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Michelle Flippin

Linda R. Watson

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Parental Broad Autism Phenotype and the Language Skills

of Children with Autism Spectrum Disorder

Running Head: Parental BAP & Child Language Skills in ASD

Michelle Flippin

University of Rhode Island

Linda R. Watson

University of North Carolina

Abstract

Father-child and mother-child interactions were examined in order to investigate concurrent associations between three characteristics of parental broad autism phenotype (i.e., aloofness, rigidity, pragmatic language deficits), parental verbal responsiveness, and language skills of children with ASD. Results for mothers indicated that aloofness and rigidity were negatively associated with both child-initiated engagement and child language skills. Maternal aloofness was also negatively correlated with verbal responsiveness, but rigidity was not. Results suggest that the associations between aloofness and child language are potentially mediated by maternal use of responsive verbal behaviors. Maternal pragmatic language deficits were not related to child language skills. In contrast, for fathers, aloofness, rigidity and pragmatic language deficits were unrelated to child language skills, however positive associations were found between paternal pragmatic language deficits and frequency of child-initiated engagement. Results are discussed in reference to potential clinical implications and directions for future research.

Keywords: autism spectrum disorder, language, broad autism phenotype, father, parent

Parent Broad Autism Phenotype, Responsiveness, and the Language Skills of Children

with Autism Spectrum Disorder

One of the earliest markers of autism spectrum disorder (ASD) is delay in language development (APA 2013). A strong predictor of language development for children with ASD is early parental verbal responsiveness. Parental verbal responsiveness refers to parents' use of language input that follows the child's lead and maps the child's focus of attention (Landry, Smith & Swank, 2006; Spiker, Boyce & Boyce, 2002; Warren & Brady, 2007). In two longitudinal studies, Siller and Sigman (2002, 2008) noted that mothers' use of responsive verbal strategies with preschoolers with ASD was positively correlated with joint attention and language skills over periods of one, 10 and 16 years. A strong positive relationship between maternal responsiveness and child language skills was also reported by McDuffie and Yoder (2010), who found that after controlling for child engagement, mothers' use of comments and directives that mapped the child's focus of attention (i.e., follow-in-comments and follow-in-directives) significantly predicted children's spoken vocabulary at 6-month follow-up. Haebig, McDuffie and Ellis Weismer (2013) also documented stronger one-year language outcomes for 40 toddlers and preschoolers with ASD whose parents used more responsive verbal behaviors. Finally, in a study that examined nine theoretically-motivated potential predictors of expressive language growth, Yoder, Watson and Lambert (2015) found that parent verbal responsiveness accounted for significant unique variance in expressive language gains across a 12-month time period for 87 young, initially preverbal children with ASD.

Given that these longitudinal studies show parental verbal responsiveness to be a predictor of language outcomes for children with an ASD, it follows that increasing parent responsiveness is often a target of early communication intervention for children with ASD. However, results from studies of parent-implemented intervention have been mixed. For instance, three randomized control trials of parent-implemented intervention for preschoolers with ASD failed to detect main effects on child outcome measures from parent coaching on responsive strategies (Carter et al., 2011; Green et. al., 2015; Rogers et al., 2012). Nevertheless, the Carter et al. and Green et al. studies reported medium to large effects on parent outcomes, including increased parent responsivity, synchronization or interaction skills. Taken together, findings from these studies suggest that parents can be effectively taught to implement a broad range of intervention strategies. However, not all parents acquire the same level of proficiency in using targeted strategies. Moreover, parents differ in their use of these strategies over time, and some may not implement targeted strategies with sufficient intensity to affect children's long-term communication outcomes (Carter et al., 2011; Rogers et al., 2012; Schertz et al., 2013).

One possible reason for lack of main effects on child outcomes of parent-implemented communication intervention is related to the fit of treatment strategies to the pre-intervention characteristics of participating children. For example, Haebig and colleagues (2013) documented that parents' use of one type of responsive strategy, follow-in comments, was relatively more effective for children who began the study with lower expressive vocabulary. Thus, baseline communication level is likely one child characteristic that influences treatment outcomes. Likewise, another reason for

differences in intervention outcomes may be related to the fit of treatment strategies to the pre-intervention characteristics, needs and strengths of participating parents and families. For instance, in a recent randomized controlled trial, Wetherby et al. (2014) compared effects of two 9-month, parent-implemented interventions on children with ASD. Findings showed greater improvements on child outcome measures of social communication, adaptive behaviors, and developmental level for individualized home-based parent coaching versus parent training delivered in a group setting. Thus, tailoring intervention to fit the needs of individual families may be more effective in improving child communication outcomes than a one-size-fits-all approach.

