The Impact of Caregiver-Mediated JASPER on Child Restricted and Repetitive Behaviors and Caregiver Responses

Clare Harrop, Amanda Gulsrud, Wendy Shih, Lilit Hovsepyan, and Connie Kasari

Restricted and repetitive behaviors (RRBs) are a core feature of autism spectrum disorder (ASD). Compared to the social-communication impairments children show, we know less about why children engage in these repetitive actions and behaviors and how to help children (and their caregivers) with these behaviors. As a result, early intervention has typically focused on social-communication. In this study, we were interested in understanding how child RRBs changed following an intervention that targeted social-communication behaviors and if the training caregivers received changed how they responded to their child's RRBs.

Eighty-six toddlers with ASD and their caregivers received one of two interventions: caregivers were either actively coached while playing with their child (JASPER) or attended information sessions about ASD. On three different occasions, caregivers were filmed playing with their child. From these recordings, we looked at child RRBs and how their caregiver responded to these behaviors.

Child RRBs did not show much change after 10 weeks of intervention in both groups, but increased when the children returned at 6 months. Caregivers who received one-on-one coaching (JASPER) responded to more of their child's RRBs and these responses were rated as more successful.

Our study provides some evidence that a short-term social-communication intervention can lead to "spillover effects" in how caregivers responded to their child's RRBs. Interventions targeting social-communication behaviors should examine how these treatments affect child RRBs and how caregiver responses to these behaviors may change following training. ***Autism Res*** *2016, 0: 000–000.* © 2016 International Society for Autism Research, Wiley Periodicals, Inc.

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Introduction

Restricted and Repetitive Behaviors (RRBs) are a core symptom of autism spectrum disorders (ASD) [American Psychiatric Association, 2013]. Despite an increase in research into this domain in recent years, less is known about effective treatments targeting RRBs in individuals with ASD [Boyd, McDonough, & Bodfish, 2012; Harrop, 2015]. While significant gains for interventions targeting social-communication impairments have been reported [e.g., Kasari, Gulsrud, Paparella, Hellemann, & Berry, 2015; Green et al., 2010; Landa, Holman, O'Neill, & Stuart, 2011], similar gains have not been reported for RRBs. In large part, this lack of evidence is due to the absence of randomized trials specifically targeting RRBs [Boyd et al., 2012] or even assessing RRBs within interventions aimed at other developmental outcomes [Harrop, 2015].

Most intervention studies aimed at RRBs have relied on single case design [Boyd et al., 2012]. These studies have varied considerably with respect to the implementer of the intervention, with notably few involving caregivers. For *lower order* RRBs, such as repetitive motor actions and physical and/or sensory manipulation of objects, behavioral strategies such as blocking, interrupting, and redirecting have been successfully employed by caregivers with their children with ASD [e.g., Ahearn, Clark, Macdonald, & Chung, 2007; Athens, Vollmer, Sloman, & St Peter Pipkin, 2008]. For *higher order* RRBs, such as presence of routines, an insistence on sameness and circumscribed interests, cognitive behavioral therapy, and differential reinforcement strategies have been utilized with some success [e.g., Boyd, McDonough, Rupp, Khan, & Bodfish, 2011; Reaven & Hepburn, 2003]. However, such techniques have rarely been examined within larger, randomized controlled studies or with children during early childhood.

To our knowledge, only one randomized controlled trial (RCT) has targeted RRBs as a primary outcome [Grahame et al., 2015]. The Managing Repetitive

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Behaviors (MRB) intervention randomized 45 caregivers of a child with ASD ages 3–7 to receive immediate or delayed caregiver education treatment. Treatment was delivered through training sessions with the caregiver (2 hr a week for 8 weeks) with the aim of helping caregivers to understand RRBs, identify triggers, and apply functional behavior analysis approaches to understand when and how to intervene with RRBs. Increased caregiver confidence was reported as well as high acceptability and feasibility. While caregiver and teacher standardized reports of RRBs did not change between the immediate and delayed treatment group, there was a reduction in restricted interests/play based on caregiver vignettes in the immediate treatment group. From video coded play sessions with the caregiver, "stereotyped behavior and non-functional interests" reduced at a faster rate in the immediate treatment group. There were also changes in caregiver responses to RRBs within the play interaction, with an increase in "distracting/developing" strategies.

Although not a direct test of intervention effects on RRBs, in toddlers with ASD prior to beginning an intervention aimed at social-communication outcomes [Harrop, Gulsrud, Shih, Hovsepyan, & Kasari, 2016]. In this study, we were interested not only in how frequently toddlers with ASD displayed RRBs but also in their caregiver's response to RRBs. A caregiver response was selected for each instance of child RRB (object, visual, motor, and verbal). Caregiver responses were then classified as either verbal/physical or redirections and rated as successful or unsuccessful based on behavioral extinction of the RRB or increased positive social-communication. Overall, caregivers responded to less than half of all child RRBs but an interesting pattern was noted in the *way* that caregiver's responded. Specifically, caregivers responded more frequently to object and visual RRBs than to motor and verbal RRBs. Caregivers were more likely to successfully employ redirection strategies for object and visual RRBs, potentially as, unlike motor and verbal RRBs, which may be fleeting, these RRBs impact the caregivers' ability to interact and engage with their child. Thus, this study confirmed that caregivers were already using a range of effective strategies to respond to their child's RRBs prior to the start of a caregiver-mediated intervention and these responses were rated as successful around 50% of the time.

