenging behavior, across different age ranges? (f) How effective is FCT with individuals with challenging behavior, across different disability categories? These questions were chosen because a variety of studies have manipulated these moderators but no study to date has combined the data into one body of research to determine the overall effectiveness of FCT for each variable.

CHAPTER II

METHOD

Literature Search

A comprehensive search was performed using a variety of databases. Academic Search Complete, Medline and PsychINFO were searched using the following terms, ‘functional communication training,’ ‘functional communication,’ ‘functional analysis communication,’ and ‘mand training’. The databases were limited to the years 1980 – 2011. To ensure that no relevant articles were excluded, the researcher also conducted a search using the same terms and restricted years using GOOGLE scholar. Finally, the reference sections of all articles that met the inclusion criteria were reviewed to ensure no articles were missed.

Each article found via the search methods was evaluated to determine whether or not it met all of the following criteria: (a) the participants had a diagnosed disability other than speech impairment, (b) the dependent variables had to include a measurement of either challenging behavior or adaptive behavior (e.g., aggression, self-injury, on-task behavior); (c) the data for challenging behavior was displayed in line graphs; (d) the study demonstrated experimental control while using a single-case research design (i.e., multiple-baseline, reversal/ABAB, alternating treatment); (e) the primary intervention was FCT with clear explanation of how function of the behavior was determined, and (f) the articles were published in peer-reviewed journals in English. An inclusion chart was created based on the inclusion criteria (Berman & Parker, 2002) to rate each article and

determine if the article should be included in the meta-analysis. The charts were completed by the researcher and an individual who was blind to the purpose of the research study. Prior to rating each article the raters discussed the inclusion criteria to ensure the criteria were judged similarly. A document was created to define each inclusion criterion and ensure that both raters were able to complete the task using the same methods (Appendix A). Each rater assessed the articles and completed the chart. The results from the charts were compared to ensure reliability. If the two raters disagreed about an article a third person rated the article and the decision of two of the three raters determined whether or not the article was included.

The combined search methods identified 80 articles, dissertations, book chapters, and other literature related to FCT. After reviewing the literature and determining whether or not each article met the inclusion criteria, thirty six articles met the criteria and were included in this meta-analysis.

Data Extraction and Coding

After the articles were selected for participation in the study, each article was coded using the potential moderating variables, (a) type of functional analysis, (b) mode of communicative response, (c) location of implementation, (d) function of the behavior, (e) participant age, and (f) primary disability. Each study was further coded into different levels within the variables. If a study contained multiple levels within a variable the data were coded and analyzed for each level within the potential moderating variable. For example, Hagopian, Wilson and Wilder (2001) used a multiple baseline design across functions of behavior (escape and tangible). The data was coded for both levels and

separate ES scores were obtained for escape and tangible to allow the data to be analyzed separately by level.

The type of functional analysis was coded as either: *Brief*, *Complete* or *Other*. Studies rated as *Other* either did not provide a detailed enough explanation of what type of functional analysis they used or used an alternate functional behavioral assessment method. Mode of communicative response was coded as Aided Augmentative and Alternative Communication (A-AAC), Unaided-Augmentative and Alternative Communication (U-AAC), *Verbal*, or *Multiple*. A-AAC included any study that used any type of speech generating device or picture cards to generate the communicative word or phrase. U-AAC is communication that requires no additional tools or devices. For this study, U-AAC included sign language and any type of gesture to gain attention, such as tapping someone on the shoulder or pointing. *Verbal* was any auditory response. *Multiple* was used when a study allowed the participant to choose from an array of communicative responses.

The location of implementation was divided into two categories, *Contrived* and *Natural*. *Contrived* settings included the research studies that used a separate classroom or a secluded area in the classroom or home and outside of typical routines. These settings were contrived because the intervention did not occur within the natural classroom or home activities. Any study that occurred without interrupting the usual classroom or home routine was coded as *Natural*.

Function of the behavior was coded as *Tangible*, *Escape*, *Attention*, *Sensory*, or *Multiple*. Each study directly specified the function of the behavior based on the results

of the FA, therefore coding was drawn from this data. Participant age was broken into age groups of *Primary* (ages 0-5 years old), *Elementary* (ages 6-12), *Secondary* (ages 13-21) and *Adult* (ages 22 and older). The disabilities were coded as either *AU*, including pervasive developmental disorders, autism, and Asperger syndrome, *ID* and *Other*. The primary disability label was used to determine the group in which the participant belongs. Therefore if a participant's primary disability was AU but they had a secondary disability label of ID the individual was coded as *AU*. If the reverse was true, ID was primary and AU was secondary, the participant was coded as *ID*. Any other disability was labeled as *Other*.

Data Analysis

Data from the articles were compiled and analyzed following coding (Berman & Parker, 2002; Kavale, 2001; Kavale et al., 2000; White et al., 1989). Most single-case research studies do not calculate ES measures to determine the magnitude of change between baseline and intervention. Therefore, ES was calculated comparing baseline performance to intervention (Kavale, 1998) for each study. In a meta-analysis, individual effect sizes are summarized to create a common unit for comparison between levels.

Unfortunately, the field has not reached a consensus regarding what effect size or analysis method is most appropriate in single-case research (Berman & Parker, 2002; Busse, Karochwill & Elliot, 1995; Center, Skiba & Casey, 1985; Kavale et al., 2000; Schneider, Goldstein & Parker, 2008; Scruggs, 1992; Scruggs & Mastropieri, 2001). Most data from single-case research do not follow the assumptions required for parametric measures, such as normal distribution and scale type (Parker et al., 2011).

When data do not follow parametric assumptions, for example, when the data is highly variable, measures such as mean, median and mode do not accurately represent the data, so non-parametric measures should be used. Among all the non-parametric measures most suitable for single-case designs, non-overlap methods are simpler and distribution free (Parker & Vannest, 2009; Parker et al., 2011).

Effect size calculations. Robust improvement rate difference (IRD) (Parker et al., 2011) was selected as the metric for calculating effect sizes in this study. Robust IRD is a calculation of the improvement rate for the intervention phase minus the improvement rate for the baseline phase (Parker et al., 2009). To compute improvement rate the researcher divides the number of “improved data points” in each phase by the total number of data points in that phase. Parker et al. define an improved data point for baseline as any point that “ties or exceeds any data point” (2009, p 139) in the intervention phase. An improved data point in the intervention phase is considered improved if it ties or exceeds *all* data points in the baseline phase (Parker et al., 2009). A 2 X 2 table is used to help organize the data in each IRD calculation. “Improved” data points for baseline, improved data points for intervention, not improved data points for baseline and not improved data points for intervention are entered into the cells within the table (Parker et al., 2009). The number of improved data points in both phases are added together and then divided equally into the two improved boxes in the 2 X 2 table. This process causes robust IRD to be less susceptible to outlier data points because these data points are spread equally between the two phases.

Robust IRD is equal to Phi, which is a respected Pearson correlation for a 2 X 2 table, as well as Cohen's Kappa and Cramer's V (Parker et al., 2011). By using software to run the analyses one can obtain confidence intervals and *p* values. Robust IRD has also been applied in single-case meta-analyses (Davis & Vannest, in press; Ganz, Parker, & Benson, 2009; Vannest, Davis, Davis, Mason, & Burke, 2010; Vannest, Harrison, Temple-Harvey, Ramsey, & Parker, 2010). Parker et al. (2009) loosely proposed criteria of robust IRD scores .50 and below as very small or questionable, .50 to .70 as moderate effects and .70 and greater as large and very large.

Robust IRD has advantages over other effect sizes, such as PND. PND calculations involve comparing data in intervention phases to the highest/lowest data point in baseline to determine the proportion of data points in the intervention phase that overlap with the baseline data (Scruggs, 1987; Scruggs & Mastropieri, 2001). PND has met with criticism because this metric does not allow confidence intervals because the sampling distribution is unknown (Parker et al., 2007). This metric is also unreliable because the results may be dependent on a data point that is considered an outlier in the baseline condition. If the baseline data are highly variable or contain a single outlier, the results will be unreliable because the entire ES is set on that outlier data point. PND should not be applied in meta-analyses due to the fact that PND has no calculable standard error (SE) and therefore cannot be combined according to meta-analysis guidelines. According to Parker et al. (2011), SE can be calculated when using Robust IRD, unlike PND.

Robust IRD can be confounded by positive baseline trend (Parker et al., 2009). Thirty data sets from this meta-analysis were randomly selected for visual analysis to determine if positive baseline trends may skew the results. Less than 5% of the 30 data sets had positive base line trend. This meta-analysis will therefore utilize Robust IRD for all effect size measures. IRD has been used in several recent single-case meta-analyses (Ganz, Earles-Vollrath, Heath et al., 2012; Ganz, Earles-Vollrath, Mason et al., 2011; Vannest et al., 2010).

Phase contrasts. Robust IRD was calculated by contrasting baseline with intervention phases for each single-case design. The major designs used in the studies reviewed were multiple-baseline designs and ABAB. For all comparisons this meta-analysis compared the first baseline with the first phase of intervention (A1 to B1). In the case of a multiple baseline designs the data from each level of the design were analyzed by comparing the baseline to the first phase of intervention In the case of ABAB designs A1 was compared to B1.

This decision was made due to the nature of the intervention and the types of research studies. FCT often includes teaching a verbal skill making it difficult to return to baseline conditions. Also many studies compared FCT to other interventions so the other phases of intervention included variations to FCT. Baseline to generalization, or maintenance, comparisons were computed to ensure that all relevant data were accounted for within each potential moderating variable.

Robust IRD scores were combined to determine the effectiveness of FCT overall. Robust IRD calculations were also combined according to each level of the potential

moderating variables to answer the questions posed in this research study. The data were processed using Number Cruncher Statistical Software (NCSS, Hintze, 2002), a common statistical analysis program. NCSS has a built in meta-analyses algorithm that is able to calculate an average ES. It does this by applying weights to each study's ES based on the inverse of the standard error.

Fixed effect size model. A *fixed effect size* model was used when calculating the Robust IRDs because it is reasonable to assume that there is one *true effect* that can be determined through a review of the existing data (Borenstein et al., 2009). In a *fixed effects* model all error is due to sampling and with an infinite number of samples the *true effect* can be found (Borenstein et al., 2009). Each study included in this meta-analysis applied the same treatment, FCT. In each study the goal of the intervention was to decrease challenging behavior by increasing appropriate communicative responses. If FCT is an effective intervention there should be one *true effect* observed in every study that utilized FCT. This meta-analysis was interested in determining the *true effect* of FCT and therefore the *fixed effects* model was used.

Determining Statistical Significance

Each level of the potential moderator variable was compared to determine if there is differential effect between the levels within the potential moderating variable. Statistically significant ($p=.05$) differences were determined by comparing the CI for each group within the moderator by setting the CI to 84.3%. Results were considered statistically significant ($p=.05$) if the CI for each measure did not overlap at the upper and lower limits (Payton, Miller & Raun, 2000; Payton, Greenstone, & Schenker, 2003;

Schenker & Gentleman, 2001). If the data revealed statistically significant differences between the levels the variable was confirmed as a moderator because the levels differentially affected the intervention.

Forest plots. Forest plots were created to visually display the IRD results for each comparison. A forest plot visually displays the individual ES and CI for each comparison (Lewis & Clark, 2001; Parker et al., 2009). The X-axis is the IRD scores and CI values. The highest number on the X-axis is 1 because the highest possible robust IRD score is one. An IRD score of 1 occurs when there is no overlap between the two phases. A negative IRD score reveals that there was potentially more improved data in the baseline phase than in the intervention phase of the intervention. The forest plot itself has a diamond representing the robust IRD score for that particular comparison. The dotted lines on either side represent the confidence intervals around the robust IRD score. Studies with small CI have more reliable results. Whereas studies with wider CI mean that the researcher can be less confident that the IRD score is a true representation for the population.

Forest plots can also be used to compare the consistency of the results within the levels of a potential moderating variable and help identify outlier data points that may skew the overall IRD score for each level. If the ES measures are closely group with a majority of the CI overlapping it can be stated that the results for that level are consistent and therefore the combined robust IRD score is a reliable measure of the true effectiveness of FCT. The forest plots created for each level will be used to help identify outlier data points as well as guide decisions about consistency of the data.

Inter-Observer Agreement

To ensure that IRD calculations were reliable, 35% of the total IRD calculations were conducted by two raters. Inter Observer Agreement (IOA) was determined by dividing the number of times the raters entered the same number in each cell within the 2 X 2 tables divided by the total number of cells in all 2 X 2 tables combined. There were 147 comparisons within and between all the studies. That means that 51 IRD 2 X 2 tables were completed by two raters. The tables were compared prior to adding the improved data points and dividing them equally between the two improved quadrants in the table to ensure that the data were accurate prior to manipulation.

Summary

An extensive literature search using Academic Search Complete, Medline and PsychINFO was completed using the following terms, 'functional communication training,' 'functional communication,' 'functional analysis communication,' and 'mand training,' in an attempt to find all studies that met the inclusion criteria. The studies were coded according to the following potential moderating variables: (a) type of functional analysis, (b) mode of communicative response, (c) location of implementation, (d) function of the behavior, (e) participant age, and (f) disability. Robust IRD scores were obtained for each study and then analyzed using NCSS according to potential moderating variables and levels. Overlap among the upper and lower limits of the CI for each IRD score were used to find statistically significant differences between the levels within the potential moderators. These data were then examined to answer the research questions.

CHAPTER III

RESULTS

The literature search resulted in 39 studies that met all the criteria for inclusion within the study. Eighty eight participants were included across the studies. Appendix B includes a table with the information about each study regarding disability category, age, function, mode of communication, environment of implementation, FA type, summary of intervention and results. Of the 39 studies, reversal, multiple-baseline across participants, and alternating treatment designs were the most frequently used designs.

One hundred and forty seven different IRD analyses were run across the 36 studies. Fifty one, or 35%, of those analyses were assessed by two raters to determine IOA. Each cell of the 2 X 2 IRD table was compared to determine the percent of cells in which both raters had the same score for each of the randomly chosen fifty one comparisons. The IOA score was 85.3%. This score was high enough to proceed with analyzing the data to determine the effectiveness of FCT overall and across different moderators.

Overall Results

In order to determine overall IRD for each study the IRD 2 X 2 tables for each comparison within a study were combined and then NCSS was used to run Robust IRD on each study. The combined overall IRD for FCT was 0.86 (CI = 0.85 - 0.87). According to Parker et al. (2009) this is a large effect. The IRD scores and CIs for each study are fairly wide spread. Peck Peterson et al. (2005) was an outlier score and the

lowest IRD score of -0.25. The follow-up data negatively impacted the IRD results for this study, because the challenging behavior was more severe than in the baseline condition. Mancil et al. (2006) had the highest IRD score of 0.96. All other scores were fairly well spread between these upper and lower numbers. Of the thirty nine studies included in this meta-analysis 54% of the studies ($n = 21$) fell within the large to very large range in overall ES. Only 15% of the studies ($n = 6$) fell in the very small or questionable range of .50 and below (Fisher, 1993; Hagopian et al., 2004; Harding et al., 2009B; Kelley et al., 2002; Peck Peterson et al., 2005; Winborn-Kemmerer et al., 2010).

Type of Functional Analysis

Functional analysis was divided into three levels: *Complete*, *Brief* and *Other*. Braithwaite and Richdale (2000) used a functional behavioral assessment that did not include a functional analysis portion. Jarmolowicz et al. (2009) reported that they did an FA but only reported the results without reporting the method used. Both studies are included in the *Other* category. Due to the lack of data for *Other* these data were not analyzed. Of the thirty six studies 66% of the studies used a *Complete* FA ($n = 24$) functional analysis and 33%, used a *Brief* FA ($n = 10$).

Table 1 contains the results for this comparison. Interventions using *Brief* FAs (0.83) had the largest effect size, and the CI do not overlap with the results for the studies using *Complete* FA (0.68), as can be seen in Figure 1. The ES for the studies using *Brief* FAs is a very large effect while the ES for *Complete* level is a moderate size. It can be stated that there is a significant difference between these levels and that FA is a moderator variable for FCT, based on the results of this meta-analysis.

Table 1

Robust IRD for Functional Analysis

Level	IRD	LL	UL	# of Studies	# of analyses
<i>Brief</i>	0.8333	0.8041	0.8625	10	35
<i>Complete</i>	0.6760	0.6561	0.6959	24	107
<i>Other</i>	0.8915	0.8122	0.9708	2	3

Note: LL = Lower Level; UL = Upper Level; CI set to 83.4%, IRD = Improvement Rate Difference

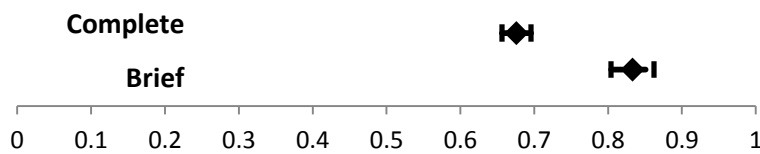


Figure 1. Robust Improvement Rate Difference for functional analysis.