Although an emerging body of evidence supports the inclusion of pre-treatment child characteristics (e.g., autism severity, sensory profile, baseline cognitive and language skills) as potentially influential variables on intervention efficacy for children with ASD, few studies have examined the potential influence of pre-treatment parent characteristics on communication outcomes for children with ASD. In a rare example, Siller, Hutman and Sigman (2013) found that mothers who initially demonstrated accepting insightfulness into their children's thoughts, feelings, and behaviors increased their synchronous responses to their young children with ASD in an intervention targeting responsive parent strategies, but mothers who were initially noninsightful did not change in responsiveness if assigned to the intervention. The Siller et al. findings illustrate the point that, because parent-implemented interventions for young children with ASD aim to improve child communication skills through changes in parent behavior, pre-intervention parental variables may also influence treatment outcomes.

One potentially influential variable in parent uptake of a parent-mediated intervention is parent gender. Despite the increased role many fathers now play in direct childcare for all children (Pleck & Masciadrelli, 2004) and the high level of father engagement in education and learning for children with ASD (Potter, 2016), fathers have been underrepresented in ASD intervention research. However, it is estimated that two-thirds of children with ASD in the United States reside in a two-parent household (Freedman, Kalb, Zablotsky, & Stuart, 2012) and including fathers is an important step towards effectively involving all stakeholders in ASD intervention. Moreover, specifically examining the contributions of fathers is important given that fathers of both children who are typically developing and at risk use language models that are distinct from mothers and thus may influence child language in unique ways. In fact, fathers' vocabulary use at 24 months has been shown to predict levels of child expressive language 1 year later at 36 months (Baker, Vernon-Feageans & The Family Life Project Investigators, 2015; Pancsofar & Vernon-Feagans, 2006, 2010), whereas mothers' language did not account for a significant portion of the variance. Overall, compared to mothers, fathers tend use vocabulary that is more varied and abstract, use higher-level syntax, and are more likely to direct questions to their children (Bernstein-Ratner, 1988; Gleason, 1975; Leech, Salo, Rowe & Cabrera, 2013; Masur & Gleason, 1980; McLaughlin, Schultz & White, 1980; Pancsofar & Vernon-Feagans, 2006; Rondal, 1980; Rowe, Coker & Pan, 2004; Walker & Armstrong, 1995). Paternal communication styles may be facilitative in supporting child social communication development. For example, Pelligrini, Brody & Stoneman (1987) reported that while mothers tended to ignore their typically developing child's violations of conversational conventions, fathers used these

opportunities to provide feedback to their child through repetition, requesting clarification, and modeling correct responses.

For children with ASD, who have impaired awareness of the impact of their communicative signals on others, the directive, didactic communication style of many fathers may help them to clarify their message, and increase their awareness of the impact of their communication on others. In fact, early studies of fathers of children with autism reported similar patterns to fathers of with fathers of children who are typically developing, fathers of children with ASD have also been found use fewer questions, labels and expansions and prompts of child utterances and a greater percentage of directives than mothers (Konstantareas, Konstantareas, Mandel, & Homatidis 1988; Wolchik, 1983). Although more current studies are needed to find out if these patterns between fathers and children with ASD still hold, more broadly, recent studies of fathers of both children who are typically developing and those who are at-risk for developmental problems due to socio-environmental factors show responsive fathering to be a strong predictor of positive developmental and academic outcomes including emotional regulation, cognition, and language development (Shannon, Tamis-LeMonda, London, & Cabrera, 2002; Tamis-LeMonda, Shannon, Cabrera, & Lamb, 2004). For instance, research with low-income families has shown that fathers who read, tell stories, and sign songs, have preschool aged children with better pre-literacy and attention skills (Baker, 2013). It may be the case that fathers' responsive verbal models are similarly associated with positive social communication outcomes for children with ASD. Thus, parent gender is one important, although often overlooked, variable that could impact the

effectiveness of parent-mediated communication intervention for children with ASD. Another potentially relevant parent variable is the broad autism phenotype.

The broad autism phenotype (BAP) refers to the phenotypic expression of elevated, but diagnostically subthreshold, levels of autism-related symptoms among relatives of individuals with ASD (Folstein & Rutter 1977). The reported prevalence of the BAP among these family members ranges from 12 to 30%, and fathers have been reported to show more BAP characteristics than mothers (Bishop et al. 2004; Hurley, Losh, Parlier, Reznick & Piven, 2007; Pickles et al., 2002). Personality, social, and language features that comprise the BAP parallel the defining behavioral characteristics of ASD, including social deficits, communication abnormalities, and stereotyped, repetitive behavior (Piven, Palmer, Jacobi, Childress & Arndt, 1997). Specifically, researchers have defined three primary components of the BAP: (a) aloofness; (b) rigid personality; and (c) pragmatic language deficits (Hurley et. al. 2007). Aloofness is characterized by diminished interest in or enjoyment of social interaction. Rigid personality is defined as difficulty adjusting to change. Finally, pragmatic language problems refer to deficits in the social use of language, resulting in reduced effectiveness of communicative exchanges.