Current Study: Rationale and Hypotheses

Delivering interventions through the training of caregivers is now a widely accepted practice in the treatment of young children with ASD; however very few studies have examined the impact of this approach on child RRBs [Harrop, 2015]. This study examined the impact of caregiver-mediated JASPER [Joint Attention, Symbolic Play, Engagement, and Regulation; Kasari et al., 2015] on child RRBs and caregiver responses to them. Building on our previous study characterizing caregiver responses to RRBs in a large sample of toddlers [Harrop et al., 2016] we extended our analyses to examine whether child RRBs and caregiver responses changed over the course of intervention aimed at social-communication (and not RRB) outcomes. The current study evaluated change during taped caregiver-child interactions (CCX) filmed pre-randomization (entry), following 10 weeks of intervention (exit), and 6 months later (follow-up).

Our hypotheses were as follows.

1. Caregivers in the caregiver-mediated JASPER group will respond to a greater number of child RRBs during the 10-minute CCX.
2. Following a 10-week intervention, object RRBs will reduce in the children receiving caregiver-mediated JASPER.

Exploratory analyses also examined whether caregivers were more successful in their responses to child RRBs following intervention. Our hypotheses were based on the prior findings of Gulsrud, Hellemann, Shire, and Kasari [2015], Kasari et al. [2015], and Shire, Gulsrud, and Kasari [2016] who all report data from this sample. Kasari et al. [2015] found increases in joint engagement, play diversity, and play level. As play and social engagement have been found to inversely relate to RRBs [Bruckner & Yoder, 2007; Harrop et al., 2014; Honey, Leekam, Turner, & McConachie, 2007], we predicted similar effects in this study. Gulsrud et al. [2015] and Shire et al. [2016] also report changes in caregiver behaviors following participation in the 10-week intervention and it was anticipated that some learned caregiver responses might spillover to RRBs.

Method

Participants

Participants represent those reported in Kasari et al. [2015] and Harrop et al. [2016]. All participants were recruited from an outpatient early intervention program that provided 30 hr a week of behavioral, speech, and occupational therapy. Inclusion criteria required a clinical diagnosis of ASD (verified through the administration of the ADOS and ADI-R by research reliable independent assessors), younger than 36 months at enrollment and the absence of significant physical disabilities. Eighty-six caregiver-child dyads were initially enrolled into the study [Fig. 1; Table 1; see Kasari et al., 2015 for further details]. One dyad was missing an entry CCX, leaving an entry sample of 85 dyads who

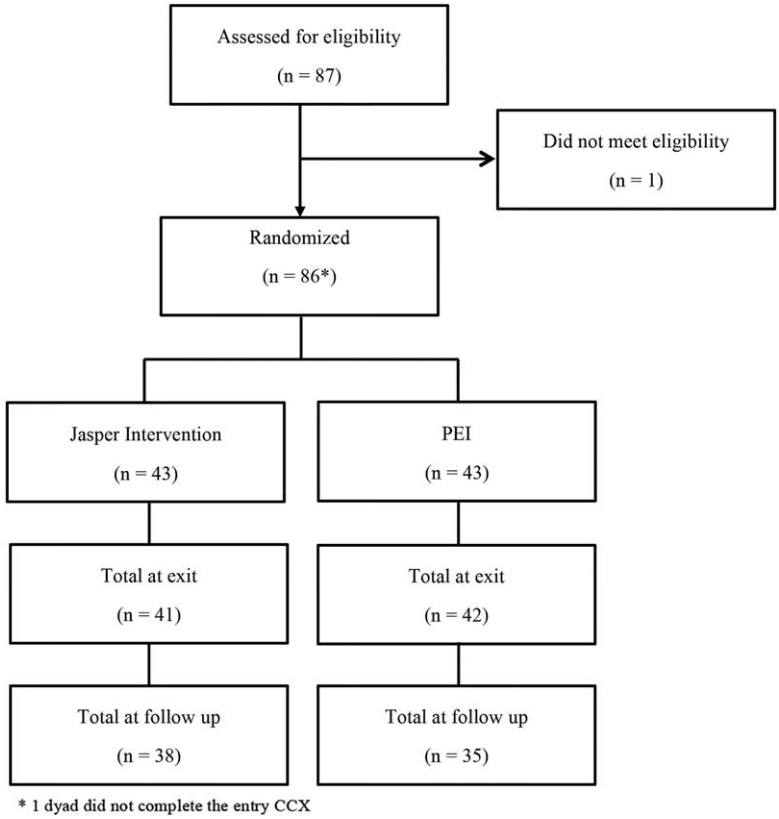

Figure 1. Recruitment flow diagram [adapted from Kasari et al., 2015].