Upon visual analysis of Figure C-2, the IRD scores for the *Brief* level are less spread out, and only two studies would be considered outliers. The results for the studies using *Brief* FA can be considered more reliable than for the studies using *Complete* FA (Figure C-3). The two lowest outliers in *Complete* came from the same study, Peck Peterson et al. (2005). The other results from *Complete* are more evenly spread out, so the results are less reliable. Overall FCT appears to be most effective when based on the results of a *Brief* FA.

Mode of Communication

Mode of communication was coded as *Verbal*, *A-AAC*, *U-AAC*, or *Multiple*. Of the 147 analyses 34%, were coded as *Verbal* (n = 49), 43%, were coded as *A-AAC* (n = 63), 31, 27%, were coded as *U-AAC* (n= 31), and only 1%, were coded as *Multiple* (n = 2). Because there were only two ES for *Multiple*, the data were not analyzed for this level. Table 2 contains the IRD results for the combined scores for mode of communicative response.

Table 2

Robust IRD for Mode of Communication

Level	IRD	LL	UL	# of studies	# of analyses
<i>Verbal</i>	0.8264	0.8033	0.8496	19	49
<i>A-AAC</i>	0.7381	0.7102	0.7659	19	63
<i>U-AAC</i>	0.4765	0.4382	0.5149	11	31

Note: LL = Lower Level; UL = Upper Level; CI set to 83.4%, IRD = Improvement Rate Difference

Verbal (.83) had the largest and *U-AAC* (.48) had the lowest ES. Figure 2 provides a forest plot of the combined ES measures for each level. Through visual analysis of the forest plot, it is clear that the CI for *Verbal* and *U-AAC* do not overlap. Thus, there is a significant difference between the effectiveness of *Verbal* and *U-AAC*. *A-AAC* (.74) also had large effect on FCT. The CIs for *A-AAC* and *Verbal* do not overlap; therefore, FCT appears to be more effective when using verbal modes of communication rather than *A-AAC* and *U-AAC*. The results for *U-AAC* and *A-AAC* are

statistically different because, CIs for these two levels do not overlap; thus *A-AAC* methods are more effective than *U-AAC* methods when implemented during FCT. Based on these results, mode of communication is a moderating variable for FCT.

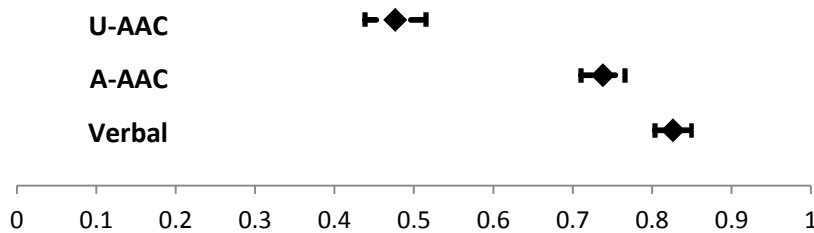


Figure 2. Robust Improvement Rate Difference for mode of communication.

IRD scores for the *A-AAC* moderator are fairly closely grouped with five studies that are clustered lower than the rest of the group (Figure C-5). The *Verbal* moderator has the most significant scores when looking at the combined score and confidence interval. Through visual analysis of Figures C-6, it is apparent that there are four outlier scores with a majority of the rest of the scores clustered between 0.6 and 1.0 IRD. The results for the *U-AAC* moderator are very widely and evenly spread, indicating that the results are less reliable (see Figure C-7). The scores are more closely grouped for *Verbal* with fewer outlier data points, therefore the results are more reliable for this level as compared to *U-AAC* and *AAC*. *Verbal* also had the strongest ES measure and is the most effective method of communication when implementing FCT.

Location of Implementation

Location was coded into two levels, *Natural* and *Contrived*. Only 25% of the studies were coded as *Natural* ($n = 9$) and 75% were coded as *Contrived* ($n = 27$). The results of the Robust IRD analysis are in Table 3. The effect size for the *Natural* setting (0.76) was larger than that of the *Contrived* setting (0.72). There is overlap between the confidence intervals for both levels (see Figure 3); therefore there is no significant difference between the two levels. Based on these results location of implementation does not moderate the effectiveness of FCT.

Table 3

Robust IRD for Location of Implementation

Level	IRD	LL	UL	# of studies	# of analyses
<i>Contrived</i>	0.7225	0.7039	0.7410	27	101
<i>Natural</i>	0.7644	0.7319	0.7969	9	44

Note: LL = Lower Level; UL = Upper Level; CI set to 83.4%, IRD = Improvement Rate Difference

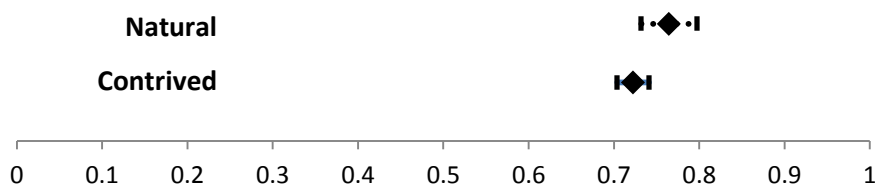


Figure 3. Robust Improvement Rate Difference for location of implementation.

Through examining Figures C-8, C-9 and C-10, the scores for both moderators are spread out. The *Contrived* scores (Figures C-8 & C-9) were more spread out with some scores falling to the negative range. The scores from the *Natural* level (Figure C-10) were less spread, than the *Contrived* scores but the results are still not grouped closely enough to be consistent. After analyzing the forest plots and comparing the combined results for each level it is clear that there is no significant difference between the two moderators and the Robust IRD scores within each level are inconsistent and possibly unreliable. Therefore FCT appears to be equally effective in both *Contrived* and *Natural* settings.

Function of the Behavior

The function of the behavior was coded as *Attention*, *Tangible*, *Escape* and *Multiple*. Some studies analyzed different functions of behavior so these robust IRD comparisons were examined independently and therefore increased the number of comparisons to 147 rather than 85. The levels of this moderator included 14% that were coded as *Attention* ($n = 21$), 33% that were *Tangible* ($n = 48$), 38% which were coded as *Escape* ($n = 56$) and 14% which were *Multiple* ($n = 20$). For behavior that served *Multiple* functions, escape with tangible and escape with attention were the two most common combinations. Table 4 contains the results of the robust IRD scores for the function of the behavior. Figure 4 contains the forest plot for the IRD results for each level to help assist with visual analysis.

Table 4

Robust IRD for Function

Level	IRD	LL	UL	# of studies	# of analyses
<i>Attention</i>	0.8118	0.7656	0.8581	11	21
<i>Tangible</i>	0.8008	0.7747	0.8269	17	48
<i>Multiple</i>	0.6795	0.6234	0.7357	11	19
<i>Escape</i>	0.6581	0.6331	0.6830	20	57

Note: LL = Lower Level; UL = Upper Level; CI set to 83.4%; IRD = Improvement Rate Difference

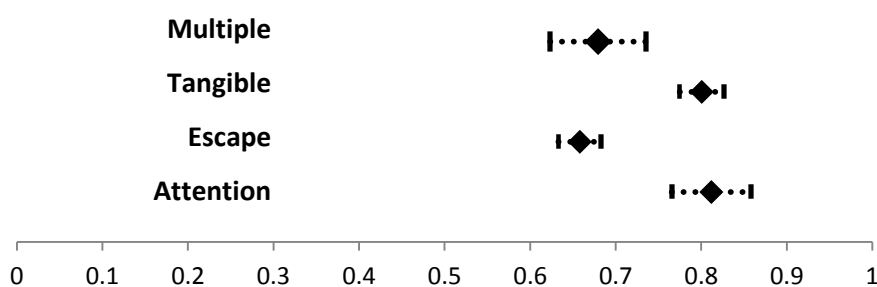


Figure 4. Robust Improvement Rate Difference for function of the behavior.

Behaviors maintained by *Attention* (0.81) had the highest ES – a large effect. *Escape* (.66) maintained behaviors had the smallest ES but still fell within the moderate effect range. The CIs for *Escape* and *Attention* maintained behaviors do not overlap; therefore, the effectiveness of FCT for *Attention* functions is significantly different from *Escape* maintained behaviors. *Tangible* (.81) was equal with *Attention* but the CI for *Tangible* was slightly smaller than the CI for *Attention*. *Multiple* (.68) had a moderate effect on challenging behavior. The CI for *Multiple* does not overlap with the CI for

Attention; therefore FCT with behaviors maintained by *Attention* rather than *Multiple* functions produce significantly higher effects. *Tangible* and *Escape* do not overlap; therefore, the use of FCT for *Tangible* functions resulted in significantly higher effects than for *Escape*-related functions. FCT applied in situations in which behavior functioned to gain access to *Tangible* items also resulted in significantly higher effects when compared to behavior serving *Multiple* functions. *Multiple* and *Escape* both have moderate ES measures. The ES and CI for *Escape* based behaviors are completely contained within those for *Multiple* functions and therefore FCT is equally effective when utilized with *Escape* and *Multiple* functions of behavior.

Figures C-11, C-12, C-13, and C-14 are the Forest Plots for each level for the functions of behavior. The individual scores for both the *Attention* (Figure C-11) and *Multiple* (Figure C-12) functions are very closely grouped with only a few outliers for each function. These results appear very reliable. The *Escape* (Figure C-13) and *Tangible* (Figure C-14) levels are equally spread with six or seven outlier data points for each level. The scores are also more spread and therefore less reliable. Based on the results from the combined IRD score and the forest plot analyses FCT works best for individuals whose behavior functions as an attempt to gain attention from others or gain access to tangible items.

Participant Age

The ages for each participant were coded into *Primary*, *Elementary*, *Secondary* and *Adult*. Fisher et al. (1993) did not report the ages of the participants in their study so four participants are not included in the results for this analysis. Twenty eight percent of

the participants were in the *Primary* age group ($n = 23$). Forty percent of the participants were *Elementary* age ($n = 33$). Only 16% of participants were in the *Secondary* age group ($n = 13$) and 16% were *Adults* ($n = 13$).

Table 5

Robust IRD for Age

Level	IRD	LL	UL	# of studies	# of analyses
Primary	0.8258	0.7969	0.8547	14	41
Secondary	0.7803	0.7272	0.8335	9	16
Elementary	0.7576	0.7336	0.7817	22	64
Adult	0.6368	0.5847	0.6889	4	17

Note: LL = Lower Level; UL = Upper Level; CI set to 83.4%; IRD = Improvement Rate Difference

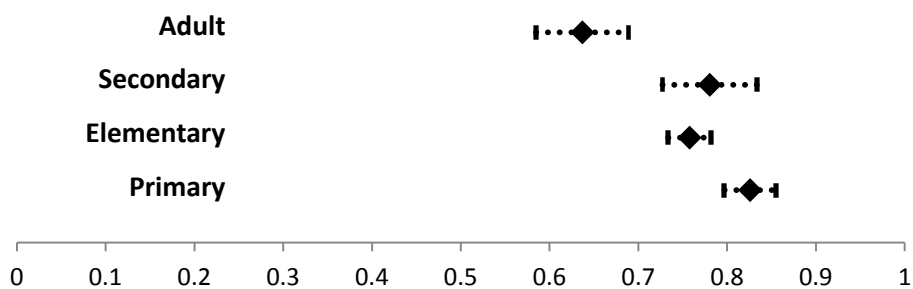


Figure 5. Robust Improvement Rate Difference for age of participants.

Table 5 contains the results for each of FCT when applied to the different age groups. All of the ES fall within the moderate or large effects. Individuals in the *Primary* age range had the highest IRD result of 0.83, and the *Adult* age range had the lowest IRD score of 0.64. The CI for individuals in the *Adult* and *Primary* age ranges do not overlap, as seen in Figure 5, therefore FCT has a significantly higher effect for individuals in the *Primary* age range than for *Adults*. The *Secondary* (.78) age group had a large effect size but the CI overlaps at the upper most end with the *Primary* age range. FCT is equally effective with *Primary* and *Secondary* age individuals. The CI for *Elementary* (.76) ages does not overlap with individuals in the *Primary* age group, so there is a significant difference between the two levels. The *Secondary* and *Adult* age groups do not have CI that overlap and have a statistically significant difference, with FCT being more effective for individuals in the *Secondary* age range. Individuals in the *Secondary* and *Elementary* age range are very close in ES and their CIs overlap. In fact, the scores for individuals at the *Elementary* age range fall completely within the CI for individuals in the *Secondary* age range, so FCT is equally effect when administered with either age range. The final comparison is between individuals of *Elementary* age and *Adults*. The *Elementary* age group had a larger ES than *Adult* level. FCT is significantly more effective for individuals in the *Elementary* age range than for *Adults*.

In analyzing the forest plots all of the results are fairly consistent with three to four data points as outliers for each moderator (Figures C-15, C-16, C-17 and C-18). Individuals in the *Secondary* age group appear to be the most consistent with a majority of the scores at the higher end (Figure C-15). *Adults* produced robust IRD scores that

were fairly spread but none of the scores fell below zero (Figure C-16). *Elementary* age individuals have the most IRD comparisons and appear to be the most spread out (Figure C-17). The scores for individuals in the *Primary* age group (Figure C-18) were slightly more reliable than those of *Elementary* age. Based on the combined scores and the forest plot analysis of the IRD results, FCT is most effective with school age children (*Primary, Elementary* and *Secondary*) and least effective with *Adults*.

Disability Category

Disability was divided into three levels, *autism (AU)*, *intellectual disability (ID)* and *Other*. There were 46% analyses with individuals with *AU* (n = 84), 31% analyses with individuals with *ID* (n = 45) and 11% with *Other* disabilities (n = 16). Table 6 contains the results for the robust IRD analyses along with their corresponding confidence intervals. Figure 6 is the forest plot for the combined results for each level to aid in visual analysis of the data.

Table 6

Robust IRD for Disability

Level	IRD	LL	UL	# of studies	# of analyses
AU	0.7865	0.7670	0.8060	24	84
Other	0.6679	0.6134	0.7225	6	16
ID	0.6431	0.6147	0.6715	16	45

Note: LL = Lower Level; UL = Upper Level; CI set to 83.4%; IRD = Improvement Rate Difference

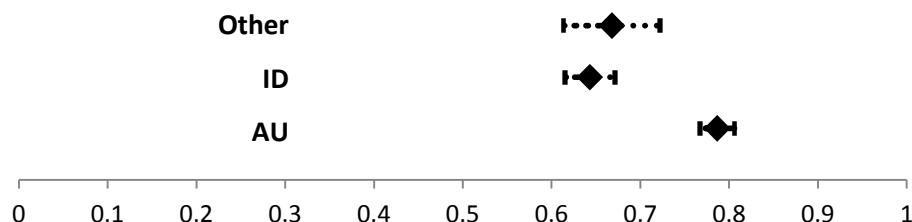


Figure 6. Robust Improvement Rate Difference for disability.

The effect size for individuals *AU* (.79) was higher than for individuals with *ID* (.64). Confidence intervals for individuals with *AU* do not overlap with individuals with *ID*, so FCT has a significantly higher effect when implemented with individuals with *AU* and rather than individuals with *ID*. Individuals with *AU* also have a higher ES than *Other* (.67) disabilities. The CI for individuals with *AU* and *Other* disabilities do not overlap. Significant difference persists between the effectiveness of FCT for individuals with *AU* versus individuals with *Other* disabilities. The ES for individuals with *ID* and *Other* disabilities are within 2 points of one another and the CI for *Other* disabilities is completely contained within the CI for individuals with *ID*. There is no statistical difference between the results of FCT with individuals with *ID* and *Other* disabilities.

Results of the forest plot analyses show that FCT is much more reliable when used with individuals with *AU* because the results are grouped more tightly together with only five outlier data points (Figures C-19 & C-20). Individuals with *ID* had scores (Figure C-21) that were spread out and less reliable than the scores for individuals with *AU*. Scores for individuals with *Other* disabilities were much more spread with two

outlier data points that were not very far from the rest of the group (Figure C-22). Based on the visual analyses of the forest plots and the combined IRD scores, FCT may be more effective with individuals with *AU* rather than with *ID* or other disabilities.

Summary

Overall FCT was found to be an effective intervention to decrease challenging behavior. FCT appeared to be more effective when the intervention was based on the results from a *Brief* FA. FCT was found to be most effective when the results of the FA determined that the student's behavior was an attempt to gain attention, or gain access to a tangible item. The most effective mode of communication was verbal responses. FCT may be more effective when used with school age children (primary through secondary) with autism. Based on the results of this meta-analysis FCT can be effectively implemented in both contrived and natural settings. FA, mode of communication, age, disability, and function of behavior are all moderator variables for FCT.

CHAPTER IV

CONCLUSION/DISCUSSION

Overall Effectiveness

Determining FCT's effectiveness in reducing challenging behavior was the primary question posed in this meta-analysis. The following questions were also posed; (a) Is FCT more effective with a complete or brief functional analysis? (b) Is FCT differentially more effective for one communication mode versus another (unaided augmentative and alternative communication, aided augmentative and alternative communication, or verbal), (c) Is FCT more effective when implemented in natural or contrived contexts? (d) Is FCT more effective for different functions of challenging behavior (attention, tangible, escape and multiple)? (e) How effective is FCT with individuals with challenging behavior, across different age ranges? (f) How effective is FCT with individuals with challenging behavior, across different disability categories?