Emerging evidence suggests that BAP characteristics can impact the communicative effectiveness of parents during exchanges with other adults. For example, compared to parents of children with Down syndrome, parents of children with ASD were found to use less frequent eye contact in interactions with adult examiners, and fathers of children with ASD used significantly less eye contact than mothers (Ruser et al., 2007). Likewise, other researchers reported that fathers of children with ASD were

more likely than fathers of typically developing children to exhibit gaze direction patterns similar to those found in ASD (Scheeren & Stauder 2008). In fact, Hartley, Papp, Blumenstock, Floyd and Goetz (2016) recently identified parental BAP as a vulnerability factor for families of children with ASD. Specifically, parental BAP was related to a higher overall rating of negative affect in couple interactions. Moreover, parental BAP levels moderated the impact of parents reporting a high level of child ASD symptoms and co-occurring behavior problems on same and next-day ratings of negative couple problem-solving interactions. Taken together, results of these studies suggest that the BAP may impact parent couple interactions and adult-adult communication. Likewise, the BAP may also influence parent-child communication. Given the strong link between the quality of early parent-child communication and later language outcomes for children with ASD, understanding any potential relationships between parental BAP and child communication skills may have important clinical implications for parent-mediated interventions.

Finally, appropriately interpreting associations among parent characteristics, parent-child interaction variables, and child outcomes requires mindfulness that parents and children have bidirectional impacts on one another. The focus in parent-mediated interventions often is overwhelmingly placed on the effects that parental interaction strategies may have on children's outcomes, such as their growth in communication skills. The effects that children are having on the nature of parent-child interactions have received less explicit attention. Research strategies to adequately capture these complex transactions between parents and children are elusive (Sameroff & MacKenzie, 2003). Nevertheless, child variables, such as the use of prelinguistic communicative gestures

(Olson & Masur, 2013; Wu & Gros-Louis, 2015) and children's sensory hyper- and hypo-reactivity (Kinard et al., 2016) have been implicated in influencing the frequency and type of parent responses occurring during parent-child interactions. In the context of the present study, it is important to consider the potential complexities of the transactions between parents and their children with ASD when children may engage in fewer behaviors that elicit parental responses or engage in unusual behaviors that may alter the quality of parent responses, while at the same time, some parents may have subclinical symptoms of ASD that influence their perceptions of and reactions to their children's behaviors. This study represents an initial effort to examine some of these interrelationships among parental BAP characteristics, parental verbal responsiveness, and child behaviors in the context of parent-child interactions involving mothers versus fathers.

The long-term goal of this program of research is to develop an individualized, parent-implemented social communication intervention for young children with ASD that effectively involves both fathers and mothers. The aims of the current study were to investigate several unanswered questions regarding relationships between parent responsiveness and BAP characteristics and the language skills of children with ASD. Specifically, this investigation sought to identify any concurrent associations between parental BAP characteristics and child-initiated engagement and language skills, and to examine whether associations between parental BAP characteristics and child language remain significant after accounting for parental verbal responsiveness. We predicted that child-initiated engagement and language skills would be concurrently negatively associated with parental scores on one or more of the BAPQ subscales. In addition, we

predicted that concurrent negative relationships between parental scores on BAPQ

subscale and child language skills would decrease with increased parent use of responsive

verbal behaviors.

Methods

Participants

Sixteen children with ASD (12 boys and 4 girls) and their mothers and fathers

participated in this study. Child participants met the following inclusion criteria: (a)

chronologic age between 36 and 69 months; (b) existing clinical diagnosis of ASD,

confirmed by the cutoff scores on the Autism Diagnostic Observation Schedule (ADOS;

Lord, Rutter, DiLavore and Risi 2006); (c) no severe sensory or motor impairments; and

(d) no identified metabolic, genetic, or progressive neurological disorders. In addition,

each participating child was required to have two biological parents, or married

caregivers, residing with the child continuously since birth. Table 1 provides

demographic information for parents and children. Other findings from this sample have

been reported previously (Flippin & Watson, 2011).

Standardized Measures

The ADOS (Lord et al. 2006) is a standardized, semi-structured play-based

assessment of social interaction, verbal and non-verbal communication, as well as

stereotyped behaviors and restricted interests. The ADOS is comprised of four modules,

based on a participant's particular expressive language level. ADOS Gotham algorithm

scores (Gotham, Risi, Pickles and Lord. 2007) meeting cut-offs for ASD were an

inclusion criteria for child participants in this study. Although each children in study had

a previous community diagnosis of autism, the ADOS was administered by research-

reliable project staff in order to confirm diagnosis of ASD and obtain severity scores for

fifteen of the sixteen participating children. For one child, ADOS had recently been

completed by the local agency determining Part C eligibility and scores were shared with

study, however the ADOS was not administered by project staff.

