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Influence of reporting effects on the association between maternal depression and child autism spectrum disorder behaviors

Teresa Bennett,[1] Michael Boyle,[1] Katholiki Georgiades,[1] Stelios Georgiades,[1] Ann Thompson,[1] Eric Duku,[1] Susan Bryson,[2] Eric Fombonne,[3] Tracy Vaillancourt,[4] Lonnie Zwaigenbaum,[5] Isabel Smith,[2] Pat Mirenda,[6] Wendy Roberts,[7] Joanne Volden,[5] Charlotte Waddell,[6,8] the Pathways in ASD Study Team, and Peter Szatmari[1]

[1]Offord Center for Child Studies, Mc Master University, Hamilton, ON, Canada; [2]Dalhousie University/IWK Health Center, Halifax, NS, Canada; [3]McGill University, Montreal, QC, Canada; [4]University of Ottawa, Ottawa, ON, Canada; [5]University of Alberta, Edmonton, AB, Canada; [6]University of British Columbia, Vancouver, BC, Canada; [7]University of Toronto, Toronto, ON, Canada; [8]Simon Fraser University, Vancouver, BC, Canada

Background: Maximizing measurement accuracy is an important aim in child development assessment and research. Parents are essential informants in the diagnostic process, and past research suggests that certain parental characteristics may influence how they report information about their children. This has not been studied in autism spectrum disorders (ASD) to date. We aimed, therefore, to investigate the possible effect that maternal depression might have on a mother's reports of her child's ASD behaviors. Using structural equation modeling, we disaggregated shared from unique variation in the association between latent variable measures of maternal depression and ASD behaviors. **Methods:** Data were obtained from a study of preschoolers aged 2–4 newly diagnosed with ASD (n = 214). Information from a parent questionnaire, a semi-structured parent interview, and a semi-structured observational assessment was used to develop a latent variable measure of child ASD behaviors. Mothers reported on their own depression symptoms. We first modeled the covariance between maternal depression and child ASD behavior. Then, to quantify unique variation, we added covariance terms between maternal depression and the residual variation associated with the individual measures of child ASD behaviors. **Results:** The model demonstrated excellent fit to the underlying data. Maternal self-report of depression symptoms exhibited a significant association with the unique variance of the questionnaire report but not with the latent variable measure of child ASD behavior. A gradient pattern of association was demonstrated between maternal depression and the unique variance of the ASD measures: most strongly for the maternal questionnaire report, more weakly for the maternal semi-structured interview, and to a trivial extent for the observational interview. **Conclusions:** Parental depression may influence reporting of ASD behaviors in preschoolers. Shared method effects may also contribute to bias. This finding highlights the importance of obtaining multimethod reports of child ASD symptoms. **Keywords:** Autistic disorder, Asperger's disorder, methodology, maternal depression, structural equation modeling.

Introduction

Parents and caregivers provide essential information about children, youth and adults with ASD. It is important to understand how parent characteristics may affect the reporting of their child's symptoms or behaviors. For example, the association between parental depression and increased severity of child behavior problems, relative to other informants (e.g., spouse, child, clinician), has been frequently reported in non-ASD children (see De Los Reyes & Kazdin, 2005; for an extensive review). Findings from previous studies indicate that increased maternal depression symptoms may be associated with increased measurement error (i.e., variance considered to reflect nonrandom factors other than the child's true symptoms) of child behavior problems (Boyle & Pickles, 1997a,b). Most studies have concluded that depressed mothers over-report their children's symptoms, consistent with the negative cognitive attributions related to their mood state, albeit to differing degrees depending on child age and type of problem or disorder (Boyle & Pickles, 1997a,b; Briggs-Gowan, 1996; Chi & Hinshaw, 2002; Chilcoat & Breslau, 1996; De Los Reyes, 2008; De Los Reyes & Kazdin, 2005; Fergusson, Lynskey, & Horwood, 1993; Najman, Williams, & Nikles, 2001).

Shared-method variance represents another source of measurement error. Study designs that rely solely on parent reports for independent and dependent variables may lead to estimates of association that are inflated because the same person provides all assessments. For example, if parents

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respond to similar questionnaires to appraise their own and their child's characteristics, their consistent style of responding may artificially increase correlations between the two variables. By contrast, combining a parent questionnaire with a clinical interview may reduce bias due to method of response; including an observational assessment might further minimize informant and method bias.