Overall the results of this meta-analysis support the findings of the NPDC-ASD (2009) in listing FCT as an evidence based practice. This study found that FCT is highly effective in decreasing challenging behavior. While FCT is an evidence based practice, this meta-analysis identified variables that may moderate the effectiveness of FCT.

Effectiveness by Variable

Functional analysis. The first potential moderating variable was the type of FA implemented – brief or complete. Results from the Robust IRD analyses found brief FAs produced higher rates of behavioral change than complete FAs. When

implementing FCT interventionists can save time and resources by utilizing brief FA procedure to help determine the function of the challenging behavior. While there was a significant difference between the two levels, the results should be viewed with caution.

Both the complete and brief FA levels had studies from a wide span of years, age ranges, and disabilities. The major difference between the two levels was the number of studies in each level. Fewer studies utilized brief FAs (10 studies) than complete FAs (24 studies). This may have had an impact on the results. It is possible that the studies utilizing a brief FA technique are not a true reflection of the population. The results for studies using brief FAs may therefore be an example of sampling error and should be viewed with caution. Five studies utilizing brief FAs were conducted by the creators of FCT (Durand & Carr, 1991; Durand, 1993; Durand, 1999; Durand & Carr, 1987; Durand & Carr, 1992). This may be evidence that the data is skewed towards higher effect size scores. It is unclear how much of an impact this had on the data itself. Overall, FCT is effective using either a complete or brief FA. More research is needed with brief FA and FCT to determine if the results are a true reflection of the population.

Mode of communication. Mode of communication was the next variable of interest in this study. This variable was coded into four levels: (a) A-AAC, (b) U-AAC, (c) Verbal or (d) Multiple. Multiple modes of communication did not have enough participants, so this level was dropped from the analysis. Based on the results of this study verbal modes of communication are the most effective mode of communication with A-AAC as the next most effective mode of communication. U-AAC fell into the small or questionable range. Mode of communication should be selected based on the

individual's ability to use the communicative response (Durand, 1990). A majority of the individuals using verbal as a mode of communication did not have ID as either a primary or secondary diagnosis. The strong results for individuals using verbal responses may be tied to the cognitive level of the participants. U-AAC was most often utilized with individuals with ID as a primary diagnosis and therefore the results may be skewed by the participants' cognitive abilities. Lower cognitive ability may have impacted the individual's ability to learn the new communication skill and thereby decrease the effectiveness of the intervention. The studies included in this meta-analysis did not contain specific information about the participants' cognitive functioning on any assessments; therefore more research is needed to support this finding.

There has been much debate over whether U-AAC is more effective than A-AAC, specifically comparing sign language to the Picture Exchange Communication System, for individuals with autism (Tincani, 2004). Tincani (2004) found that PECS was more effective for one participant, whereas sign language (U-AAC) was more effective for the other participant. Individual learning preferences and learning styles may have impacted the results for Tincani (2004). Learning preference and learning styles should be taken into consideration in the planning phase of FCT. Therefore cognitive ability may be the best possible explanation for the difference between the levels. In order to determine if the difference between the levels was truly due to the mode of communication all other variables would need to be consistent between each level.

This meta-analysis indicates that verbal responses and A-AAC result in stronger effects than *U-AAC*. These results should be viewed with caution based on the discrepancy between the cognitive levels of the participants across the modalities. Interventionists should always take into consideration the needs and learning rates of the individuals when determining the mode of communication.

Location of implementation. Contrived versus natural settings were compared to determine their effect on the implementation of FCT. The results of the Robust IRD analysis show no difference between the settings of implementation for FCT. FCT is equally effective in both *Contrived* and *Natural* settings with large effects for both. In the process of determining the function of the behavior, and selecting an appropriate communicative response, the setting for the intervention had an impact on the process. FCT should therefore be effective in the environment in which it was designed to be implemented.

Functions of the behavior. FCT's effectiveness was examined across different functions of behavior (Attention, Tangible, Escape and Multiple). When behavior functioned as a means to gain attention or tangible items, the results were equally effective, both with very large effects. FCT is less effective with behavior that serves as a means of escape or behaviors with multiple functions.

When developing communication skills individuals learn how to communicate by first labeling and then asking for the item (Sundberg, 1983). When an individual's challenging behavior serves as a means to gain access to attention or an item, the communicative response could be the name of the item or person in which the individual

desires to interact with. In this case the individual is being taught a communication response that follows the natural progression of learning to communicate. This may therefore lead to higher rates of using the response and therefore higher rates of decreased challenging behavior. In the case of escape maintained behavior the individual is usually taught to request a break. The idea of a break may not be clearly defined for the individual and therefore may be less likely to be utilized because the individual is may not understand what they are requesting.

Another factor that may have impacted the effectiveness of FCT with escape maintained behavior is that when an individual is attempting to escape from a task they may be attempting to gain access to attention from an adult or peer, a new task, time alone, or possibly a preferred item (Hagopian et al., 2001). In these situations the individual usually learns to request a break but is not taught how to appropriately request what the individual is trying to get. The secondary function of the challenging behavior is not being met and therefore the individual may continue to rely on challenging behavior in order to gain access to the secondary reinforcer. The results for challenging behavior that serves as a means to escape may have been unfairly biased by this inconsistency within the intervention itself.

FCT appears to be less effective when applied to situations where the behavior serves multiple functions. The communicative response needs to meet the same function as the behavior (Durand, 1990). If the behavior serves multiple functions, for example escaping school work and gaining access to preferred toys or attention, it may be difficult to find one communicative response that appropriately matches the needs of the

individual. The communicative response may only address the need for attention and not address the desire for the tangible item as well. Further research is needed to confirm these hypotheses.

Age of participants. FCT was also examined based on the age of the participants. FCT had the largest effect on challenging behavior for individuals at the primary age level. The results for primary aged individuals were not statistically different from elementary and secondary age groups. These three groups are statistically significant when compared to adult participants.

Federal legislation mandates early intervention because it is the most effective means of changing an individual's quality of life (Anderson et al., 2003; IDEA, 2004; Love et al., 2005; Ramey & Ramey, 1998, Ramey et al., 2000). All children at the primary age are still building appropriate communication skills. As an individual gets older communication skills may be more difficult to develop. Ganz et al. (2011) found that A-AAC was more effective with individuals at younger ages. The current study confirms that communication skills may be easier to learn at younger ages. This may have led to FCT being more effective at earlier ages. As an individual gets older FCT can still be effective but the effects are potentially less "strong." Results may be skewed due to the small number of adult participants.

Disability categories. The final variable of interest was disability. There was a significant difference between the effectiveness of FCT with individuals with autism versus individuals with ID and other disabilities. Students with autism and ID may have impaired communication skills (Heflin & Alaimo, 2007; Pinborough-Zimmerman et al.,

2007). When communication skills are impaired, individuals are more likely to exhibit challenging behavior (Carr, 1985; Carr & Durand, 1985; Neel et al., 1983; Reichle & Yoder, 1979). FCT focuses on improving communication skills in an attempt to decrease challenging behavior (Durand, 1990). The cognitive ability of the individuals with ID may have impacted their ability to obtain and use the new communicative skill.

Individuals with ID may have impaired communicative ability as well as impaired cognitive ability. This is not true for the individuals with autism in this study. While some of them had a dual diagnosis of autism and ID a majority of them did not and therefore there was potentially a difference between the two levels. This difference was dependent on the individuals being correctly diagnosed. A majority of the articles did not report cognitive ability so there was no way to confirm if there was a difference between the individuals with autism and individuals with ID.

Limitations of this Study

This study was limited in that all of the levels were not equally populated. A small *n* for any level allows outlier data points to have a stronger impact on the results. This can cause the confidence intervals to be larger. Statistical significance is determined by overlap of the CIs (Payton, Miller & Raun, 2000; Payton, Greenstone, & Schenker, 2003; Schenker & Gentleman, 2001). Smaller CI could reduce overlap and therefore impact statistical significance. The levels impacted the most were *Other* disabilities, *Multiple* modes of communication, *Other* FA, and *Adult*.

This study was also limited by the information provided in the studies. Cognitive and communicative ability were not reported in any of the studies. Cognitive and

communicative ability may have impacted the effectiveness of FCT within each level. This information provided some clarity about why individuals with AU had larger ES than ID or other disabilities. The level for disability could have been dropped, and cognitive and communicative ability added as potential moderator variables if studies were consistently reporting this data.

Implications for Practice

This study confirms the findings of the NPDC-ASD (2009), that listed FCT as an evidence based practice. This meta-analysis also confirms the conclusions of Kurtz et al. (2011). The NCLB (2001) and IDEA (2004) laws push for schools to use evidence based practices as their primary strategies. FCT is an individualized intervention that is effective at decreasing challenging behavior as well as teaching a more appropriate replacement behavior. Challenging behavior can lead to teacher turn over and more restrictive settings for the individual displaying the challenging behavior (Hastings & Brown, 2002; Lowe et al., 2007; Machalicek et al., 2007). Finding reliable interventions that can decrease the challenging behavior should be a high priority for interventionists.

Current findings show that FCT appears to be an effective intervention that can be implemented in all environments. A majority of the studies implemented in contrived settings were also implemented by researchers. Conversely, a majority of the studies implemented in natural settings were implemented by teachers and family members. It is possible to assume that FCT is effective in any environment with an implementer that is trained in the intervention. FCT is therefore a very individualized intervention that can be applied in a variety of settings with a variety of implementers.

Future Research

Overall FCT was found to be highly effective in decreasing challenging behavior. More research is needed to determine if cognitive ability or communicative ability impact the effectiveness of FCT. For this to be addressed, research studies need to include information for each participant in regards to cognitive and communicative ability based on standardized assessments.

A limited number of studies included adults and individuals at the secondary age range. Kurtz et al. (2011) found similar results in that the adult age range was limited in high quality studies and therefore considered *probably efficacious*. The lack of participants in the secondary and adult levels is a limitation within the field of FCT research as a whole. This could be due to the fact that public schools provide easy access to research participants. Once individuals are no longer in public schools it may be harder to find participants.

Another topic for future research is type of functional analysis. The current study found that a brief FA led to more effective results than a complete FA. Both complete and brief FAs are effective in determining the function of a behavior (Durand, 1990; Durand & Carr, 1991; Durand & Merges, 2001). The FA is the foundation of FCT (Durand, 1990; Mancil, 2006; Kurtz et al., 2011). If the function is accurately identified the intervention is more likely to be effective (Durand, 1990). The current study was unable to determine why a brief FA led to more effective results than a complete FA. More research is needed to investigate this finding.

Conclusions

FCT is an effective intervention for decreasing challenging behavior. Age, disability, type of FA, mode of communication, and function of the behavior all moderate the effectiveness of FCT. FCT was most effective with primary and elementary age children with autism. A brief FA can effectively determine the function of the behavior and be used to develop an effective intervention. When FCT is applied in situations in which attention or tangible are the function of the behavior FCT has higher rates of positive behavioral change. Verbal communication may lead to higher ES. The only variable that did not change the effectiveness of FCT was the setting of implementation. More research is needed to determine if these results accurately reflect the current field of research with FCT. As with any intervention, the needs of the individual should always guide the implementer in choosing an appropriate strategy. The results of this meta-analysis can be used to guide the decision making process when implementing FCT.

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APPENDIX A

INCLUSION CRITERIA EXPLAINED

Each observer will receive one set of pdf files and an excel sheet for entering their responses. It is the observer's responsibility to review each article according to the following inclusion criteria. Use the Excel sheet to track your comments for each article. If the article meets each criterion (Yes to all) then the article is accepted. If you answer no please briefly state why you said no in the comments section.

FCT Inclusion Criteria

1. Participants must have a disability that impacts their ability to learn in a general education setting.
 - a. Potential disabilities include: Autism, Autism Spectrum Disorder, Pervasive developmental disorder- not otherwise specified, developmental disorders, emotional behavioral disorder, intellectual disability, cerebral palsy, chromosomal abnormalities, down syndrome may also apply.
 - b. Speech impairment alone does not meet these criteria since there is no significant impact on the individual's ability to learn.
 - c. Location in the article: This information is usually found in the methods section of the paper. It is also sometimes mentioned in the in abstract.
2. Outcome variable: The study must directly measure challenging behavior.
 - a. This can include: aggression, Self-injurious behavior, throwing a tantrum, eloping, property destruction, kicking, hitting, biting, etc.
 - b. Location in the article: This is also found in the methods section of the paper. You can also look at the graph and see if one set of data points related to challenging behavior.
3. Intervention focuses primarily on FCT:
 - a. A Functional Behavioral Assessment or Functional Analysis must be included in the procedures for implementation. Some articles break this into two separate studies. Study one is the Functional Analysis and Study two is FCT.
 - b. If there is no comment how they determined the function of the behavior they are not doing FCT. There should be a statement about using a ____ assessment and determining the behavior was functioning to get either: attention, a tangible item, escape from the task or possibly sensory.
 - c. Location in the article: The study may be broken into two studies and therefore very clearly FCT. If the article is not two studies the methods section will describe the process for determining the function of the behavior and choosing an appropriate communication strategy.
4. Experimental Control
 - a. Experimental control can be determined by analyzing the graphs. If the graph is divided into more than two phases it is possible that there is experimental control.

If there are multiple graphs stacked on top of one another it is possible that the research is using a multiple-baseline design.

- b. The methods section or abstract may contain a statement about the research method used. Multi-element, multiple-baseline, and alternating treatment design (ABAB) have experimental control.
 - c. An AB design (two phases) does not meet criteria for experimental control.
- 5. Data displayed in line graphs
 - a. The graph measuring the change in behavior must be a line graph. There may be other graphs (bar graphs and such) but the graph containing the data on challenging behavior must a line graph.
- 6. No dichotomous variables
 - a. A dichotomous variable is a variable that only measures two responses, yes/no, positive/negative.
 - b. The y-axis must contain a scale with more than two responses. Percentages and number of occurrences of the behavior are the most common acceptable measures.
- 7. Research Article, Printed in English
 - a. This study is limited to research articles only. If the article is a literature review or an explanation of how to implement FCT with no actual data taken it cannot be used in this study. Dissertations can be included but only if there has not been article written using the same data set. The article will be included but the dissertation will not to avoid duplicate data entries.
 - b. There is research in other languages that utilize FCT as an intervention. For the sake of this meta-analysis those studies will not be accepted due to the need for someone to translate the article.

APPENDIX B

ARTICLE SUMMARIES

	Primary Disability	Age	Function/Mode Communication	Setting	FA	Intervention summary	Results
Braithwaite & Richdale, 2000	AU	7	Tangible, Escape Verbal	Contrived	Other	FCT was combined with extinction to decrease SIB and aggression. Prompt fading (2 sec and 5 sec. delay) was also used to increase independence.	SIB and aggression dropped to near zero levels with intervention.
Buckley & Newchok, 2005	AU	7	Tangible AAC	Contrived	Complete	FCT + EXT was used to decrease challenging behavior. Also investigated low effort verses high effort responses.	FCT + EXT was effective. Low effort responses maintained results whereas high effort responses caused behavior to return to baseline conditions.
Carr & Durand, 1985	AU, Brain Damage Brain Damage DD	13, 13, 14, 7	Escape, Attention Verbal	Contrived	Complete	Initial FCT study that focused on teaching relevant verse irrelevant phrases to decrease challenging behavior.	Relevant phrases were able to decrease challenging behavior whereas irrelevant phrases increased challenging behavior.
Casey & Merical, 2006	AU	11	Escape Verbal	Natural	Brief	FCT was used in isolation to decrease challenging behavior in a school setting.	The behavior decreased.
Durand & Carr 1991	AU AU ID	12 12 9	Escape, multiple Verbal	Natural	Brief	Longitudinal study (3 years) Investigated the effectiveness of FCT across teachers and settings.	Low levels of challenging behaviors maintained across teachers and settings with only one student needing a brief booster session.