Calibrated severity scores, which allow comparisons across different ADOS

modules, were calculated from the ADOS total scores according to Gotham, Pickles, and

Lord (2009). Calibrated severity scores range from 1 to 10, with scores from 6 to 10

corresponding to approximate fifths of individuals included in Gotham et al. who

received ADOS algorithm scores classifying them in the autism range. Severity scores

are reported for children in our sample for descriptive purposes (see Table 2).

[Insert Table 2 about here]

The MSEL (Mullen, 1995) is a comprehensive measure of cognitive function for

children from birth to 68 months of age. The test is comprised of five subscales: gross

motor, visual reception; fine motor, receptive language, and expressive language. The

MSEL is recommended for evaluating verbal and non-verbal development quotients for

young children with autism (Akshoomoff, 2006). The Visual Reception (VR) subscale

measures visual processing skills, spatial organization, and visual memory. The MSEL

VR subscale has been shown to be a predictor of later receptive and expressive language

growth in children with ASD (Bedford, Pickles & Lord, 2016). For participating children,

scores obtained within 3 months were shared from larger projects, or the VR subtest was

administered concurrent with their participation in this study (for three children). Data for

VR T-scores (mean of 50, SD = 10) are provided for descriptive purposes (see Table 2);

however, the summary statistics include seven (of 16) participating children who

achieved the lowest possible T-score on the VR subtest (i.e., 20).

The Preschool Language Scale-4 (PLS-4; Zimmerman et al., 2002) was

administered to assess child language skills. The PLS-4 is a standardized measure of

receptive and expressive language skills for children birth to 6 years, 11 months of age.

The test is composed of two subscales: Auditory Comprehension and Expressive

Communication. The PLS-4 yields norm-referenced scores for each subscale, as a well as

a total score computed from the two subscales. PLS-4 standard scores have a mean of

100 and a standard deviation of 15. For analytic purposes, total language raw scores were

used as the metric of child language skills, as 5 of 16 children in this study obtained the

lowest possible total language standard score (i.e., 50) on the PLS-4 (see Table 2).

The Broad Autism Phenotype Questionnaire (BAPQ; Hurley et al. 2007) was

administered to assess personality and language characteristics of the BAP with

participating parents. The BAPQ was chosen because it is an efficient and valid

informant report instrument designed to identify and characterize the BAP in adult

relatives of individuals with ASD. To avoid potential response bias, authors of BAPQ

entitled the form distributed to parents "Personality Styles and Preferences

Questionnaire." The questionnaire is composed of 36 items, organized into 3 subscales

(Aloof; Rigid; Pragmatic Language) that reflect the social, stereotyped repetitive, and

communication behavioral domains characteristic of autism spectrum disorder. Items are

rated along a six point Likert scale (ranging from "very rarely" to "very often"). Each

mother and father enrolled in the study completed the BAPQ twice: once as a self-report

questionnaire and once as an informant questionnaire for his/her spouse. Composite "best

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estimate" scores were then calculated by averaging corresponding self- and informant-report values for each of the individual subscales as well as Total BAPQ score, with higher scores indicative of the BAP. Table 3 describes BAPQ scores for participating parents. Sensitivity and specificity of composite scores are 81.8% and 78.1% respectively (Hurley et al., 2007).

Although the current study included only 16 mother-father dyads, a wide range of BAP characteristics were represented within the parent sample. Among individual parents, three mothers and five fathers did not meet criterion on any of the BAPQ subscales (Aloof, Rigid, Pragmatic Language); whereas, two mothers and three fathers met criterion on all 3 subscales. In addition to the wide range of BAPQ scores for individual mothers and fathers, there was also a wide range of combinations of BAP characteristics within and across parent couples. For example, at one extreme, two mother-father dyads did not meet criterion for any of the three BAPQ subscales. At the other extreme, for one parent dyad, the mother met criteria for all three BAPQ subscales whereas the father met for none. Table 4 describes the various BAP characteristics of the 16 parent couples.

Participating parents completed a demographic questionnaire to indicate ethnicity (Hispanic or non-Hispanic) and race (i.e., American Indian/Alaska Native; Asian; Black/African-American; Native Hawaiian/Pacific Islander; White), and to measure levels of household income and parental education. Household income was measured as one of six levels: (a) less than $20,000 (b) $20,000-$39,999; (c) $40,000-$59,999; (d) $60,000- $79,999; (e) $80,000-$99,999; (f) greater than $100,000. Parental education was measured as one of six highest levels of education completed: (a) grades 1-11; (b)

high school graduate/GED; (c) Associates/Technical degree; (d) Bachelors; (e) Masters; or (f) Doctorate/equivalent professional level degree.