Table 1. Sample Characteristics

Child and Caregiver Characteristics: *N* (%)		JASPER ($N = 43$)	PEI ($N = 43$)	Total	Test	*P*
Chronological age (months): Mean (SD)		30.7 (3.5)	32.3 (2.7)	31.5 (3.2)	F (1, 84) = 6.3	0.01*
Gender (M:F)		35: 8	35: 8	16 (19%)	X^2 (1) = 0.0	1.00
Ethnicity	African-American	0 (0%)	2 (5%)	2 (2%)	X^2 (4) = 4.5	0.34
	Caucasian	27 (63%)	26 (60%)	53 (61%)		
	Hispanic	3 (7%)	4 (9%)	7 (8%)		
	Asian	4 (9%)	6 (14%)	10 (12%)		
	Other/Multiracial	9 (21%)	5 (12%)	14 (17%)		
MSEL developmental quotient: Mean (SD)		68.0 (20.3)	68.1 (20.6)	68.0 (20.3)	F (1, 84) = 0.0	0.98
Age of mother		36.9 (4.4)	34.9 (4.7)	35.9 (4.6)	F (1, 83) = 3.9	0.05
Maternal years of education		17.2 (2.3)	16.4 (2.6)	16.8 (2.4)	F (1, 84) = 2.6	0.11

*$P < 0.05$.

were randomized to one of two interventions (see *Randomization and Intervention* Approaches). The majority of caregivers were mothers ($n = 76$). In addition to eight fathers, one grandmother also participated. Participant characteristics for both intervention groups are reported in Table 1. The University Institutional Review Board approved the study and parents provided written consent to participate.

Randomization and Intervention Approaches

Participants were randomized to one of two conditions that involved 1 hr of interventionist contact per week for 10 weeks (detailed below) in addition to the 30 hr a week early intervention program. The two groups were matched on demographic variables (see Table 1) with the exception of age of entry, which was younger in the JASPER group. As noted above, of the 86 dyads recruited into the study (Fig. 1) one did not complete the entry CCX, three dyads did not complete the 10 weeks of intervention, and a further ten did not complete follow-up assessments (Fig. 1).

Full details of the randomization procedure and intervention approaches are provided in Kasari et al. [2015] and outlined below.

Caregiver-Mediated JASPER

The JASPER arm of the study was delivered by a trained interventionist through active coaching of the caregiver with their child 1 hr a week for 10 weeks (two sessions of 30 min per week). JASPER is an empirically supported and manualized treatment that has shown to increase periods of joint engagement, joint attention gestures and play skills in a number of studies [Kasari, Freeman, & Paparella, 2006; Kasari, Gulsrud, Wong, Kwon, & Locke, 2010; Kasari et al., 2015]. Caregivers are taught to identify the child's current play and social-communication level, and coached to provide the child opportunities to initiate interest in toys/activities and establish dyadic play routines. Caregivers use various strategies to maintain engagement with their child while also improving the frequency of social-communication gestures, spoken language, and play acts [Kasari et al., 2015]. Strategies are delivered to caregivers in a structured sequence based on previous studies [Kasari et al., 2010, 2014]. A full description of the intervention is available in Kasari et al. [2015].

The main study reported increases in joint engagement in dyads receiving caregiver mediated JASPER and secondary outcomes on play diversity, highest level of play achieved, and generalization to classroom joint engagement [Kasari et al., 2015]. In addition, recent secondary data analyses of the same sample found that caregivers in the JASPER group were rated as more responsive to their child's social-communication behaviors following 10 weeks of intervention and this increase in responsiveness was associated with child gains in joint engagement [Shire et al., 2016]. Caregivers in the JASPER group also increased in their use of specific strategies that mediated the changes in child joint engagement [Gulsrud et al., 2015].

Psychoeducational Intervention (PEI)

The PEI arm of the study aimed to provide education and support to caregivers through 1:1 meetings with an interventionist [Brereton & Tonge, 2005]. Sessions were an hour per week for 10 weeks. Content was delivered through informational sessions and covered specific topics including information about ASD, behavioral management strategies, and managing caregiver stress. There was no direct contact with the child. PEI was selected as an appropriate comparator as the content delivered was similar to that offered within the more hands on JAPSER. As parent education interventions are less expensive and burdensome, this type of approach is preferable if found to be similarly effective to hands on interventions. Compared to other interventions, both JASPER and PEI are considered low intensity in their sessions per week and intervention duration.

Outcome Measures

Caregiver child play interaction (CCX). Child RRBs and caregiver responses were coded from the CCX (see *Coding*). The CCX was designed to represent a naturalistic play interaction between the child and their primary caregiver. All CCXs were filmed in an observation room to ensure they were as standardized as possible. Caregivers were provided with a standardized set of toys selected for developmental appropriateness and variety (Blocks; Peg Bus; Dump Truck; Animal Blocks; Small Figurines; Furniture; Bike and Ramp; Phones; Ball; Dinosaurs; Pop-Up; Utensils; Shape Sorter). Caregivers were instructed to play as they would at home and to use as many or as few toys as they wished. Interactions were videotaped and later coded. CCXs were recorded on entry into the study (entry), immediately following 10 weeks of treatment (exit), and 6 months post exit (follow-up).

Coding

Coding was based on that described by Harrop et al. [2016] and outlined below. Three variable categories were coded from the CCX—child RRBs, caregiver responses, and response success.