	Primary Disability	Age	Function/Mode Communication	Setting	FA	Intervention summary	Results
Durand, 1993	CP	5	Multiple, tangible, Escape AAC	Natural	Brief	Investigated if FCT could be used with SGDs and if participants would “enjoy” the treatment.	Challenging behavior decreased and positive facial expression increased.
	ID	3					
	ID	15					
Durand, 1999	AU	9	Attention, Escape, Tangible AAC	Natural	Brief	Investigate the effectiveness of FCT in the classroom and the community.	Communication generalized from school to community and was effective in both environments in decreasing challenging behavior.
	AU	11					
	CP	5					
	CP	15					
Durand & Carr, 1987	AU	11	Escape	Natural	Brief	Investigate if teaching a communicative response to request help during difficult tasks would reduce the rate of self-stimulatory behavior.	Significant reduction in self-stimulatory behavior for all participants.
	AU	13	Verbal				
	PDD	7					
	PDD	11					
Durand & Carr, 1992	AU	4	Attention	Contrived	Brief	Comparison between groups with six participants in each group. One group received FCT while other were given timeout.	Both showed initial decrease in challenging behavior but FCT was more durable across conditions.
	ID	5	Verbal				
Fisher et al. 2005	AU	14	Escape,	Contrived	Complete	Preference for positive verses negative reinforcement was assessed by giving participants two communicative responses one for each reinforcement scenario. In the first study they could only choose one. In the second study they could use one or both simultaneously.	For study one the participants consistently chose the positive reinforcing communicative response over the negative. In the second study one participant continued with the same choice while the other chose to use both responses.
	AU	13	Multiple				

	Primary Disability	Age	Function/ Mode Communication	Setting	FA	Intervention summary	Results
Fisher 1993	ID	not reported	Escape, Tangible Gestural	Contrived	Complete	Can FCT alone decrease challenging behavior or does it need to be combined with a form of punishment or extinction?	For some participants FCT was not sufficient on its own and produced the best results when combined with punishment.
	ID						
	ID						
	ID						
Franco, 2009	AU	7	Multiple	Natural	Complete	Investigate if a SGD can be used during FCT.	When the SGD was available the challenging behavior decreased across settings.
			AAC				
Gibson et al, 2010	AU	4	Tangible	Natural	Brief	Can FCT be implemented effectively when the implementer is trained via video conferencing?	FCT was implemented with a high degree of fidelity and the challenging behavior was significantly reduced.
			Gestural				
Hagopian et al., 2004	ID	10	Tangible,	Contrived	Complete	FCT was combined with EXT and the schedule of reinforcement was modified to see if it had an impact on effectiveness of the intervention. A dense-to-lean schedule was compared to a fixed lean schedule.	Results were mixed for both participants. Study reports that FL has a quicker effect than DTL.
	ID	10	Multiple				
			AAC, Gestural, Verbal				
Hagopian et al., 2005	AU	7	Multiple,	Contrived	Complete	FCT with EXT was compared to FCT with EXT and access to competing stimuli during schedule thinning. i.e. if you cannot respond immediately to the request for attention but you give them a toy will the behavior still decrease?	FCT + EXT & competing stimuli achieved quicker results than FCT + EXT alone.
	AU	12	Tangible,				
	PDD	13	Attention				
			AAC, Verbal				

	Primary Disability	Age	Function/ Mode Communication	Setting	FA	Intervention summary	Results
Hagopian, Wilson & Wilder, 2001	AU	6	Escape, Tangible Verbal	Contrived	Complete	FCT was combined with NCR to treat challenging behavior that served multiple	FCT + NCR were effective in both conditions at reducing challenging behavior.
Hanley et al., 2005	ID AU	8 5	Multiple, attention AAC, verbal	Contrived	Complete	FCT combined with punishment was compared to FCT used in isolation.	FCT with punishment was more effective than FCT alone and participants clearly preferred FCT with punishment over FCT alone.
Harding et al. 2009B	ID ID	4 4	Multiple, Escape AAC	Natural	Complete	Problem behavior maintained by escape generally is treated with negative reinforcement (NR). In this study in one phase the child was only given the option of NR but in phase 2 the children were given a choice between NR and PR (access to tangibles).	Treatment results were similar across both conditions.
Jarmolowicz et al, 2009	AU	13	Tangible AAC	Contrived	Other	During schedule thinning FR1, EXT and FR1+EXT were compared to see if there was an effect on the behavior.	FR1 + EXT worked better across thinning schedules than FR1 or EXT alone. FR1 was more efficient than EXT during dense reinforcement and the inverse occurred during leaner schedules.
Kahng, et al. 1997	ID ID ID	50 45 29	Escape, Attention Gestural, Verbal	Contrived	Complete	Control over the delivery of reinforcement has been given as the reason for the effectiveness of FCT. This study evaluated this concept by comparing FCT with NCR.	Both FCT and NCR were equally effective. FCT did have a different benefit in that there was a more consistent increase in alternative responses than NCR.

	Primary Disability	Age	Function/ Mode Communication	Setting	FA	Intervention summary	Results
Kelley, Lerman, VanCamp, 2002	ID	10	Tangible, Escape,	Contrived	Complete	FCT alone was compared with FCT + EXT, and FCT + Response blocking, when FCT alone seemed to not be effective.	When FCT alone is not effective combining it with EXT or response blocking can increase the effectiveness of FCT.
	AU	9	Multiple				
	Cornelia Delange	10	Gestural, AAC				
Kuhn, 2010	AU	8	Attention	Contrived	Complete	After teaching students to use FCT the participants were then taught to recognize when the caregiver was engaged in "busy" verses "nonbusy" behaviors and only make requests during "nonbusy" times.	Students were able to differentiate between "busy" and "nonbusy" behaviors and primarily made requests during "nonbusy" times.
	ID	9	Verbal				
Lalli et al. 1995	AU	13	Escape	Contrived	Brief	FCT was implemented first. Response chaining was then introduced where the student was required to complete one step in the task before being able to escape. # of tasks was increased until the student completed the entire task before getting to escape.	The chaining procedure effectively increased work completion and still maintained low levels of challenging behavior by delaying reinforcement after the FCT request for a break.
	ID	10					
	AU	15	Gestural, AAC, Verbal				
Mancil et al., 2006	PDD	4	Tangible Verbal	Contrived	Complete	FCT was used at home with the parent as implementer to decrease challenging behavior, increase mands and spontaneous communication.	The intervention was effective in all areas.
Mancil et al., 2009	AU	7	Tangible	Natural	Complete	FCT was combined with milieu therapy by parents in the natural environment in both home and school.	Children generalized FCT between school and home with a decrease in challenging behavior.
	AU	4					
	AU	4	AAC				

	Primary Disability	Age	Function/ Mode Communication	Setting	FA	Intervention summary	Results
Mehta Albin, 2005	ID	9	Tangible	Contrived	Complete	What is the effect of extinction verse FCT on challenging behavior and communication?	FCT decreased challenging behavior as effectively as EXT but FCT increased communication more effectively than EXT.
			Verbal				
Olive et al., 2008	AU	4	Attention	Contrived	Brief	FCT applied in home setting by mother using VOCA.	Mom implemented FCT with fidelity. Child's communication increased as challenging behavior decreased.
			AAC				
Oneill, 2001	AU	6	Escape	Natural	Complete	FCT + EXT investigated as to generalization to untrained tasks.	FCT generalized to untrained tasks.
	AU	15	AAC				
Peck Peterson et al. 2005	DD	4	Escape,	Contrived	Complete	FCT was implemented to mastery. Participants were then given the choice to choose a higher quality break to finish work or a shorter break to escape work.	Participants chose to complete work and get a higher quality break more often than taking the short break.
	ID	9	Gestural, verbal				
Ringdahl et al 2009	DD	4	Tangible,	Contrived	Complete	Topography of the response was assessed to determine if topography affects outcome. Highly proficient responses were compared to low proficient responses based on assessment results.	Highly proficient mands were more effective than low proficient responses.
	DD	24					
	DD	9	AAC				

	Primary Disability	Age	Function/Mode Communication	Setting	FA	Intervention summary	Results
Shirley et al., 1997	ID	29	Tangible, escape	Contrived	Complete	FCT compared to FCT + EXT.	FCT + EXT was more effective than FCT alone.
	ID	24					
	ID	39	Gestural				
Sigafoos 1996	ID	8	Attention, Tangible	Contrived	Complete	FCT was used with individuals with multiply determined problem behavior to determine if FCT is more effective for different functions of behavior for the same individual	FCT was equally effective across all functions.
	ID	8					
			Gestural, AAC, Verbal				
Volkert et al., 2009	AU	8	Escape,	Contrived	Complete	FCT was trained to mastery and then exposed to extinction to determine if challenging behavior would reemerge when the alternative behavior was no longer reinforced.	For all but 1 participant challenging behavior returned when FCT was exposed to EXT.
	AU	5	Attention,				
	AU	9	Tangible				
	AU	5					
	AU	5	Gestural, AAC, Verbal				
Winborn et al., 2002	DD	2	Escape	Contrived	Brief	Novel verse existing mands were compared during FCT to determine which mand would be used most often and have the best effect.	Participants used existing mands more often than novel mands but with higher rates of challenging behavior.
	DD	2	AAC , Gestural, Verbal				
Winborn-Kemmerer, et al., 2009	PDD	7	Attention	Contrived	Complete	Novel verse existing mands were assessed separately, and then both available in the final phase.	Participants used mands equally with low rates of behavior in both conditions. For one participant lowest rate was in final phase.
	ID	20	AAC				

	Primary Disability	Age	Function/Mode Communication	Setting	FA	Intervention summary	Results
Winborn-Kemmerer, Wacker, & Harding, 2010	DD	3	Attention,	Contrived	Complete	Novel mands and existing mands were used together in the first FCT intervention to determine if multiple options would decrease challenging behavior. The second study alternated between novel mand being present and absent.	FCT phase 1: challenging behavior decreased. Novel mands used more often than existing mands. FCT phase 2: Problem behavior remained low in both phases showing that the novel mand missing did not interfere with participants' use of FCT.
	Down Syndrome	3	Escape AAC, Gestural, Verbal				
Worsdell, 2000	ID	31	Tangible,	Contrived	Complete	FCT and EXT were combined in the first phase of the study. In the following phases EXT was intermittently used to determine if problem behavior would return if EXT was not used consistently but FCT was reinforced consistently.	4 out of the 5 participants acquired the communicative response. All participants showed a decrease in levels of challenging behavior.
	ID	29	Attention				
	ID	22					
	ID	27	Gestural, AAC				
	ID	44					

Note: AU = Autism, ID = Intellectual Disability, FCT = Functional Communication Training, CP = Cerebral Palsy, PDD = Pervasive Developmental Disorder, AAC = Alternative and Augmentative Communication, FBA = Functional Behavioral Assessment, EXT = Extinction, DD = Developmental Disability

APPENDIX C

FOREST PLOTS

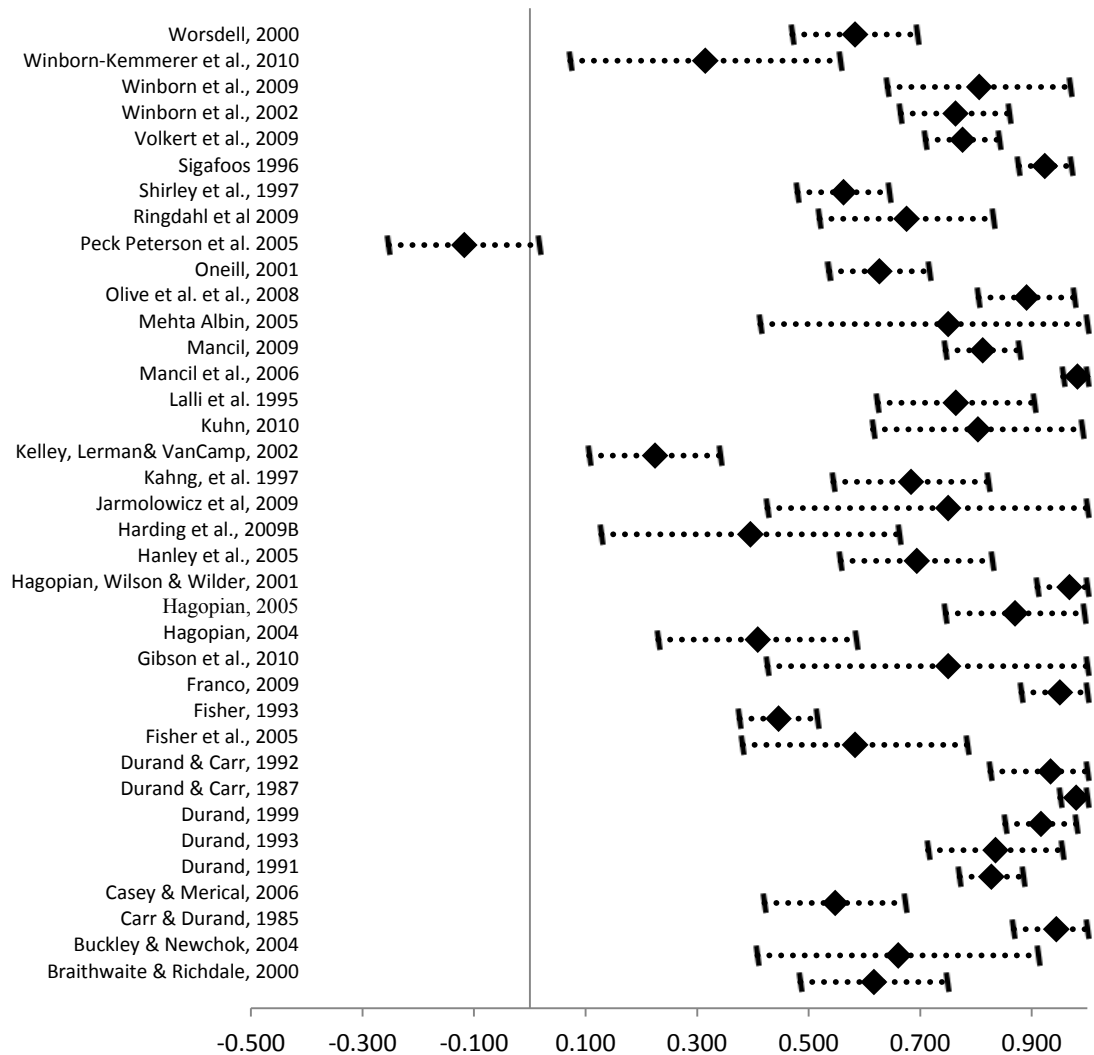


Figure C-1: Robust Improvement Rate Difference for each study.

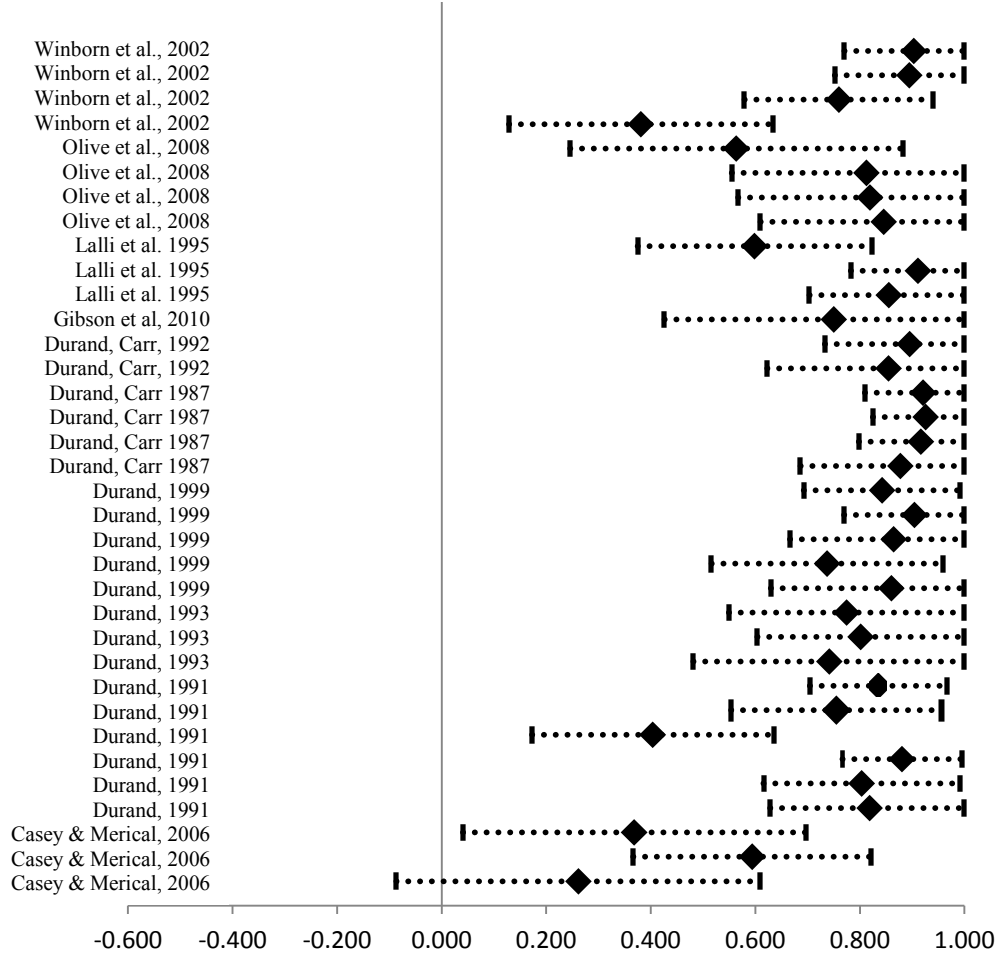


Figure C-2. Robust Improvement Rate Difference for Brief functional analysis.