Observational Measures

   Parent-child Naturalistic Play Observations. Mother-child and father-child fifteen-minute naturalistic play observations were conducted in the lab. The order of mother-child and father-child sessions was counterbalanced across parents to control for order effects. Two different standard, parallel sets of age-appropriate toys were assembled so that toys would be equally novel to each child in play sessions with mothers and with fathers. Each toy set included masculine (male figures, trucks, cars), feminine (female figures, baby dolls) and gender-neutral (blocks, twirlers) categories. At the start of each session, parents were directed to, "Play as you would normally play at home. Feel free to use some or all of the toys. We ask that if you are going to sit, parents sit in the larger blue chair so that it is easier to see the child on video." Sessions were video-recorded for later coding.

   Coding and Reliability. Observational measures in this study were adapted from a coding schema developed by Yoder, Fey, Thompson, McDuffie, and Lieberman (2007). Using Procoder software (Tapp 2003), fifteen minutes of each parent-child play session were coded at 5-second intervals (180 intervals). Coding was conducted in three passes.

   Codeable. On the first pass, coders determined whether each 5-second interval was either (a) codeable or (b) uncodeable. Codeable intervals required the child to be visible on screen for the entire 5-second interval period. For all codeable intervals, child engagement was then coded on the second pass through the media files.

Child-initated engagement. On the second pass, child-initiated engagement was coded for all intervals in which the child either looked at or physically touched an object or person. Child-initiated engagement in this study did not require that the child initiate an intentional communication bid to the parent. Rather, the child merely needed to initiate attention to or physical engagement with an object or event in such a way that a parent can determine the child's focus of attention. Specifically, three types of child-initated engagement were coded: "look engagement"; "touch engagement" or "no engagement". If a child looked at a toy, person, or event during the 5-second interval, an instance of visual or "look" engagement was coded. If a child actively touched a toy during the 5-second interval, tactile or "touch" engagement was coded. Touch engagement was not coded if child was engaged in perseverative or self-stimulatory use of an object. For intervals in which child both actively touched one toy, but looked at another, child was credited with visual engagement. If a child was not engaged with either looking at or touching a person or object (e.g., child was running, climbing) during the duration of the 5-second interval "no engagement" was coded. In addition, if a parent redirected a child's attention to a new focus during a given interval, the child was only credited with child-initiated engagement if the child maintained a focus on the object introduced by the parent (by looking at and/or touching it) over the following two 5-second intervals. Thus, parents who redirected their children's attention frequently reduced the number of intervals in which a child could be scored as showing child-initiated visual or tactile engagement.

Parent Verbal Responsiveness. On the third pass through the media files, parent responses were coded for each 5-second interval for which a child was coded with visual

or tactile engagement on the previous pass. Parent utterances (i.e., comments and requests) were coded as responsive if they (a) referenced the child's focus of attention (e.g. object or event), and (b) had a specific semantic relationship to the child's focus of attention, including the object, proprieties of the object (e.g. color, size, textures, sounds associated with the object) and action, or qualities of the action (e.g. "black hat"; "Can you put the hat on top?"). Parent utterances that referenced an object or action outside of the child's focus of attention were not coded as responsive. In addition, parent use of affirmatives (e.g. "all right"; "good job"), negative response words, interjections and vocatives (e.g. "um," "Eh?"), and routinized utterances, (e.g. counting, alphabet recitation, songs, finger plays) were not coded as parent verbal responsiveness.

Reliability. Coding of parent-child observations videos was completed by two coders, with backgrounds in public health, and communication sciences and disorders, respectively. The primary coder was blind to the research questions and hypotheses, and both coders were trained to 80% reliability on each behavioral code on practice videos. The second coder independently coded the full parent-child play sample and then codes were compared. Intraclass correlations (ICCs) were calculated across a randomly selected 25% of the parent-child play observations (four mother-child sessions and four father-child sessions). ICC values were uniformly above .80 for each coded variable, exceeding the ICC value of .70 suggested to reflect acceptable reliability (Mitchell 1979). ICCs were as follows: codeable, .99; 95% CI [0.88, 1.00]; touch lead, 1.00; 95% CI = [0.99, 1.00]; look lead, .96; 95% CI [0.96, 0.99]; mother verbal responsiveness, .99; 95% CI [0.96, 1.00]; father verbal responsiveness, .99; 95% CI [0.86, 1.00].

Procedures

For child participants recruited from larger projects (n = 13), the PLS-4, parent-child play observations, and parent questionnaires were completed on the same day. For two children not recruited from larger studies, MSEL VR subscale and ADOS were administered by research-reliable project staff prior to PLS-4, and parent-child play observations and questionnaires. Finally for one child for whom the ADOS was administered by local agency determining Part C eligibility and share with this study, MSEL VR subscale was completed prior to PLS-4, parent-child play observations, and questionnaires. Table 2 describes child assessment data. Sessions were scheduled on weeknights and Saturdays, as needed, to allow both fathers and mothers to participate. Upon completion of the assessments and observations, each participating family received $25 for travel expenses.