It is particularly important to understand how reliance on single, parent-based reports of child ASD behaviors may influence results in ASD research. First, diminished capacity for self-reflection and communication, often demand that parents act as primary respondents rather than those with ASD. Second, parents of individuals with ASD have been found to have higher than average rates of depression and mental health problems (Daniels et al., 2008; Estes et al., 2009; Micali, Chakrabarti, & Fombonne, 2004; Wolf, Noh, Fisman, & Speechley, 1989), which may affect their report on the child (Abbeduto et al., 2004; Bromley, Dougal, Davison, & Emerson, 2004; Estes et al., 2009; Wolf et al., 1989). Finally, as sample size requirements increase in research, the need for parsimony of measures and expediency of data collection may increase reliance on single informant (e.g., parents) and/or other cost-effective methods (e.g., questionnaires).

Determining whether parent characteristics or reporting effects contribute to bias in reports of child ASD behaviors requires an independent criterion measure of ASD for comparison (Richters, 1992). Insofar as diagnosis usually depends on parental report, this may not be possible: typically parents are the only ones able to provide information about developmental milestones and low base-rate behaviors. An alternative is to create a latent variable criterion informed by multiple assessment approaches, including maternal report. This makes it possible to: (a) disaggregate criterion content of the mother's ASD report (shared variance with other assessments) from residual content (unique or nonshared variance and random measurement error), and (b) quantify associations between maternal depression and each source of variance: shared and unique.

This study aims to examine the extent to which mothers' reports of their own depression symptoms are associated with a criterion latent variable measurement representing a quantitative trait of child ASD behaviors versus unique variance in maternal reports of child ASD behaviors specific to each assessment instrument. To our knowledge, this is the first study to investigate such associations in ASD, and the first to develop a criterion latent variable for autism behaviors using valid, reliable and widely used ASD assessment scales – the Social Responsiveness Scale (SRS, a parent questionnaire, Constantino & Todd, 2000), the Autism Diagnostic Interview-Revised (ADI-R, a parent interview, Lord, Rutter, & Le Couteur, 1994) and the Autism Diagnostic Observation Schedule (ADOS, an observational assessment, Lord et al., 1989; Lord, Rutter, DiLavore, & Risi, 1999). We hypothesized that: (a) maternal depression would be positively associated with a criterion measure of child ASD behaviors, and (b) maternal depression would also be positively associated with the unique variance embedded in the maternal-report questionnaire of ASD behaviors (i.e., the SRS). We further hypothesized a gradient of association – from strongest to weakest, – between maternal depression and unique variance across the 3 methods of assessing child ASD; maternal depression self-report would be most strongly correlated with the residual variance of the SRS, more weakly with that of the ADI-R and nonsignificantly with the residual of the ADOS, reflecting the extent of the measure's reliance on maternal input.

Because only maternal self-report data of depression symptoms were available, this study cannot determine the extent to which a potential association with increased measurement error in offspring ASD reports is due to characteristic cognitive bias or shared method effects. However, determining whether such an association exists is an important first step in ASD measurement research, particularly as it pertains to the tradeoffs inherent in choosing single versus multiple informants and methods.

Methods

Participants

Data were obtained from a Canadian multisite longitudinal inception study of preschoolers aged 2–4 diagnosed with any ASD (autistic disorder, Asperger Syndrome, PDD-NOS) in the previous 4 months. Participants consisted of children presenting for initial assessment at major ASD centres in Halifax, Montreal, Toronto, Hamilton, Edmonton and Vancouver. For inclusion, participants had to meet DSM-IV criteria for autistic disorder, Asperger Syndrome or pervasive developmental disorder-not otherwise specified (PDD-NOS) PDD-NOS according to clinical judgment by an interdisciplinary team with diagnostic expertise as well as criteria for ASD according to both the ADOS (semi-structured standardized assessment; Lord et al., 1989, 1999) and ADI-R (semi-structured parent interview, Lord, Rutter & Le Couteur, 1994) using the Risi et al. (2006) criteria. Exclusion criteria comprised: known genetic syndrome or neurological basis for disorder; spoken language other than English or French (prohibiting engagement in testing). Inclusion in the current study required maternal (rather than paternal) response on the SCL-90 psychopathology questionnaire and child completion of ADOS Module 1 (to compare child ASD behaviors using the same measure). The final sample therefore comprised 214 children (from a total of 371) and their mothers. There were no differences between those who did and did not complete all questionnaires on the SCL-90, ADI and ADOS or on age of child at diagnosis. Ethics approval was obtained from all participating research sites; parents gave informed consent for family participation.