Child RRBs. Children RRBs were coded from the CCX using Noldus Observer® [Noldus, 1991]. Observational coding was based on the coding scheme originally developed by Harrop et al. [2014] and modified to include caregiver responses by Harrop et al. [2016]. The four categories of RRBs were motor, visual, object, and verbal (Fig. 2). Each RRB observed within the 10 min play session was coded during the CCX (followed by a caregiver response—outlined below; Fig. 2). For behaviors such as *hand flapping* or *spinning*, we did not code each individual action but instead each *burst* [for more information see Harrop et al., 2014, 2016]. Forty percentage of clips were double coded for inter-rater reliability. The intra-class correlation (ICC) for total RRBs was 0.92. All ICCs for individual RRB categories were high (Motor: 0.95; Visual: 0.92; Repetitive Object Use: 0.92; Verbal: 0.92).

Caregiver responses to RRBs. Full details of the coding of caregiver responses are provided in Harrop et al. [2016]. As with child RRBs, caregiver responses were coded using Noldus Observer® [Noldus, 1991]. A response (or non-response) was selected for each child behavior (Fig. 2). A caregiver response was defined as any caregiver behavior that occurred within 10 sec of the child's observed RRB and was directed toward the child's behavior. Five categories of caregiver response were included based on previous literature [e.g., Boyd

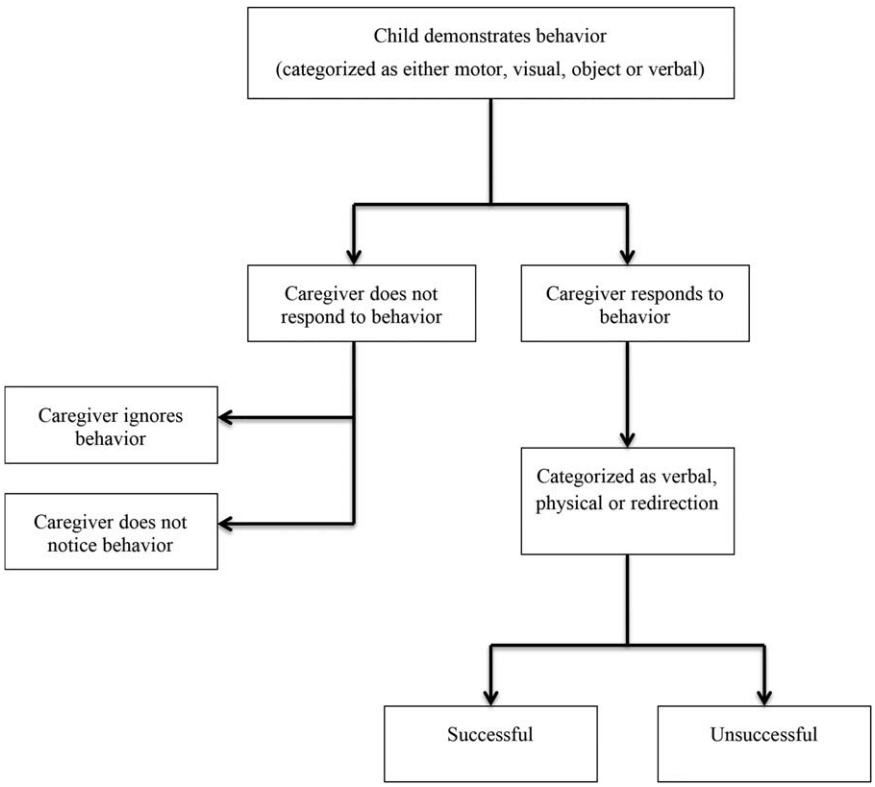

Figure 2. Coding of child repetitive behaviors and caregiver response.

et al. 2011; Lovaas, 1987] and correspond with those reported in our study characterizing caregiver responses in the same sample prior to randomization and intervention commencement [Harrop et al. 2016]. Caregiver responses were first coded as *response* (verbal, physical, or redirection) or *non-responses* (ignore or did not notice).

Verbal responses were classed as the caregiver making comments about the child's RRBs (*"you like pressing the buttons don't you?"*) as well as direct requests for the child to stop the behavior (*"please stop doing that"*). However, when a caregiver verbally responded with play suggestions that expanded on the child's RRB, this was coded as a *redirection* (see below). *Physical* responses included the parent physically preventing the RRB from continuing; such as placing their hand over the child's to stop flapping or removing a toy. *Redirections* entailed the caregiver attempting to modify the child's behavior into a more functional activity. Examples include introducing new toys/actions, rearranging the play environment or making alternative play suggestions/building on the child's perseverative actions. If a caregiver removed a toy (*physical*) to introduce a new one, this was classed as a *redirection*. As discussed by Harrop et al. [2016], these behaviors were not mutually exclusive, however the coders selected the *dominant* code [see Harrop et al., 2016 for further details].

Non-responses fell into two categories. The first category—*did not notice* (DNN)—was assigned when the caregiver did not observe the action, i.e., they had their back turned. The other category of *non-response* was *ignore*. This code represented when the caregiver appeared to notice the behavior but not respond to it—i.e., a behavior occurred directly in front of them but they did not make an active response to this [see Harrop et al., 2016 for further details]. These categories were combined at the analysis stage.