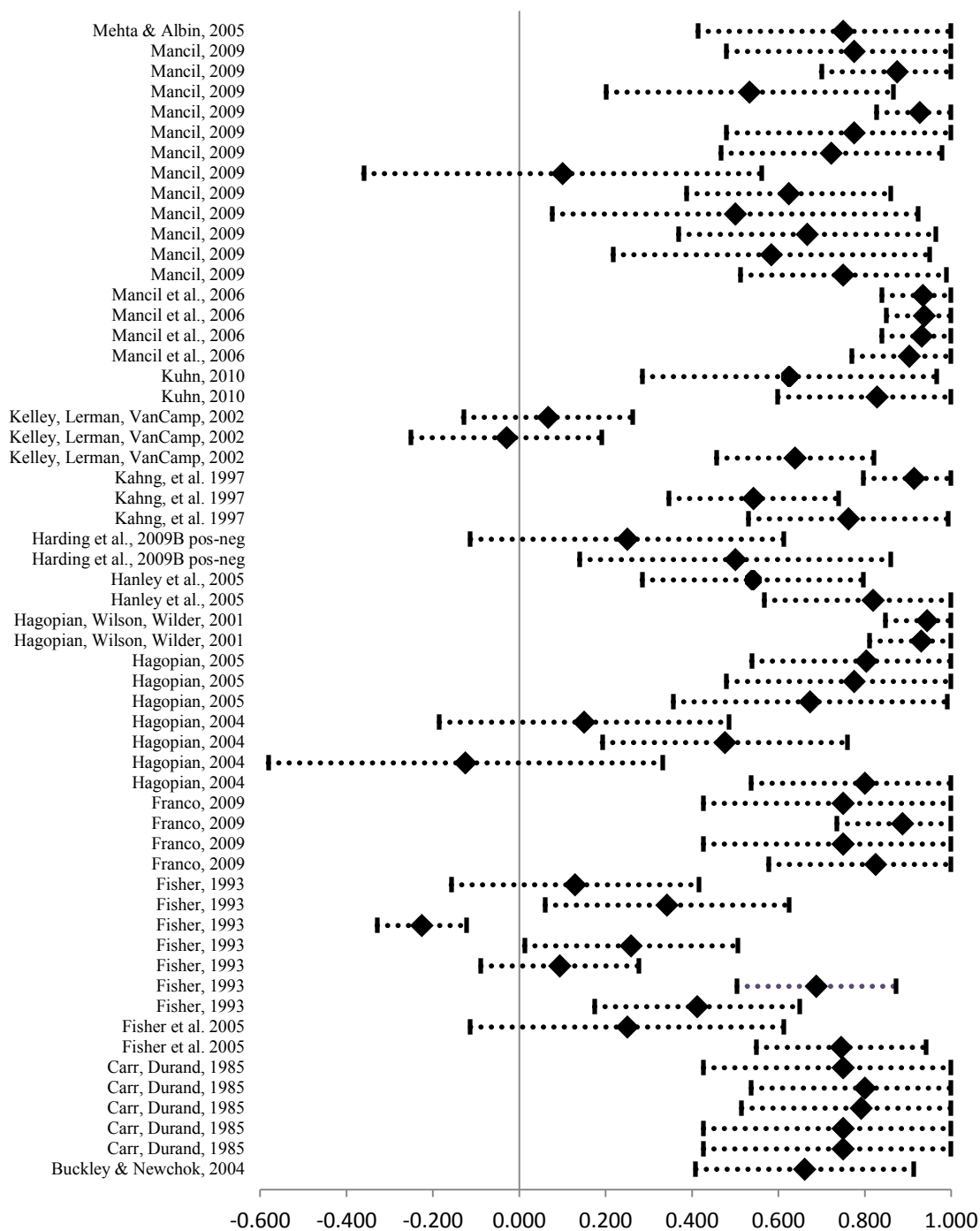


Figure C-3. Robust Improvement Rate Difference for complete functional analysis, Section A.

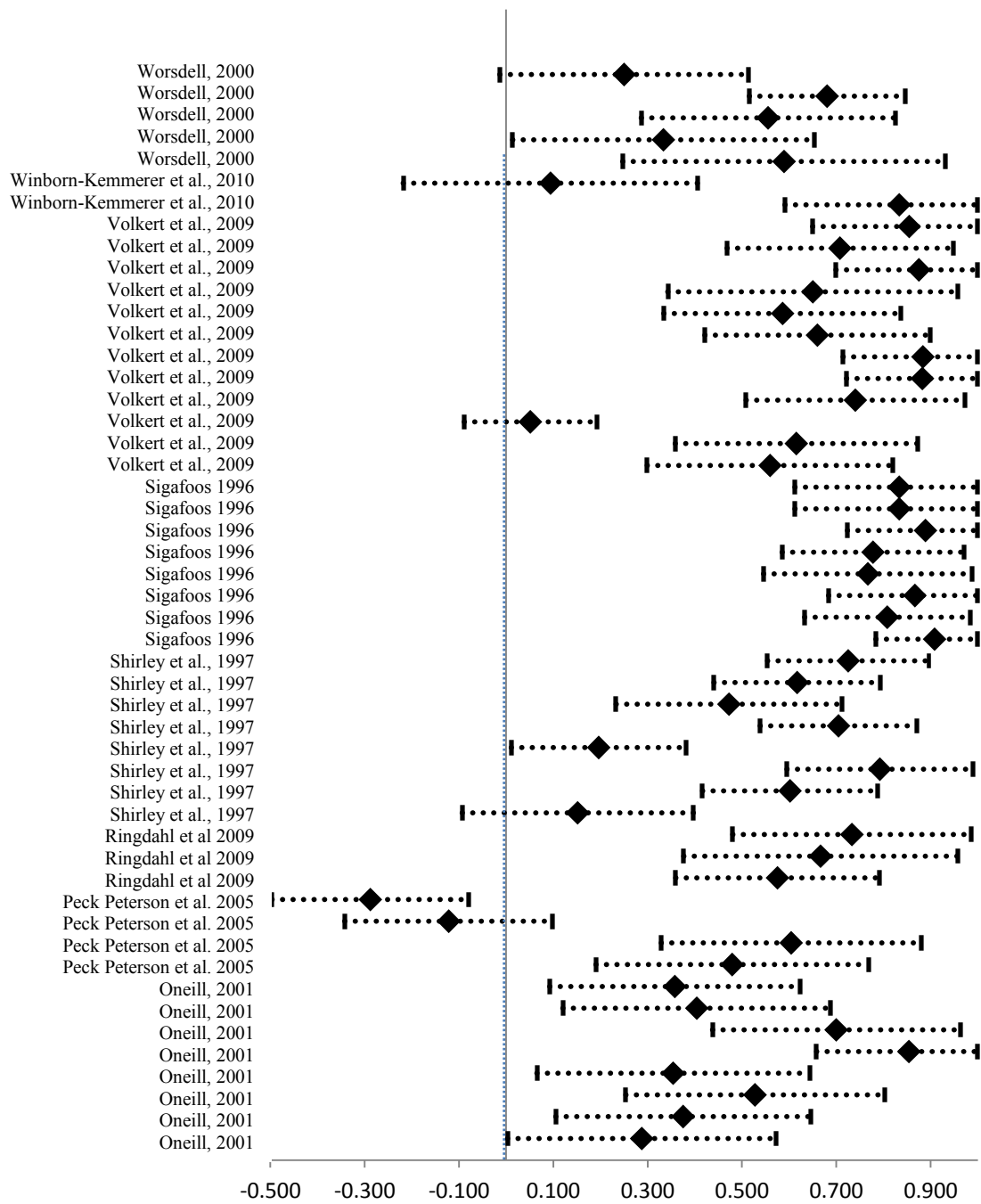


Figure C-4. Robust Improvement Rate Difference for complete functional analysis, Section B.

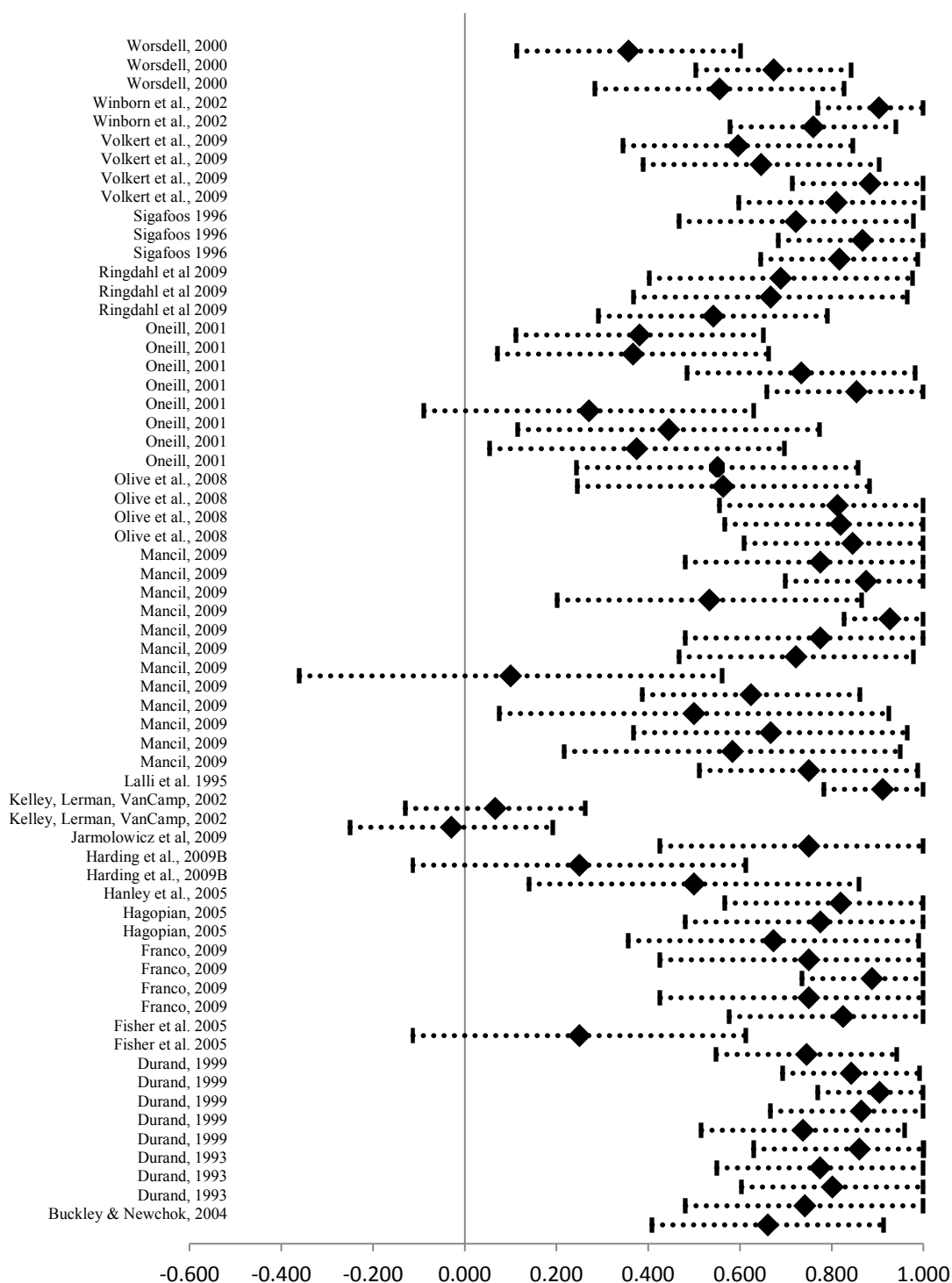


Figure C-5. Robust Improvement Rate Difference for A-AAC as the mode of communication.

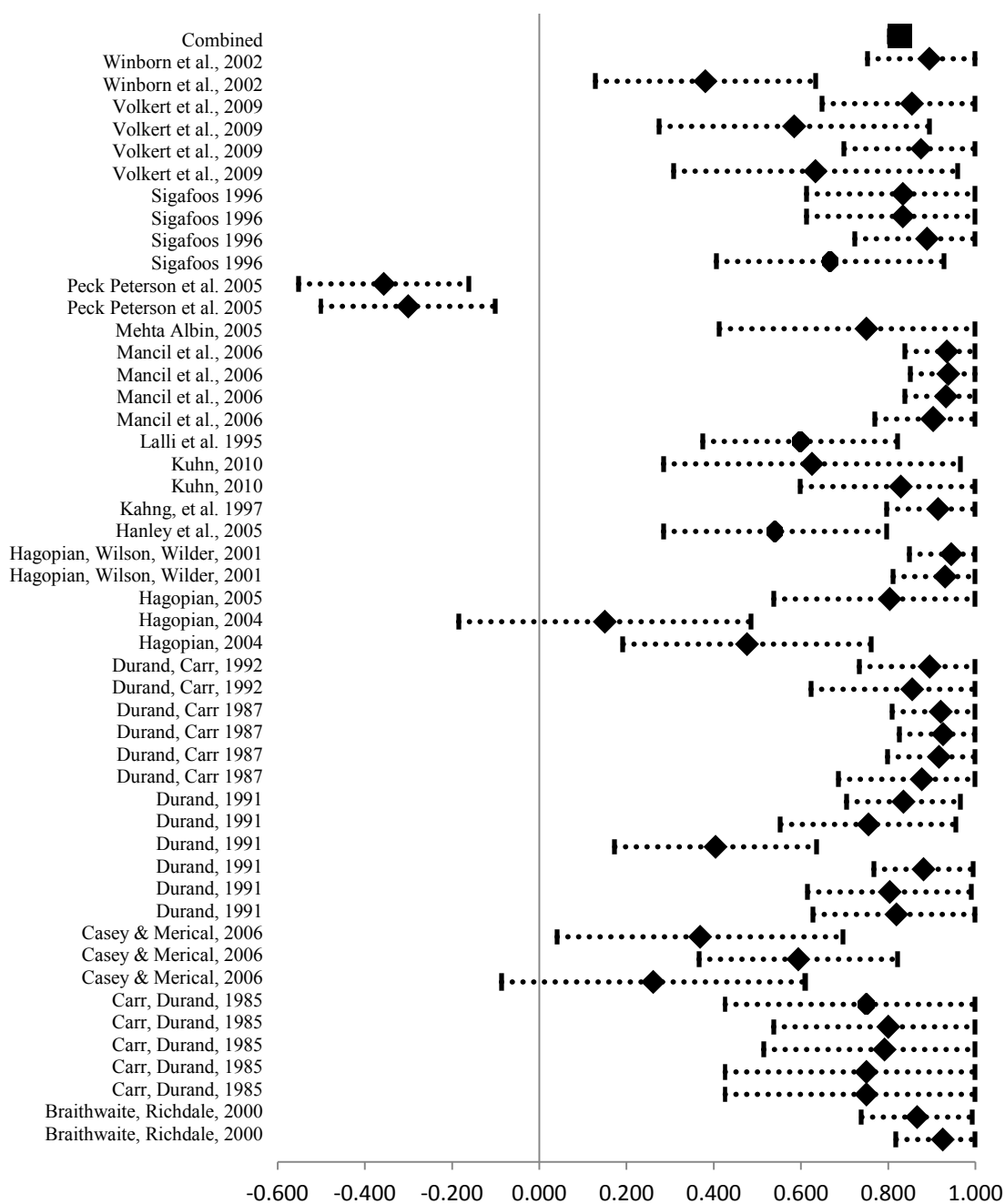


Figure C-6. Robust Improvement Rate Difference for Verbal.