Measures

Autism spectrum disorders behaviors were assessed using the SRS (Constantino & Todd, 2000), the ADI-R (Lord et al., 1994) and the ADOS (Lord et al., 1989, 1999). ADI-R and ADOS training took place across sites using the same training video and protocol; inter-rater reliability was regularly evaluated by one of the authors (EF) to ensure a minimum of 80% agreement,

The SRS comprises 65 items about ASD symptoms or behaviors, on a scale rated from 0 to 3 ('not true' to 'always true'). It has a factor structure similar to the ADI-R (Constantino et al., 2004, 2003), exhibits high inter-rater reliability and is not associated with IQ (Constantino et al., 2003; Constantino & Todd, 2000). The caregiver report version of the SRS was developed for youth aged 4–18. A recent study of preschoolers aged 3- and 4-years old demonstrated strong inter-rater (r = .79) and test-retest reliability (r = .74) as well as agreement with scores on the ADI-R (r = .63) and ADOS (r = .49; Pine, Luby, Abbacchi, & Constantino, 2006). In this study, the total SRS t-score was used as one of three indicators for the ASD severity latent variable (internal consistency α = .92, current sample).

The ADI-R is a semi-structured parent interview that assesses developmental abilities and behaviors related to DSM-IV-TR diagnostic criteria for ASD (American Psychiatric Association., 2000). Items are scored from 0 (no abnormality present) to 3 (extreme abnormality). In this study, items were limited to contemporaneous ASD behaviors due to participant age. The ADI-R was administered before the ADOS in order to minimize bias in maternal interviews due to possible ordering effects. Although the ADI-R was originally developed for use in diagnostic cut-offs for ASDs, item totals have also been used dimensionally for research purposes (Constantino et al., 2003; Pine et al., 2006; Smith, Seltzer, Tager-Flusberg, Greenberg, & Carter, 2008). Items requiring verbal abilities were excluded to compare scores across verbal and nonverbal children, for a total of 23 ASD algorithm items (internal consistency α = .84, current sample).

The ADOS (Lord et al., 1989, 1999) is a semi-structured, standardized assessment in which a trained clinician engages participants in activities developed to assess social and communication behaviors indicative of DSM-IV-TR symptoms of ASD (American Psychiatric Association., 2000; Gotham, Risi, Pickles, & Lord, 2007; Lord et al., 1989). The summed score of the Module 1 items common to 'No Words' and 'Some Words' versions (11 items, Cronbach's α = .70, current sample) was used instead of the ADOS severity metric because it demonstrated greater variance of scores in this sample (Gotham, Pickles, & Lord, 2009).

The Symptoms Checklist-90 is a 90-item self-report checklist of psychiatric symptoms across 9 symptom dimensions that has been widely used in community and clinical samples (Derogatis, Lipman, & Covi, 1973). The somatizing and interpersonal subscales were included with the depression dimension as indicators because they were moderately to highly correlated and represented commonly associated symptoms of depression. For simplicity, however, the latent variable will be referred to as 'maternal depression.' Alpha reliability estimates for these scales have been consistently good in various studies, ranging from .72 to .92 (Derogatis, Rickels, & Rock, 1976; Horowitz, Rosenberg, Baer, Ureno, & Villaesnor, 1988; Hunter et al., 2005). In keeping with SCL-90 scoring algorithms (Derogatis et al., 1973), mothers were described as meeting criteria for 'caseness' of self-reported depression if they had depression t-scores of 63 or greater (90th percentile) and a t-score of 63 or greater on one other subscale (interpersonal sensitivity or somatizing) or on the general symptom index (GSI) of the SCL-90.

Analyses

Development of the latent criterion variable. The first step in testing our hypotheses involved developing an appropriate criterion latent variable for child ASD behaviors using a confirmatory factor analysis (CFA) approach, a maternal questionnaire (SRS), a maternal interview (ADI-R) and independent observation data (ADOS). The ADI-R and SRS involve gathering information from mothers; however, maternal input varies appreciably between the two measures: mothers respond independently to the SRS checklist of items, while the ADI-R involves an interviewer who poses questions, requests examples and interprets and scores the parent responses. Clinical judgment is involved in assessing the responses for coding as is usual for a semi-structured as opposed to a structured interview (Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000). If there are effects on reporting of child ASD behaviors due to maternal depression a gradient of association should exist, from strong to weak across the measures based on degree of maternal input and clinician interpretation of information (i.e., from maternal questionnaire to interview to observation).