Plan for Data Analyses

Prior to answering the research questions, distributions of variables were examined to determine whether they met assumptions of normality. Child scores on the Mullen Visual Reception subtest (VR) scores and PLS-4 total language raw scores were negatively skewed; however, ADOS Gotham algorithm scores (Gotham et al., 2009) were more normally distributed, suggesting the study sample reflected a wide range of ASD characteristics. Next, associations between levels of household income and parent education and measures of child language skills and parent verbal responsiveness were examined. Levels of household income were not significantly associated with the child MSEL VR subtest ($rho = -.123$, $p = .313$) or PLS-4 scores ($rho = -.163$, $p = .273$) and therefore were not considered further. To answer the three research questions, correlations were run between: (1) parent BAPQ subscale scores and parent

responsiveness; (2) parent BAPQ subscale scores and child language raw scores; and (3) parent BAPQ scores and child language raw scores, controlling for parent responsiveness. For all correlations, non-parametric Spearman *rho* was utilized. The Spearman correlation coefficient is based on the ranked values for each variable rather than the raw data and is appropriate for examining monotonic relationships between two variables, in which the variables tend to change together, but not necessarily at a constant rate. Statistical analyses were conducted using SPSS 24.0 for Mac. Results of data analysis procedures are described relative to each of the research questions below.

Results

Research question 1. Are there concurrent associations between parent BAP characteristics and frequency of child-initiated engagement? Spearman's *rho* correlations were run to examine relationships between frequency of child-initiated engagement and parent BAPQ scores. Child-initiated engagement was negatively associated with mothers' scores on both Aloof (*rho* = -.586, *p* = .01) and Rigid BAPQ subscales (*rho* = -.568, *p* = .02). In contrast, child-initiated engagement was not associated with mothers' Pragmatic Language subscale scores (*rho* = -.225, *p* = .40). Therefore, as the frequency of child-initiated engagement increased, mothers tended to show less aloof and rigid characteristics, as indicted by lower BAPQ subscale scores. For fathers, child-initiated engagement was also not associated with paternal Aloof (*rho* = .049, *p* = .42) or Rigid BAPQ subscale scores (*rho* = .089, *p* = .37); however, a positive association was found between frequency of child-initiated engagement and fathers' scores on the Pragmatic Language subscale (*rho* = .470, *p* = .03), indicating children showed more engagement during interaction with fathers with more impacted pragmatic language skills.

[Insert Table 5 about here]

Research question 2. Are there concurrent associations between parent BAP characteristics and verbal responsiveness? To answer the second research question, Spearman's *rho* correlations were run to examine the concurrent relationships between parent verbal responsiveness and mothers' and fathers' BAPQ subscale scores. For mothers, significant negative associations were found between frequency of responsive verbal behaviors and Aloof subscale scores (*rho* = -.621, *p* = .01), indicating that mothers who had higher Aloof subscale scores tended to use fewer responsive verbal behaviors in interactions with their children with ASD. In contrast, mothers' scores on the Rigid and Pragmatic Language subscales were not significantly associated with verbal responsiveness (*rho* = -.375, *p* = .152; *rho* = -.285, *p* = .142, respectively), although the negative correlations were in the predicted direction. For fathers, no significant associations were found between frequency of responsive verbal behaviors and subscale scores of the BAPQ: Aloof (*rho* = -.080, *p* = .365); Rigid (*rho* = .181, *p* = .251); or Pragmatic Language (*rho* = .293, *p* = .136). The directions of these nonsignificant associations also varied.

Research question 3. Are there concurrent associations between parent BAP characteristics and child language skills and do these relationships remain significant after accounting for parent verbal responsiveness? For question 3, we first ran Spearman's *rho* correlations to examine concurrent relationships between child language skills and parent BAPQ scores. For mothers, significant negative associations were found between child language skills and parent scores on Aloof (*rho* = -.500, *p* = .048) and Rigid BAPQ subscales (*rho* = -.691, *p* = .003), indicating that higher maternal scores on

the Aloof and Rigid subscales were concurrently associated with lower child language scores. In contrast, mothers' scores on the Pragmatic Language subscale were not associated with child language skills (rho = -.285, p = .284). For fathers, no associations were found between child language skills and paternal scores the three BAPQ subscales: Aloof (rho = -.013, p = .968); Rigid (rho = .186, p = .245); Pragmatic Language (rho = .118, p = .331).

Given the significant associations between child language and mothers' Aloof and Rigid BAPQ subscales, we next ran partial correlations for mothers' Aloof and Rigid BAPQ subscales to examine whether associations between child language skills and maternal scores on these two BAPQ subscales remained significant after controlling for frequency of mothers' responsive verbal behaviors. After partialling out maternal responsive verbal behaviors, correlations between mothers' scores on the Aloof subscale and child language scores were no longer significant (rho = .33, p =. 22), indicating that mothers use of responsive verbal behaviors is a potential mediator of the relationship between aloof parental BAP characteristic and child language skills. In contrast, correlations between mothers' scores on the Rigid BAPQ subscale and child language skills remained moderately strong and significant after partialling out mothers' verbal responsive behaviors (rho = -.58, p = .022).