Inter-rater reliability was calculated on 40% of cases. All codes reached a high level of agreement. For total *responses* and *non-responses*, ICCs were 0.89. Similarly high ICCs were found for individual categories (*Verbal*: 0.94; *Physical*: 0.88; *Redirection*: 0.87; *DNN*: 0.94; *Ignore*: 0.90).

Response success. In the final stage of the coding scheme, the coder was required to select whether this response was *successful* or *unsuccessful* (Fig. 1). Coding of successful and unsuccessful responses drew from both a behavioral framework and a social-developmental framework. Success was defined in two ways—the child disengaging from the RRB for at least 10 sec or the child demonstrating an alternative *positive* behavior such as social-communication and engagement with the caregiver [see Harrop et al., 2016 for further details]. An *unsuccessful* response was coded in two ways—the child did not disengage from the RRB or the child did disengage following a caregiver response but a significant negative reaction

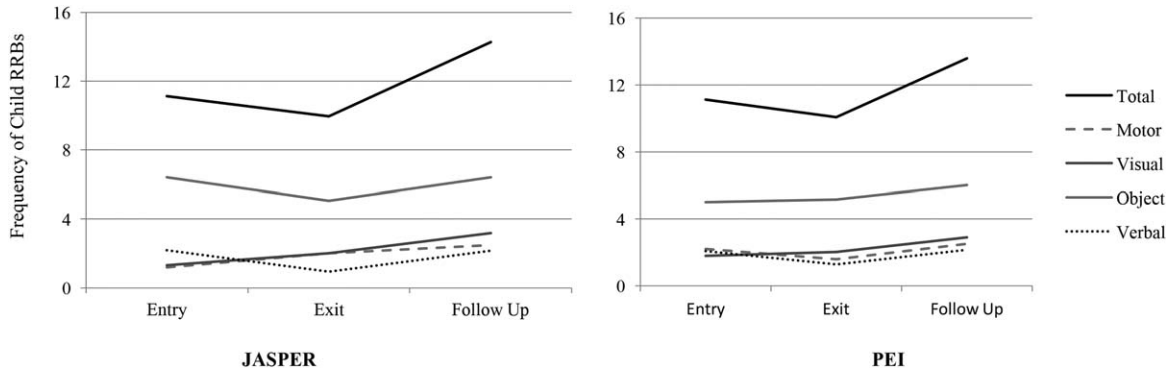

Figure 3. Frequency of child RRBs at entry, exit, and follow-up.

was observed as a result of this response impacting the engagement of the dyad and the child's regulation. There was also an option to capture whether the child disengaged from the RRB prior to the caregiver response. If the parent did not respond to the RRBs, success was not scored. Coders had high agreement on whether responses were *successful* (0.85) or *unsuccessful* (0.86).

Data analysis

Analysis was completed in three parts. First, a descriptive analysis was conducted to explore the distributions of (1) child RRB type; (2) caregiver responses vs. non-responses; (3) response type; and (4) success of response at all three time points (entry, exit, and follow-up). Our main analysis focused on whether caregiver response (frequency and success) changed during intervention and whether this varied between the two interventions (JASPER and PEI). Generalized linear mixed models were utilized to model the trajectories of the outcomes over time and treatment groups. Main effects of time and treatment group allocation (JASPER and PEI) were included in the model. Total RRB and child RRB types were controlled for depending on the outcome assessed. The effect of time point and treatment cannot be estimated for individual levels of caregivers' responses (redirection, physical, or verbal) because of the complexity of the model and, as a result, estimates failed to converge Hence, descriptive statistics and figures are provided as exploratory analyses. Effect sizes (ES) are reported using Cohen's f where effect sizes of 0.10, 0.25, and 0.40 are generally regarded as small, moderate, and large, respectively.

Results

Child RRBs: Entry, Exit, and Follow-Up

Children in both intervention groups entered the study with a similar rate of RRBs (Fig. 3). Total RRBs remained stable for children in both the JASPER and PEI groups from entry to exit ($F(1, 81)=1.41$, $P=0.239$, ES = 0.13) and there was no significant interaction effect between intervention group and time point ($F(1, 81)=0.002$, $P=0.997$, ES = 0.005). At follow-up, 6 months post intervention, both groups showed significant increased rates of RRBs from exit (Fig. 3; JASPER: $F(1, 151)=10.07$, $P=0.002$, ES = 0.26; PEI: $F(1, 151)=5.19$, $P=0.024$, ES = 0.19).

At all time points and in both intervention groups RRBs with objects were the most common category (Fig. 3). Children in the JASPER group had moderately higher rates of this type of RRB at entry ($F(1, 81)=4.47$, $P=0.037$, ES = 0.23). There was trend toward a significant interaction effect between time point and intervention group ($F(1, 78)=3.64$, $P=0.06$, ES = 0.22) where children in the JASPER group had a marginal decrease in object RRBs compared to children in the PEI group from entry to exit. There was no significant effect of time point indicating that the rate of change in object RRBs was stable from entry to exit for children in both treatment groups ($F(1, 78)=0.10$, $P=0.75$, ES = 0.035). Although both groups increased slightly from exit to follow-up in their rate of Object RRBs (Fig. 3), the increase was minimal and was not statistically significant (JASPER: $F(1, 148)=0.03$, $P=0.869$, ES = 0.014; PEI: $F(1, 148)=0.004$, $P=0.956$, ES = 0.005).