The following three variations on the same model were developed to test our hypotheses. (a) Using a CFA approach, a baseline model specified a covariance term between two latent variables – maternal depression and offspring ASD behaviors (φ_1) – to test the hypothesized bi-directional relationship between maternal depression and a quantitative estimate ASD behaviors (see Figure 1). Goodness of fit values indicated whether the linear associations outlined in the model fit the variance–covariance associations between the variables in the underlying data. (b) The hypothesized model was then developed, which included the covariance between maternal depression and child ASD behaviors (φ_1), plus

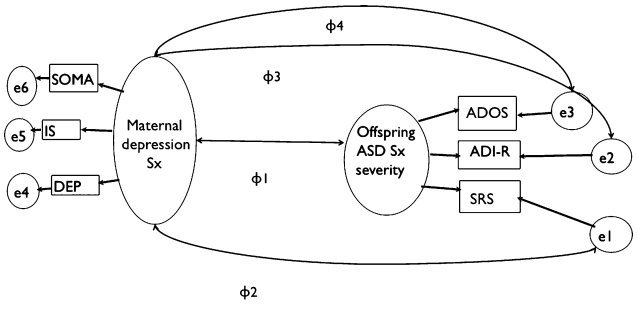

Figure 1 Latent Variable Model. ϕ = covariance estimate. SOMA = SCL-90 Somatizing Scale; IS = SCL-90 Interpersonal Sensitivity Scale; DEP = SCL-90 Depression Scale

two covariance associations between the maternal depression latent variable and the unique variance terms for the maternal reports (i.e., the SRS (φ_2) and ADI-R (φ_3)). Significantly superior fit compared to the baseline model, with significant positive associations between maternal depression and the unique variance terms would support the hypothesis that maternal depression influences maternal reporting behavior. (c) A third 'gradient' model then appraised the hypothesized influence of maternal depression on reporting by testing whether a gradient in strength of association existed between maternal depression and the unique variance terms for the three ASD indicators, from strongest to weakest, beginning with the parent questionnaire (SRS; φ_2), interview (ADI-R; φ_3) and independent observation (ADOS; φ_4). In this model, the covariance between maternal depression and ASD (φ_1) was dropped. The model was then constrained so that all paths to the unique variance terms were equal. A significant worsening of fit compared to the unconstrained gradient model would strengthen the argument for the effect of maternal depression.

AMOS 17.0 was used to compute CFA analyses (Arbuckle, 2006). Full information maximum likelihood was used to calculate estimates while accounting for missing data after ensuring that data met the appropriate assumptions (e.g., multivariate normality, linearity of associations). Unstandardized estimates were used when explicitly comparing the sizes of covariance relations, unless otherwise specified. Tests of goodness of fit included the chi-squared value, the comparative fit index (CFI) and root mean square error of approximation (RMSEA) with 90% confidence intervals. Nonsignificant chi-squared values ($p > .05$) and CFI values over .95 were considered to reflect good fit of the model to underlying data. RMSEA values .05 or less were considered to reflect excellent fit and .10 or greater, unacceptable fit (Hu & Bentler, 1999). Statistically significantly worse fitting models were assumed when the chi-squared value for a nested model was significantly higher than for the associated unconstrained model. The Akaike Information Criterion (AIC) was included as a test of comparative fit, with lower values reflecting better-fitting, more parsimonious models (Browne & Cudeck, 1993; Hu & Bentler, 1999).

Results

Participants

In the study sample, mean child age was 37.84(*SD* = 7.58) months and boys comprised 84.5% of the sample ($n = 181$). Eighty-three percent ($n = 178$) of the sample was diagnosed with autistic disorder on the ADOS. Thirty-two percent ($n = 66$) of mothers scored themselves at the 90th percentile on the SCL-90 depression subscale, meeting the scale's cut-offs for 'depression.' The mean ASD questionnaire scores were significantly higher for children of mothers who scored themselves as 'depressed' (mean SRS scores = 81.21(12.94) compared to 72.80(11.34) in children of self-rated 'nondepressed' mothers ($p < .001$, effect size = .69)). There were no differences between mean total scores on the ADI-R or ADOS between depressed versus nondepressed maternal informants (ADI-R: 32.09(7.83) versus 30.51(7.39), $p = .16$); ADOS: 14.68(3.39) versus 14.43(3.05), $p = .68$).

Latent variable model

Bivariate correlations between measures included in the latent variable model demonstrated a gradient effect, from higher to lower, between maternal depression severity on the SCL-90 and the SRS, ADI-R and ADOS (See Table 1). The baseline model demonstrated an unacceptable fit to the data based on χ^2 and RMSEA values: $\chi^2(8) = 24.32$, $p < .02$, CFI = .96, RMSEA = .10 (.06–.14); AIC = 62.32; see Table 2). Not shown in Table 2, the standardized factor loadings for the SRS, ADI-R and ADOS ($\beta = .56, .76, .43$ respectively) were all statistically significant ($p < .01$). For the child ASD behavior variable, the unique variance terms for each indicator demonstrated a gradient effect in size: the SRS unique variance was highest (variance = 449.35, *SE* = 58.37, $p < .01$) followed by that of the ADI-R (variance = 19.98, *SE* = 8.23, $p = .19$) and the ADOS (variance = 8.54 (*SE* = .92), $p < .001$); this also reflected the observed variance of each measure. Furthermore, the standardized maternal depression factor loadings were high ($\beta = .94, .73, .85$ respectively for depressive, somatizing and interpersonal sensitivity indicators) and statistically significant at $p < .01$. The covariance between maternal depression scores and offspring ASD behaviors was small and statistically significant ($\varphi_1 = 15.96$ (*SE* = 5.03), $p < .001$).