Discussion

In this study, we examined the extent to which parental BAP characteristics were concurrently associated with parents' verbal responsiveness to their young children with ASD, and with child-initiated engagement and level of language functioning. Several findings emerged.

Parental BAP and Child-Initiated Engagement. First, significant concurrent associations were found between frequency of child-initiated engagement and mothers' scores on the Aloof and Rigid subscales. Children initiated less engagement with mothers who had higher Aloof and Rigid BAPQ scores. This finding is consistent with findings from other recent studies documenting associations between maternal BAP traits and child social communication skills (Hasegawa et al., 2015; Taylor et al., 2013). In considering these findings; however, it is important to remember that the operational definition of a child-initiated engagement in this study does not require that the child initiate an intentional communication bid to the parent. Rather, the child merely needs to have initiated attention to or engagement with an object or event in such a way that a parent can determine the child's focus of attention. Thus, it appears that mothers who have more aloof and rigid characteristics have children who tend to be less attentive to and engaged with their environment overall, and not just less socially engaged. As Hasegawa et al. (2015) and Taylor et al. (2013) describe, it is unclear whether associations such as these between parental BAP status and child-initiated engagement are caused by genetic or environmental factors, or a combination of both. For mothers, Pragmatic Language subscale scores were unrelated to child-initiated engagement.

In contrast to the findings for mothers, fathers' Aloof and Rigid subscale scores were unrelated to child-initiated engagement; however, a positive association was found between frequency of child-initiated engagement and fathers' scores on the Pragmatic Language subscale. That is, children in this study used more visual and tactile engagement with fathers whose pragmatic language characteristics more strongly resembled those seen in individuals with ASD. The finding of positive correlations

between paternal scores on the Pragmatic Language subscale and child-initiated engagement was unexpected and warrants further study. There may be several explanations for why Pragmatic Language subscale scores were significantly correlated with child-initiated engagement for fathers and not for mothers (where the association was of a low magnitude as well as nonsignificant). One possible explanation is that items of the BAPQ Pragmatic Language subscale are specific to adult-adult relationships and may not directly generalize to parent-child communication exchanges, where appropriate pragmatic performance may be easier. In fact, Pragmatic Language subscale items are marked in asterisk to prompt respondents to answer in terms of "casual interaction with acquaintances, rather than special relationships such as with close friends and family members" (e.g. "I can tell when someone is not interested in what I am saying"; "I am good at making small talk"; "I can tell when it is time to change topics in conversation"; Hurley et al., 2007, p. 1689). Another potential explanation may be that fathers with pragmatic language difficulties are less directive of child play, allowing their children to take the lead in play interactions. That is, the style used by these fathers may not have imposed limits on the number of intervals in which a child could be credited with initiating engagement. Finally, it may be the case that the language models of fathers are in some way supportive in interactions with children who share pragmatic language deficits.

Parent Verbal Responsiveness and Child Language. Similar to findings with child-initiated engagement, mothers' scores on the Aloof and Rigid BAPQ subscales were also negatively related to child language scores. In contrast, none of the paternal BAPQ subscale scores were associated with child language scores. Findings of

significant correlations between parental BAP traits and child language skills with

mothers but not fathers in the current study are consistent with results of Hasegawa et al.

(2015). In their study, higher Autism Spectrum Quotient (Baron-Cohen, Wheelwright,

Skinner, Martin & Clubley, 2001) scores for mothers, but not fathers, were a significant

predictor of higher Social Responsiveness Scale (Constantino, 2002) total scores in

children. Findings of significant associations between BAP child language skills and

maternal, but not paternal, characteristics may reflect the stronger history of interaction

between the participating mothers and children with ASD, as 14 of the 16 mothers in this

study identified caregiving as their primary role. In addition, effects may be operating

across parent couples. For instance, higher maternal scores on the Aloof subscale were

correlated with less child-initiated engagement during mother-child interactions only,

whereas higher maternal scores on the Rigid subscale were associated with less child-

initiated engagement across both mother-child and father-child interactions. Thus it is

possible that mothers and fathers may be taking cues from one another in communicating

with their child with ASD. For example, a parent with higher Rigid subscale scores may

influence the parent partner to adopt a less flexible parent-child communication and

interaction style. Alternatively, a parent with higher Aloof BAPQ scores may use

communication styles related to the Aloof subscale (e.g. using long pauses while talking,

losing track of the conversation topic, not being "in tune" with another person during

conversation,) that are less influential on the partner's parent-child communication style.

The potential impact of couple effects is interesting to consider, and future research with

larger samples is warranted to determine whether this relationship between the frequency

of child-initiated engagement and parent BAPQ subscale scores and is found with a larger sample and persists over time.