Verbal, visual, and motor RRBs remained low across all time points and were recoded into binary processes (none vs. one or more instances). For verbal RRBs, there was no significant interaction effect between time point and intervention groups from entry to exit ($F(1, 78)=1.23$, $P=0.27$, ES = 0.13). However, there was a significant effect of time point for verbal RRBs, indicating that the odds of presenting with one or more verbal RRBs decreased for children in both groups from entry to exit ($F(1, 78)=6.05$, $P=0.016$,ES = 0.28). The rate of change significantly differed from exit to follow-up ($F(1, 148)=4.72$, $P=0.032$, ES = 0.19) with children in the PEI group displaying more verbal RRBs (one or more vs. none) compared to children in the JASPER group 6 months after intervention completion.

For visual RRBs and motor RRBs, no significant interaction effect of time point by intervention group was

noted (JASPER: $F(1, 78)=0.78$, $P=0.381$, ES = 0.10; PEI: $F(1, 78)=3.00$, $P=0.087$, ES = 0.20, respectively). There was a non-significant effect of time point, indicating that the odds of having visual and motor RRBs remained stable for children in both groups from entry to exit (JASPER: $F(1, 78)=0.54$, $P=0.466$, $P=0.083$; PEI: $F(1, 78)=1.94$, $P=0.167$, ES = 0.16). In addition, there was no significant difference in the rate of change in both visual and motor RRBs from exit to follow-up (JASPER: $F(1, 148)=1.47$, $P=0.227$, ES = 0.10; PEI: $F(1, 148)=0.003$, $P=0.958$, ES = 0.005) with both groups remaining fairly stable post intervention.

Caregiver Response Types: Entry, Exit, and Follow-Up

Caregivers in both groups entered treatment responding to a similar percentage of their child's RRBs—responding to just under 50% of their child's RRBs (Fig. 4). There was a significant main effect of time point ($F(1, 1422)=28.42$, $P<0.001$, ES = 0.14) with caregivers in both intervention groups responding to a greater percentage of their child's RRBs at exit. There was also an interaction between time point and intervention group ($F(1, 1422)=15.19$, $P<0.001$, ES = 0.10) between entry to exit with caregivers in the JASPER group responding at a great rate to their child's RRBs immediately post intervention compared to caregivers in the PEI group. However at the 6-month follow-up, caregivers in both treatment groups similarly displayed more responses toward their child's RRB compared to their responses at entry (JASPER: $F(1, 2275)=2.62$, $P=0.009$, ES = 0.034; PEI: $F(1, 2275)=4.03$, $P=0.045$, ES = 0.042) suggestive of improvement of caregiver responses overtime.

While overall caregivers in the JASPER group increased in the overall percentage of responses to their child's RRBs between entry and exit (Fig. 4), when separated by individual response type this result was driven by the increased number of redirections (Fig. 5). As shown in Figure 5, caregivers in the JASPER group increased in the number of redirections they employed at exit, maintaining this rate to follow-up. Redirections decreased in the PEI group from entry to exit but increased at follow-up (Fig. 5). The other forms of caregiver response (verbal and physical) remained low and stable in both groups over time.

Caregiver Response Success: Entry, Exit, and Follow-Up

Caregiver responses were rated as successful around 50% of the time in both groups at entry (Fig. 6). There was a significant main effect of time point ($F(1, 709)=5.78$, $P=0.017$, ES = 0.09) with caregivers in both interventions groups were rated as more successful in their responses post intervention. This was observed to a greater extent in the JASPER group with a modest significant interaction between time point and group ($F(1, 709)=3.69$, $P=0.055$, ES = 0.072). Last, response success reduced from exit to the 6-month follow-up in the JASPER group ($F(1, 1186)=6.09$, $P=0.01$, ES = 0.072), but remained constant in the PEI group ($F(1, 1186)=1.25$, $P=0.264$, ES = 0.032) (Fig. 6). The difference in the changes from exit to follow-up between the two groups was not significant ($F(1, 1186)=0.71$, $P=0.401$, ES = 0.024).

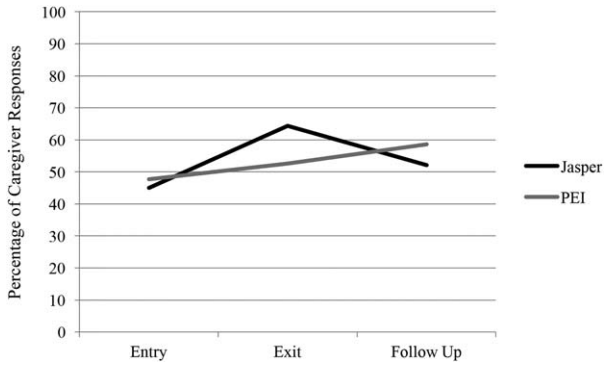

Figure 4. Percentage of caregiver responses at entry, exit, and follow-up.