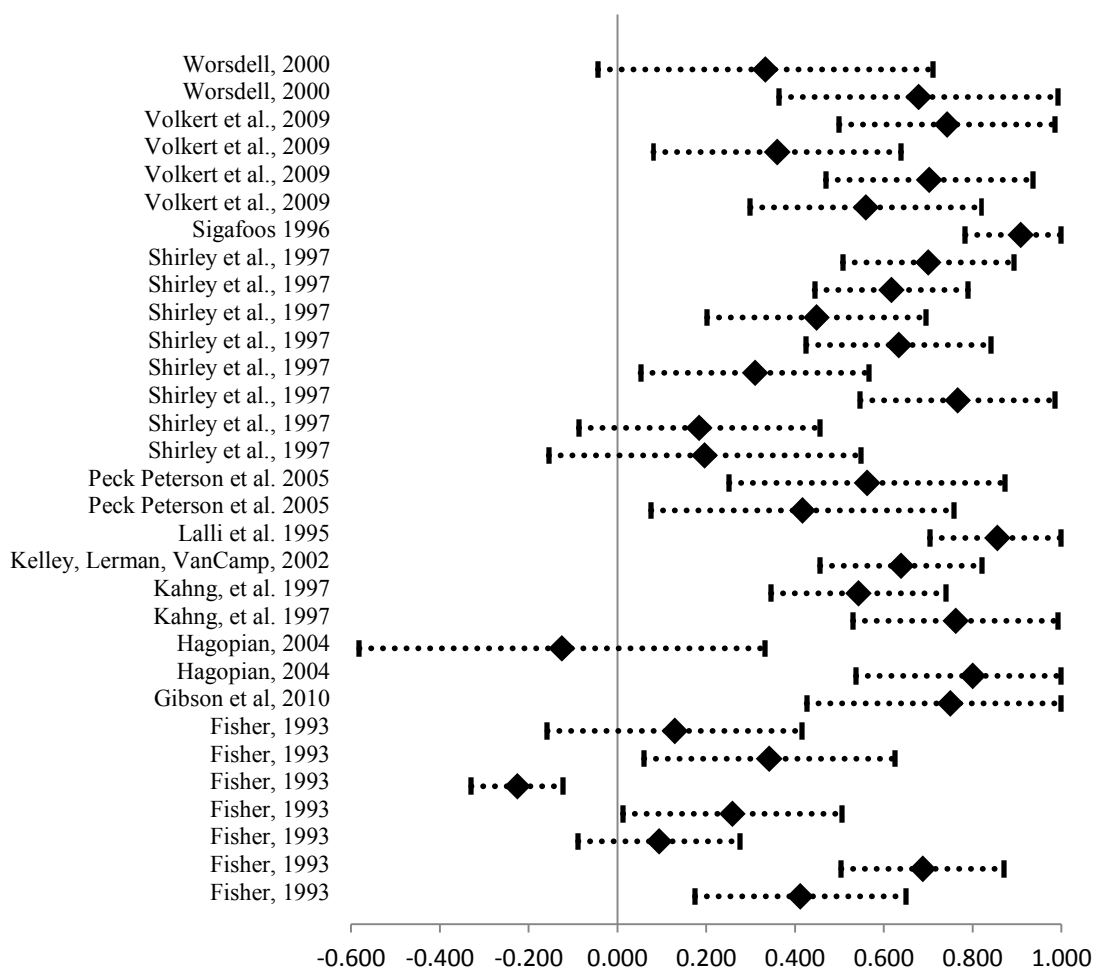


Figure C-7. Robust Improvement Rate Difference for U-AAC as the mode of communication.

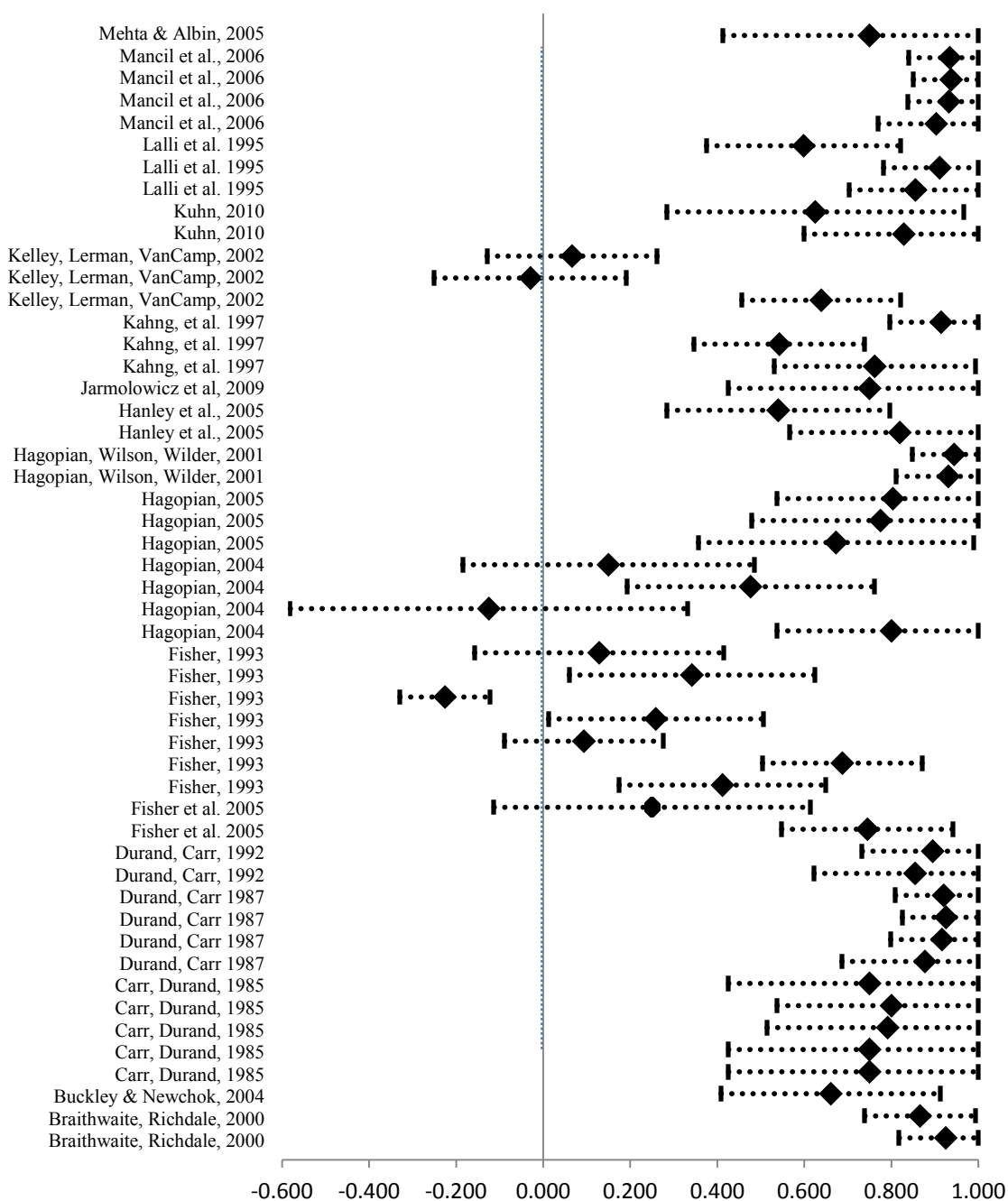


Figure C-8. Robust Improvement Rate Difference for contrived setting, section A.

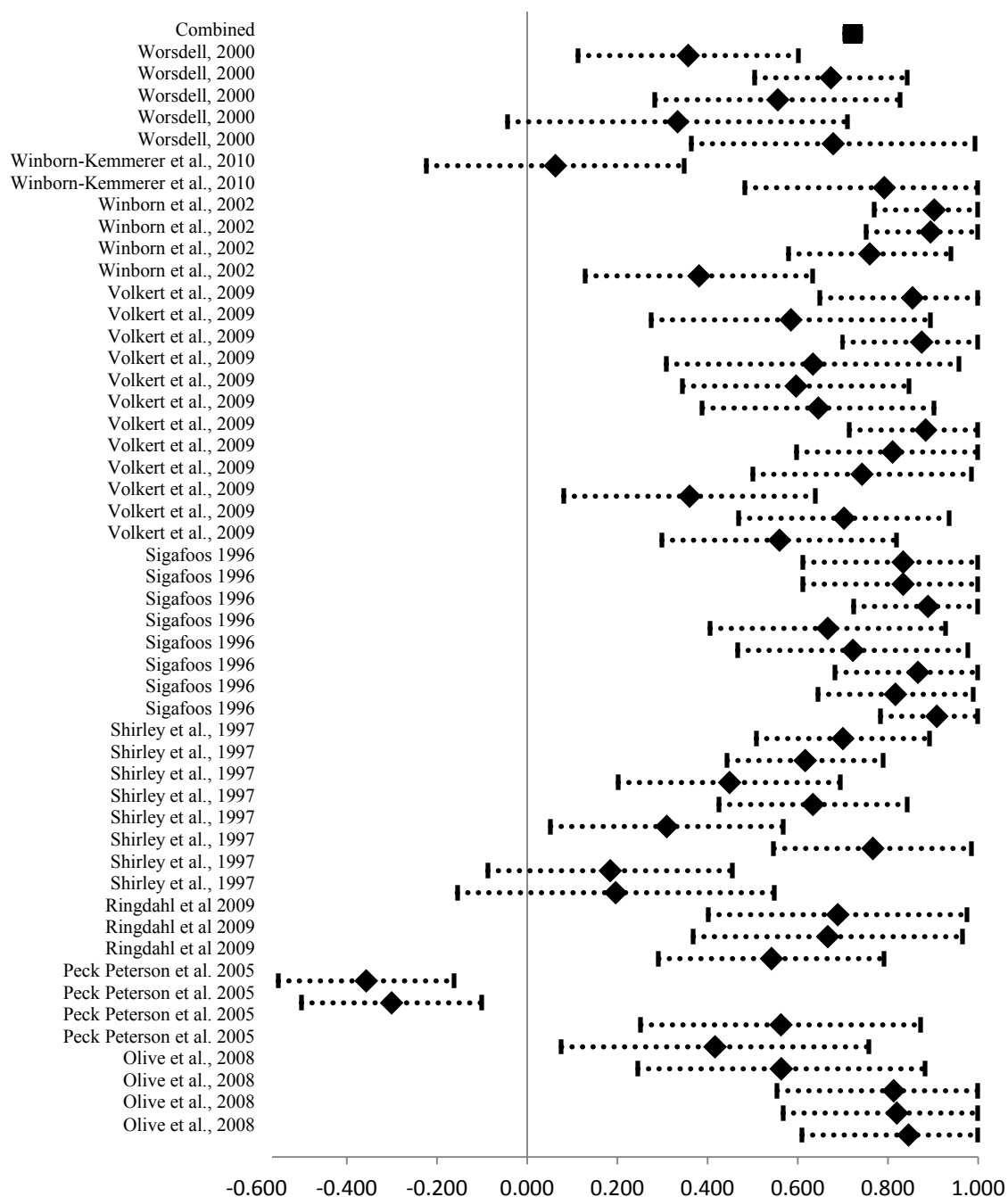


Figure C-9. Robust Improvement Rate Difference for contrived setting, section B.

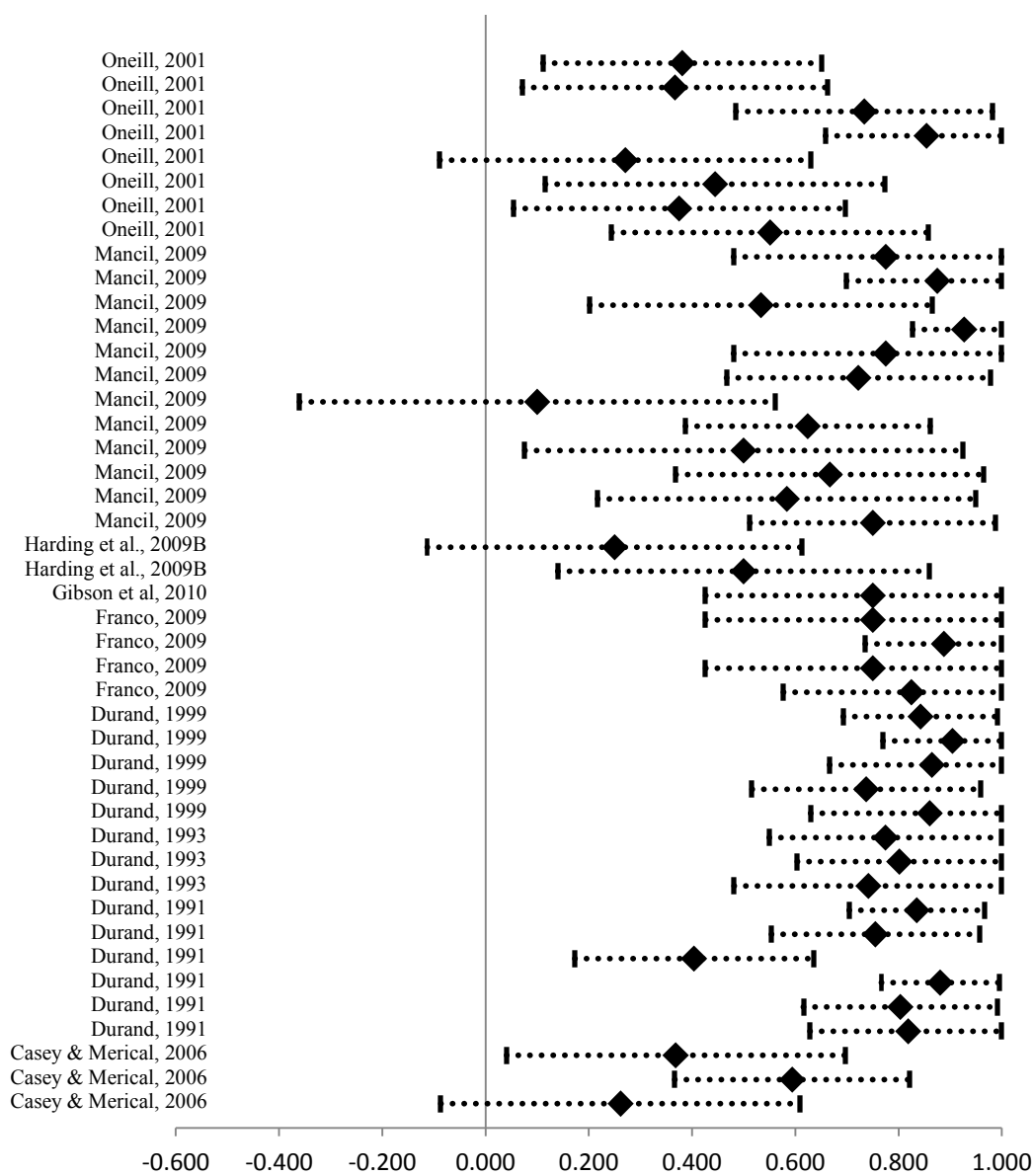


Figure C-10. Robust Improvement Rate Difference for natural setting.

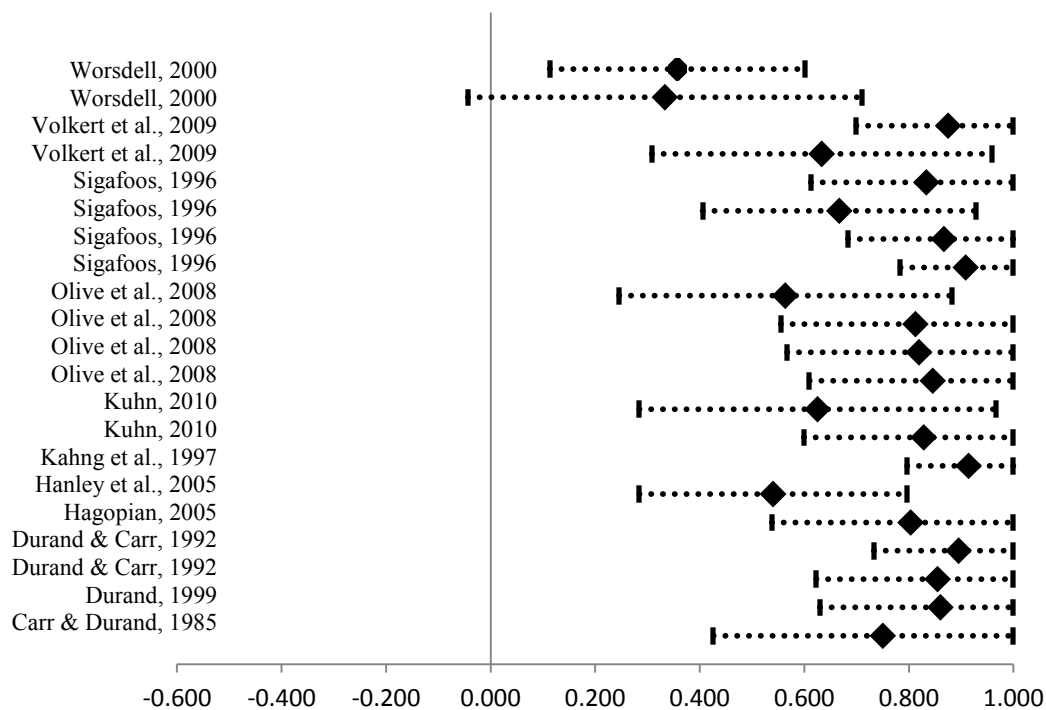


Figure C-11. Robust Improvement Rate Difference for attention as the function of the behavior.