Parent Verbal Responsiveness as Potential Mediator for Parental BAP and Child Language Skills. After controlling for mothers' responsive verbal behaviors, negative correlations between mothers' scores on the Aloof subscale and child language scores were no longer significant, suggesting that increased frequency of responsive verbal behavior potentially mediates the relationship between aloof traits and child communication skills. However, such interpretations based on examining concurrent associations are speculative at this stage. As we have reported elsewhere, there are concurrent positive correlations between the frequency of parent verbal responses and child language skills in this sample for both mothers and fathers (BLINDED). Given evidence supporting bidirectional influences between child language level and parent responsiveness (e.g. Sterling, Warren, Brady & Fleming, 2013; Warlaumont, Richards, Gilkerson and Oller, 2014; Yoder et al., 2015), we acknowledge that longitudinal and experimental studies could better elucidate the potentially complex relationships among parent BAPQ characteristics, child language, and parent verbal responsiveness.

Whereas partialling out maternal verbal responsiveness resulted in a nonsignificant correlation between the Aloof BAPQ subscale scores and child language, the negative correlation between maternal Rigid BAPQ subscale scores and child language scores remained substantive and significant after controlling for mothers' use of responsive verbal behaviors. In this study, parent utterances were coded as responsive if they (a) referenced the child's focus of attention (e.g. object or event), and (b) had a specific semantic relationship to the child's focus of attention, including the object,

proprieties of the object (e.g. color, size, textures, sounds associated with the object), and action, or qualities of the action. However, flexibility of the verbal response was not measured in this coding schema. Parent language was coded as responsive even if parents repeated the same or similar responses to a child's continued visual or tactile engagement related to the same target. Thus, simply increasing frequency of verbal responses may not mediate the negative relationship between parental rigid traits and child communication skills, especially if verbal responses of mothers with high scores on the Rigid BAPQ subscale reflect repetitiveness or inflexibility in the way mothers are responding to their children.

Study Limitations

Results from this study have provided some early evidence regarding concurrent associations between the language skills of children with ASD and parent verbal responsiveness and BAP characteristics; however, several limitations must be highlighted. The first limitation of this study is the small sample size (n=16), which restricted our choices of appropriate statistical models, the ability to rule out potential confounders or adjust for the multiple correlation coefficients examined without greatly inflating the risk of Type II errors. Second, this study examined relationships between parent BAPQ scores, verbal responsiveness, and child language skills at a single time point. Other research designs that examine longitudinal associations and potentially manipulate variables of interest (e.g., increasing parent responsiveness through coaching) are necessary to determine whether these associations hold up across time, examine temporal precedence, and test causal hypotheses. Third, although the parent sample varied racially and ethnically, median family income was $100,000, and the middle-to-

high socio-economic status of the sample may have affected results. Fourth, parents who participated in this study may differ in important ways from parents who do not choose to participate in research. Finally, due to the nature of the research questions, parents who participated in this study were married, which is not reflective of all families of children with ASD.

Clinical Implications and Future Directions

An emerging body of evidence supports the inclusion of pre-treatment child factors (e.g. verbal skills, joint attention skills, imitation skills) as potentially influential variables on intervention efficacy for children with ASD. In contrast, few studies have examined the potential influence of pre-treatment parent factors on communication outcomes for children with ASD. However, parents who demonstrate characteristics of the BAP (i.e. aloofness, rigid personality, pragmatic language problems) may benefit from coaching models that are tailored to their unique social communication needs, strengths, and personalities. Individualizing parent coaching to fit parent pre-intervention characteristics in this way may increase the fidelity and effectiveness of parent-implemented intervention, resulting in improved social communication outcomes for children with ASD. Specifically, parents who meet criteria for Aloof characteristics of the BAP may benefit from interventions focused on increasing verbal responsiveness by coaching parents to share their child's focus of attention and model language that linguistically maps to the child's focus of attention. Conversely, coaching models focused solely on increasing frequency of responsive behaviors may be less effective for parents who meet criteria for rigid BAP characteristics. For these parents, coaching to help parents use a variety of flexible responsive verbal behaviors to better scaffold their

children's engagement and language learning may be more effective. Overall, understanding which responsive strategies are both beneficial to children with ASD and amenable to parents may be an important component of developing effective parent-implemented intervention.

In summary, findings from this observational study provide important early empirical support for continued investigations to examine associations between pre-intervention parent variables and communication skills of children with ASD. More research is needed to examine the best set of parent and child predictors of language outcomes for children with ASD. Specifically, future intervention research should investigate whether individualized parent coaching fits the needs and strengths of parents who demonstrate characteristics of the BAP. Understanding which responsive strategies best fit both parent and child pre-intervention variables may be an important component in developing maximally effective communication intervention for children with ASD. Identifying these variables will allow for greater specificity in matching parent coaching strategies to pre-treatment child and parent variables and may be beneficial for long-term communication outcomes.

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