Discussion

In this study, change in child RRBs was examined following a caregiver-mediated intervention aimed at increasing child social-communication behaviors. The study differs from previous studies in the focus on both child expression of RRBs and caregiver responses following a social-communication intervention, and in the measures used to address change. For example, previous studies have used checklist measures, such as the RBS-R, or global measures of ASD severity, such as ADOS scores [Dawson et al., 2010; Green et al., 2010], whereas this study applied a detailed behavioral coding system to CCX sessions. Results indicated that caregivers who received caregiver-mediated JASPER responded to more of their child RRBs and were rated as more successful in their attempts to address them immediately post intervention. Our findings are suggestive of spillover effects of a caregiver-mediated social-communication intervention in targeting caregiver responses to child RRBs, with a modest short-term reduction of in RRBs involving objects.

Toddlers in early intervention (receiving a base program of 30 hr per week) plus JASPER showed a modest reduction in the frequency of their RRBs over a 3-month period, however higher rates of RRBs were noted at the 6-month follow-up. This pattern is consistent with short-term longitudinal reports that indicate relatively consistent rates of RRBs in early childhood [Honey, McConachie, Randle, Shearer, & Le Couteur, 2008;

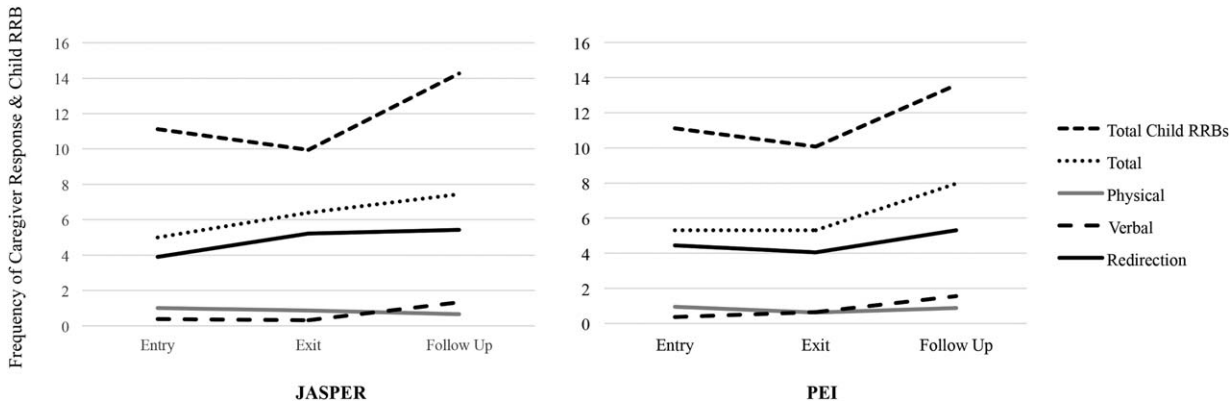

Figure 5. Percentage of caregiver responses at entry, exit, and follow-up by response type.

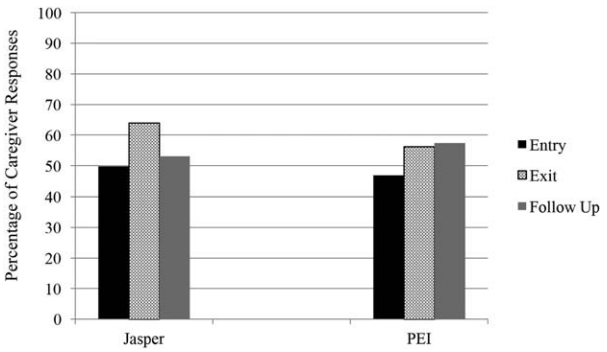

Figure 6. Caregiver response success at entry, exit, and follow-up.

Richler, Huerta, Bishop, & Lord, 2010] with slight increases into preschool years [Harrop et al., 2014]. Given the focus of JASPER on social-communication behaviors, this relative lack of change in child RRBs is unsurprising and suggests meaningful change may not be possible without specifically targeting these behaviors within intervention.

Caregivers in the JASPER condition responded to more RRBs over the course of treatment. Specifically, between entry and exit, caregivers in the JASPER group increased in their percentage of responses to child RRBs and these responses were rated as more successful than caregivers in the PEI group. These data suggest that a targeted social-communication intervention may yield spill over to other core domains such as RRBs in the short term. Increasing play and joint attention skills may result in reducing interfering behaviors, such as RRBs, or increasing caregiver's awareness and ability in how to redirect these behaviors and reduce their impact on the interaction.

While caregivers in the JASPER group did show an overall increase in their responsiveness to their child's RRBs, the reduction in child behaviors themselves was modest and not maintained at follow-up. This dissociation between caregiver and child behaviors is worthy of further discussion and investigation. While RRBs are not specifically targeted within JASPER, many of the strategies employed are directly relevant to RRBs and may lead to reduction in these behaviors. Descriptively, caregivers in the JASPER group were employing slightly more redirections (Fig. 5), suggesting that their improvements in overall responsiveness [Shire et al., 2016] and adoption of JASPER strategies [Gulsrud et al., 2015] were potentially impacting the way in which they responded to their child's RRBs. Specific strategies may include the arrangement of toys in the play environment and mirroring/expanding the child's appropriate play actions [Gulsrud et al., 2015]. While this effect was not maintained at follow-up, it represents the benefit of targeted social-communication interventions on the core domain of RRBs that is worthy of further investigation.