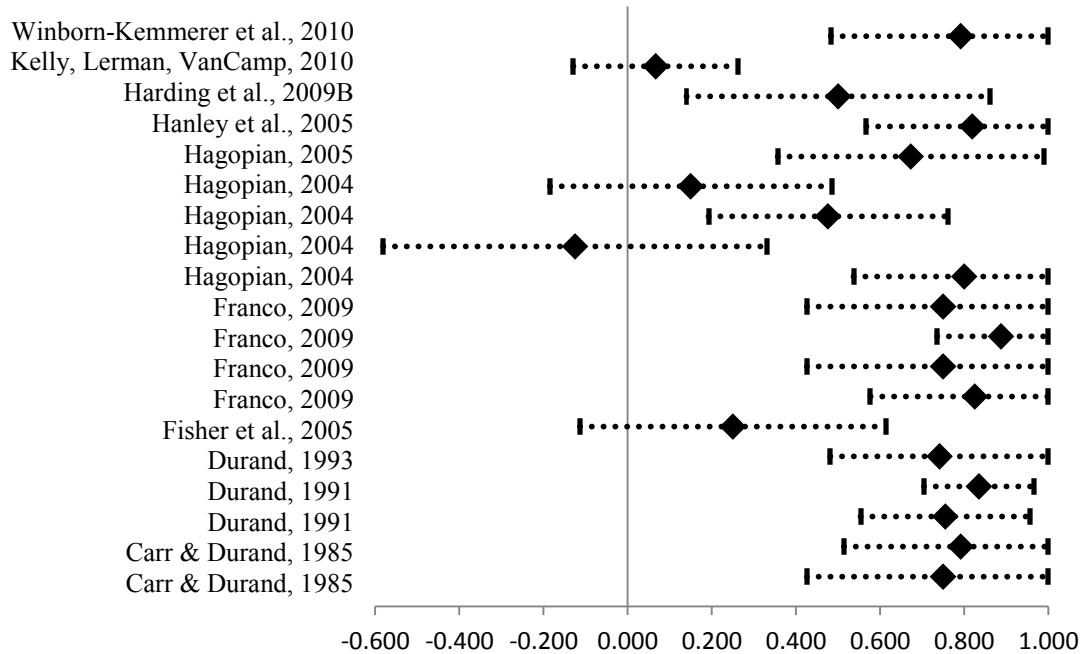


Figure C-12. Robust Improvement Rate Difference for behavior that serves multiple functions.

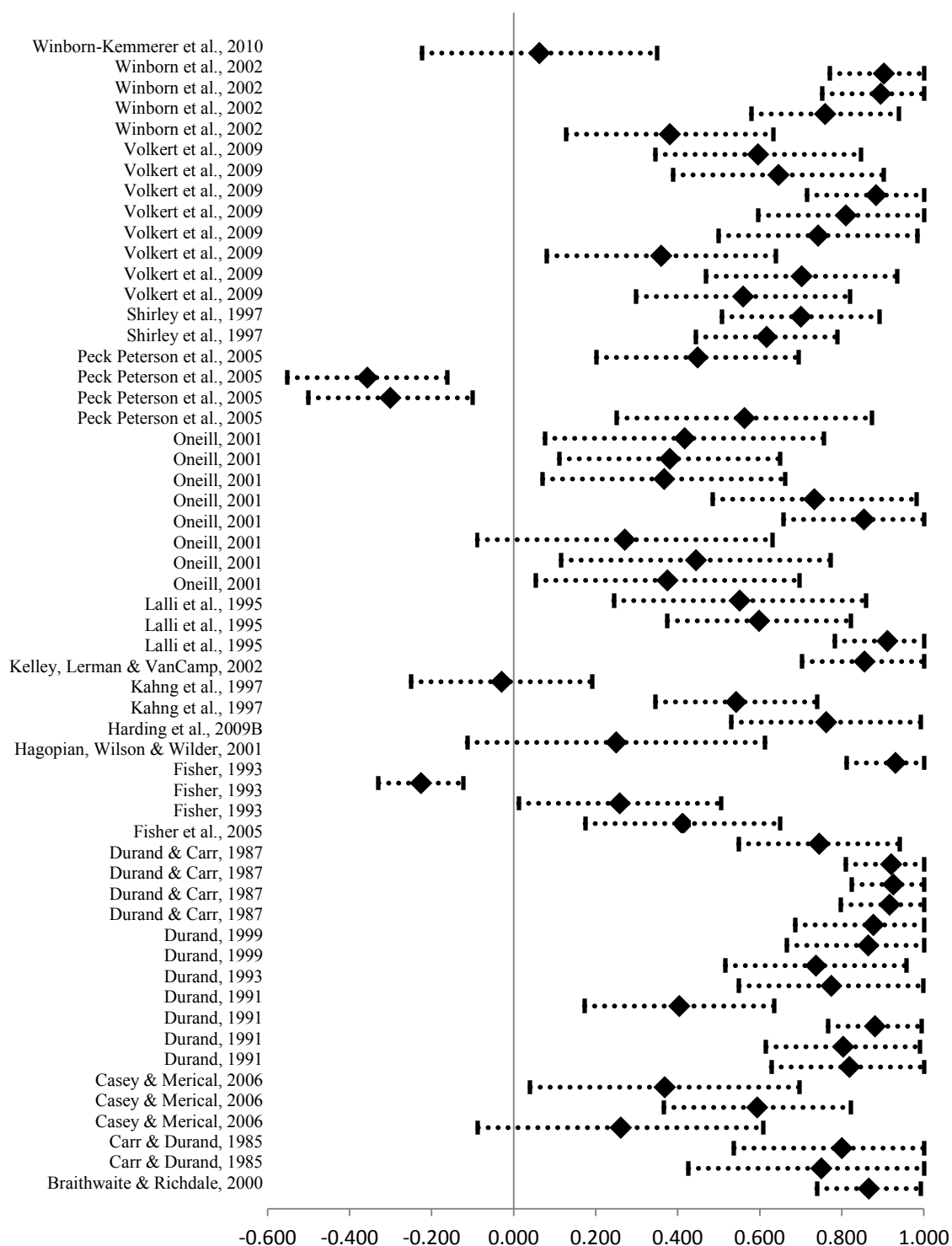


Figure C-13. Robust Improvement Rate Difference for behavior that functions to gain escape.

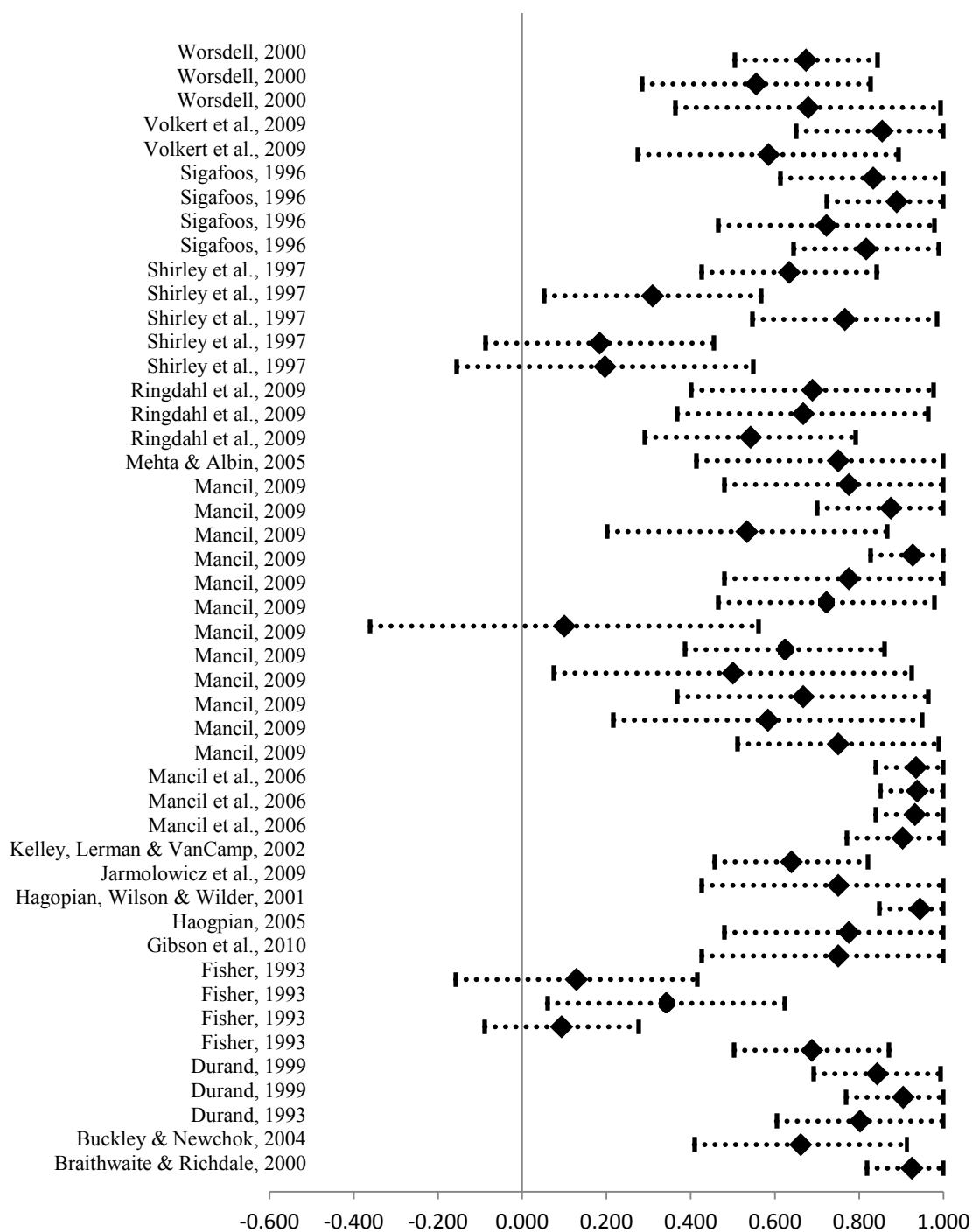


Figure C-14. Robust Improvement Rate Difference for behavior that functions to gain access to tangible items.

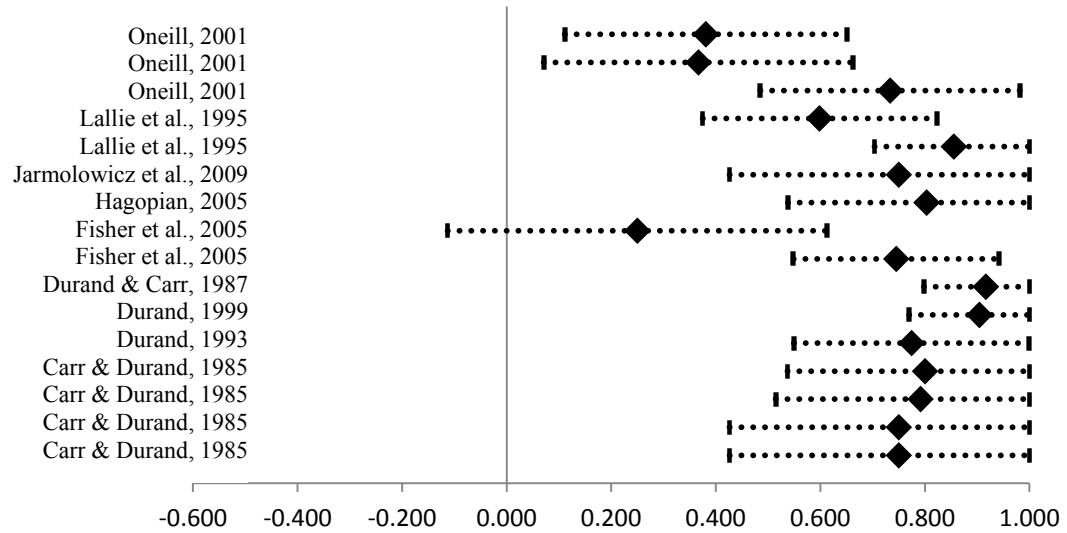


Figure C-15. Robust Improvement Rate Difference for individuals that are in the secondary age range.

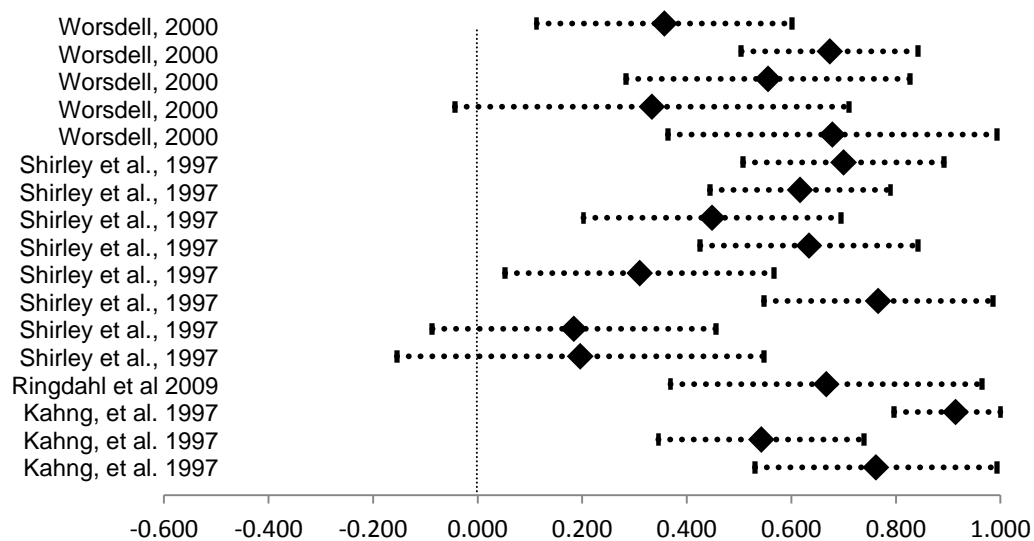


Figure C-16. Robust Improvement Rate Difference for individuals that are in the adult age range.

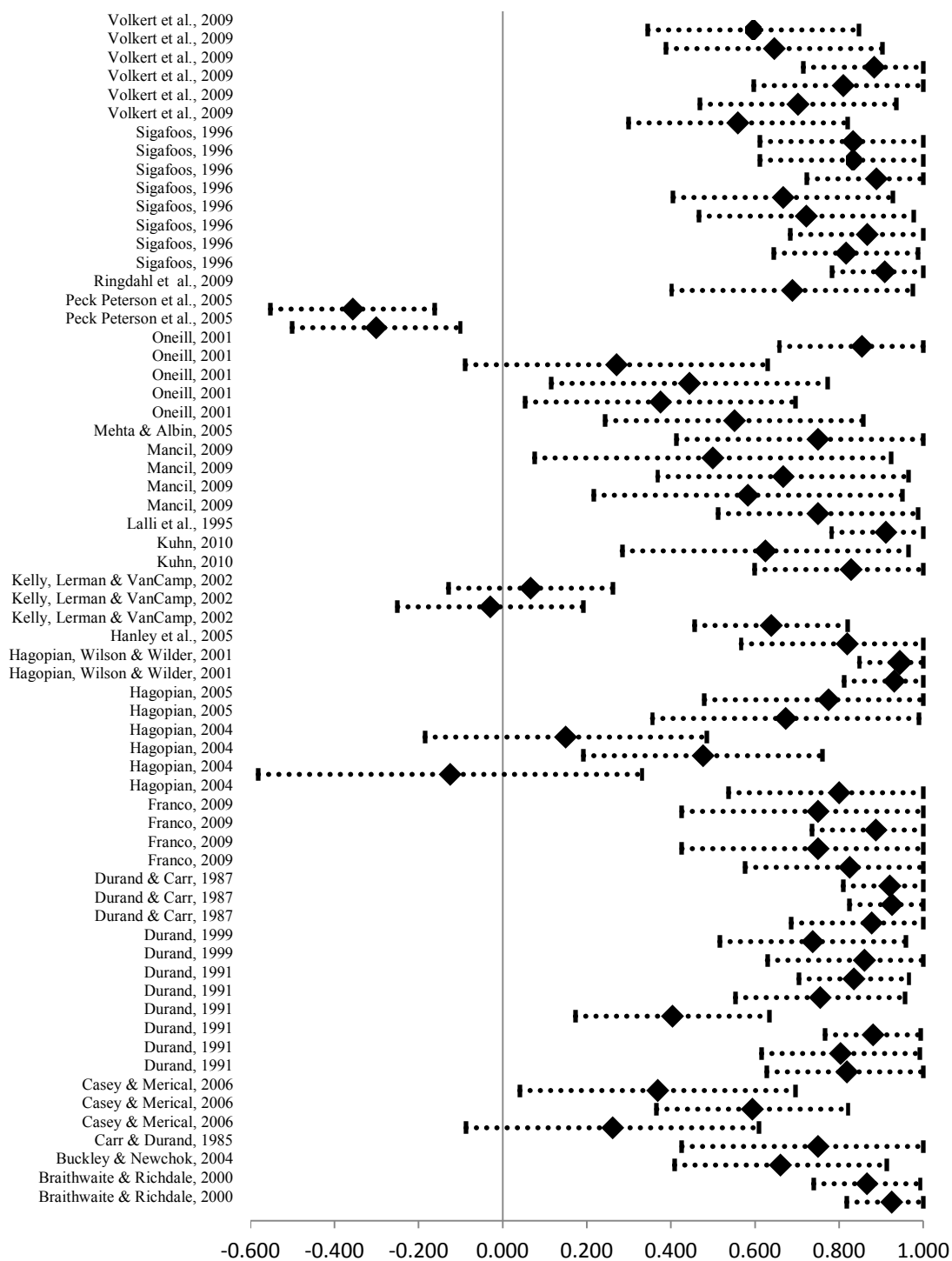


Figure C-17. Robust Improvement Rate Difference for individuals in the elementary age range.