These results raise important questions as to the need for targeted intervention for RRBs in early childhood. As noted, the presence of RRBs remained largely stable over the 3-month treatment period, and increased over the 6-month follow-up. This suggests that RRBs remained unchanged despite increases in social and communication behaviors [Kasari et al., 2015]. Both interventions, JASPER and PEI, are considered low intensity in their number of sessions per week and duration. One possibility is that a more intensive delivery of JASPER (more sessions, longer overall duration) may result in more of an impact on child RRBs. However, this current study was less intense than the MRB intervention [Grahame et al., 2015—2 hr a week for 8 weeks] and yielded similar outcomes despite the focus not being on RRBs themselves. Therefore our study raises a number of theoretical questions such as whether RRBs or specific categories of RRBs should be targeted within early intervention, whether these should be targeted only when they impede on the acquisition of other skills (such as communication and play) and

what type of intervention is appropriate for these behaviors.

Current evidence-based practice guidelines for RRBs are anchored within single subject design [see Boyd et al., 2012 for review] and often not focused on early, caregiver-mediated approaches [Harrop, 2015]. It has been hypothesized that certain *lower order* RRBs are not mediated by social contingencies and may be resistant to/increase with social consequences [Cunningham & Schreibman, 2008; Durand & Carr, 1987; Goh et al., 1995]. Therefore we need to understand more about the function of the RRB itself before understanding if and how these behaviors change with social-communication attempts by their caregiver. Further, many of the recommendations and strategies for targeting reductions in RRBs, such as response blocking, contrast with those employed within more naturalistic interventions, such as following the child's lead. Therefore, further work is required to understand how these strategies "fit" with more naturalistic, developmental approaches such as JASPER and whether these approaches could be combined to target both the core domains of ASD.

Our findings are similar to those of Grahame et al. [2015] who, following a brief caregiver training specifically focused on RRBs, found caregivers in the immediate treatment group increased in their use of "distracting/development" strategies. As with our study, Grahame et al. did not observe large reductions in RRBs, with only one type of RRB reducing within a CCX following treatment. However both these studies indicate that while change may not be observed in child RRBs following low intensive interventions, these approaches may be particularly beneficial for caregivers' ability and confidence to successfully redirect RRBs that may otherwise hinder the ability to engage in play routines and dyadic interactions with their child.

Further work is required to examine the impact of current evidence-based practice (typically aimed at cognition and social-communication) delivered through caregivers and/or interventionists on RRBs to determine whether separate targeted approaches are required. It is possible that a hybrid approach to tackling RRBs may be beneficial, combining the direct coaching of a caregiver mediated approached such as JASPER with caregiver training and information sessions [such as those reported by Grahame et al., 2015]. Future work should also examine which specific aspects and strategies taught within JASPER led to the "spillover" effects observed for child object RRBs and also increases in successful caregiver responses. This will help us understands what "active ingredients" are also applicable for RRBs and how these can be applied/adapted in future interventions targeting RRBs.

Limitations

While this study represents the first attempt to study in-depth the effect of a caregiver mediated intervention on the other core domain of ASD—RRBs—there are a number of limitations worthy of discussion and future work. First, we did not ask caregivers whether their training (both JASPER and PEI) influenced their interaction style toward their child's RRBs. While we could observationally assess effects of the interventions on RRBs it would be interesting to know if caregivers were consciously implementing JASPER strategies in response to these behaviors. Second, the low intensity nature of both interventions (1 hr per week for 10 weeks) may have been too short to influence child RRBs, especially as this is not the goal of JASPER. While these interventions were added to an existing 30 hr week intensive intervention, very few intensive intervention packages have found significant reductions on child RRBs [Dawson et al., 2010] suggesting these may be *resistant* to intervention or require a different approach to behaviors typically targeted within early intervention.

A further limitation to our study is the length of the CCX may have been insufficient to fully capture a range of RRBs, particularly those that are classed as higher order (not under investigation in our current study due to the age of our sample). While 10 min CCXs are common within intervention research and represent a naturalistic way to observe RRBs and caregiver responses [e.g., Grahame et al., 2015], this time frame may be too brief to yield sufficient variability in RRBs. Coupled with only a single observation at each time point, the reliance on the CCX could lead to floor effects for certain classes of RRBs.

Conclusions

Our findings demonstrate that caregivers undergoing an intervention aimed at increasing social-communication also responded more to their child's RRBs in the short term. While child RRBs remained largely unchanged, a modest reduction in object RRBs was observed in the JASPER group following 10 weeks of CMI. In the face of increasing RRBs at 6-month follow-up in both intervention groups [often observed in early preschool years, e.g., Harrop et al., 2014], children in the caregiver-mediated JASPER group continued to develop social-communication skills [Kasari et al., 2015] suggesting that growth in other areas is still possible despite increasing RRBs. Our findings have implications for separate targeting of RRBs either within our current evidence based interventions or through add on training for caregivers.

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