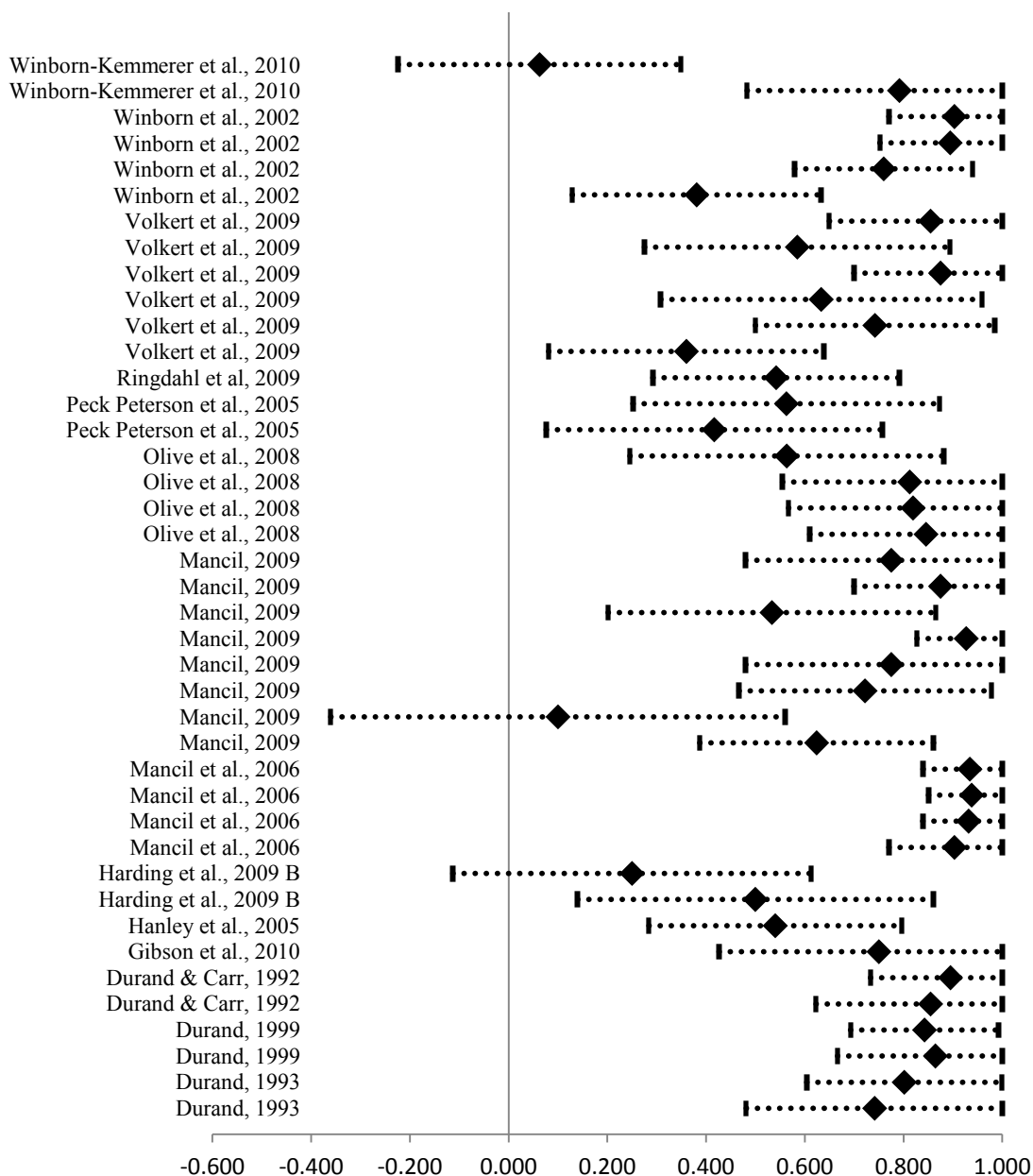


Figure C-18. Robust Improvement Rate Difference for individuals in the primary age range.

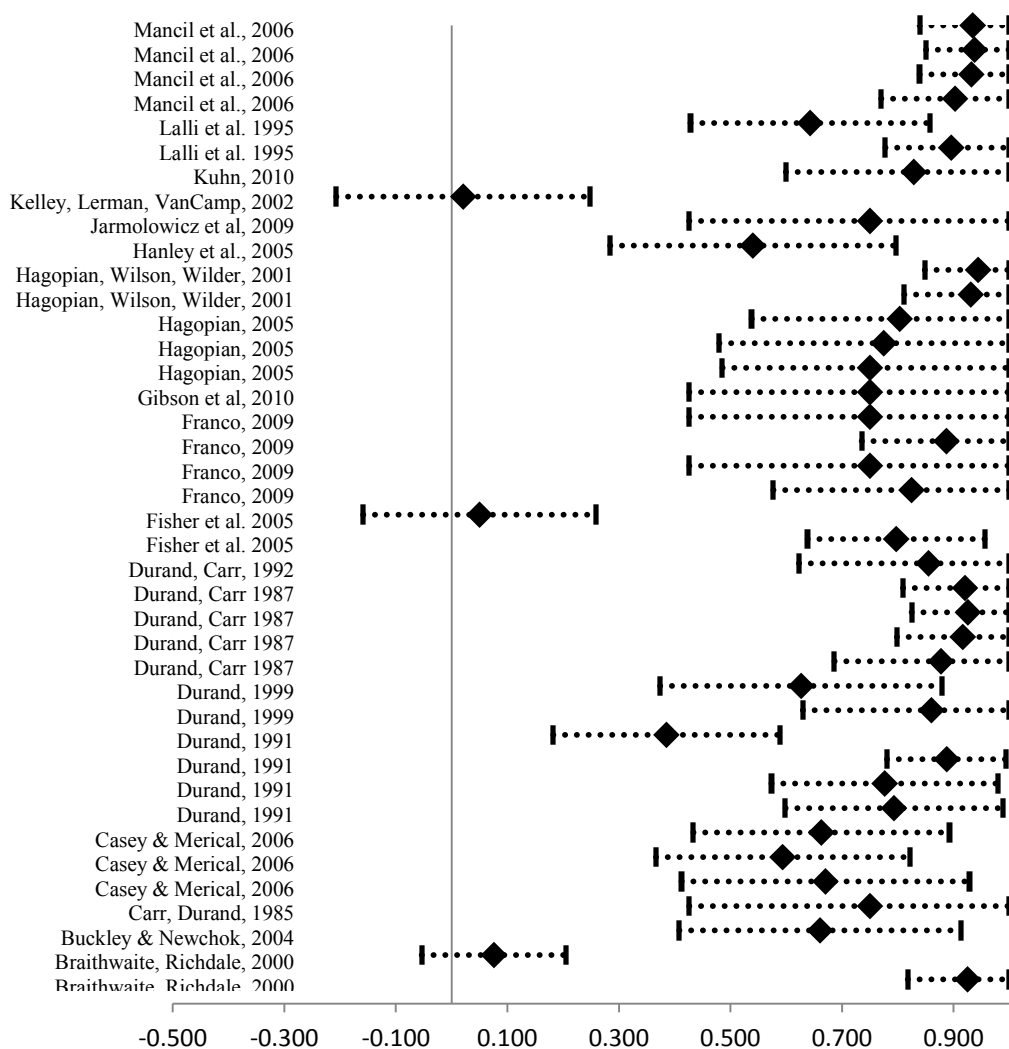


Figure C-19. Robust Improvement Rate Difference for individuals with autism section A.

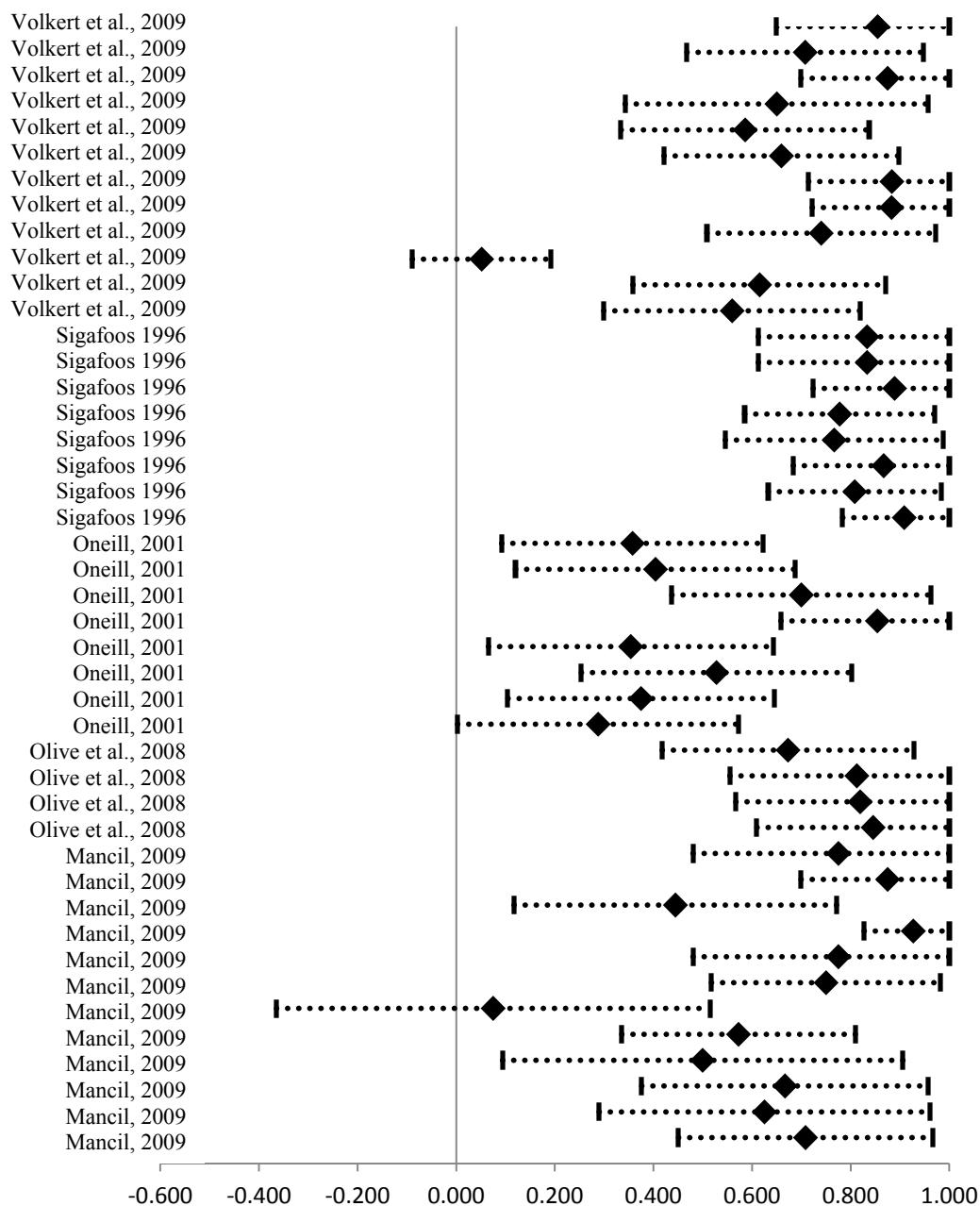


Figure C-20. Robust Improvement Rate Difference for individuals with autism section B.

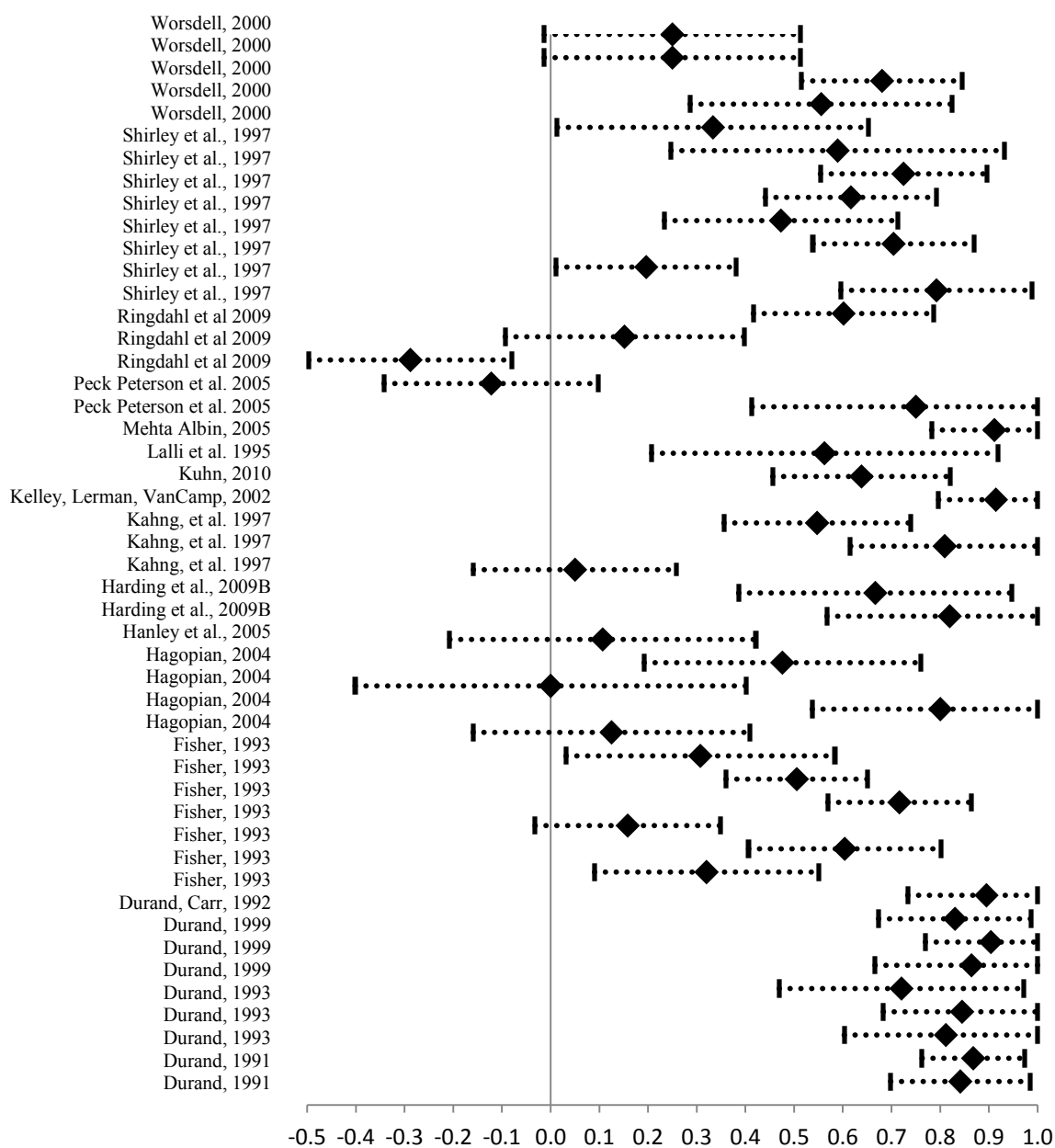


Figure C-21. Robust Improvement Rate Difference for individuals with intellectual disabilities.

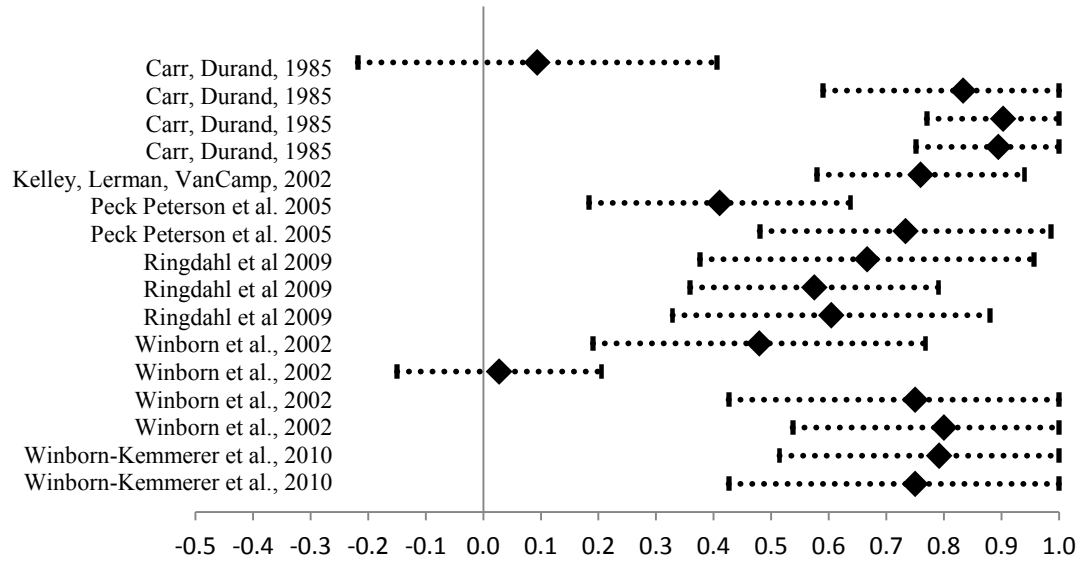


Figure C-22. Robust Improvement Rate Difference for individuals with other disabilities.

VITA

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