The hypothesized model (Figure 1) demonstrated an excellent fit to the data ($\chi^2(7) = 7.54(6)$, $p = .27$,

Table 1 Bivariate correlations and mean scores of indicator variables

	SRS	ADI-R total	ADOS total	SCL-DEP	SCL-IS	SCL-SOM
SRS	1.0					
ADI-R total	0.42**	1.0				
ADOS total	0.18*	0.37**	1.0			
SCL-DEP	0.33**	0.14*	0.01	1.0		
SCL-IS	0.31**	0.16*	0.05	0.81**	1.0	
SCL-SOM	0.35**	0.19*	0.10	0.69**	0.62**	1.0
Mean (*SD*) score	84.44 (24.58)	31.00 (7.54)	14.41 (3.15)	58.83 (10.07)	56.72 (10.83)	52.56 (10.94)

**$p < .01$; *$p < .05$; DEP = depression; IS = interpersonal sensitivity; SOM = somatizing.

Table 2 Goodness of fit of structural models

Goodness of fit indices	Baseline model Φ2 = 0 Φ3 = 0 Φ4 = 0	Hypothesized model Φ4 = 0	Gradient model $\phi 1 = 0$	Constrained model $\phi 1 = 0$ Φ2 = Φ3 = Φ4
χ^2 (*df*), *p*-value	24.32 (8), $p < .02$	7.54 (6), $p > .27$	7.54 (6), $p > .27$	32.89 (8), $p < .001$
CFI	.96	1.0	1.0	.95
RMSEA (CI)	.10 (.06–.14)	.04 (.00–.11)	.04 (.00–.11)	.11 (.07–.15)
AIC	62.32	49.55	49.55	70.89
χ^2 difference (*df*), *p*-value, assuming hypothesized model correct*	16.78 (2); $p < .001$	–	–	–
χ^2 difference (*df*), *p*-value, assuming error gradient model correct*	–	–	–	25.35 (2), $p < .001$
Covariance				
Φ1	15.96 (5.03), $p = .001$	4.91 (11.40),$p = .67$	0	0
Φ2	0	75.10 (23.32) $p < .01$	82.86 (18.03), $p = .01$	0.59 (2.14), $p = .78$
Φ3	0	6.99 (10.33) $p = .68$	11.86 (5.22), $p = .02$	0.59 (2.14), $p = .78$
Φ4	0	0	0.89 (2.14), $p = .68$	0.59 (2.14), $p = .78$

The chi-squared test can only estimate changes in goodness of fit for nested models. Significant differences in chi-squared goodness of fit are said to occur at levels of $p < .05$.
Φ = Covariance parameter.

CFI = 1.0, RMSEA = .04 (.00–.10), AIC = 49.55), which was significantly superior to the fit of the baseline model (see Table 2). However, in the hypothesized model, the association between the maternal depression and child ASD severity latent variables was small, and nonsignificant ($\varphi_1 = 4.91$, $SE = 11.40$, $p = .67$; see Table 3). The covariance between the unique variance of the SRS and maternal depression ($\varphi_2 = 75.10$, $SE = 23.32$, $p < .01$) was larger than that between the unique variance of the ADI-R and maternal depressive symptoms ($\varphi_3 = 6.99$, $SE = 10.33$, $p = .50$).

In the 'gradient model' a clear gradation effect was seen across the covariances between maternal depression and the SRS ($\varphi_2 = 82.86$, $SE = 18.03$, $p = .01$), the ADI-R ($\varphi_3 = 11.86$, $SE = 5.22$, $p = .02$) and the ADOS ($\varphi_4 = 0.89$, $SE = 2.14$, $p = .68$) unique variance terms. Constraining the covariances between maternal depression and the three unique variance terms for the ASD indicators to equal each other resulted in a significant worsening of fit (see Table 2, 'Constrained model').

Discussion

This study aimed to investigate the association between maternal depression and child ASD behaviors in a sample of preschoolers newly diagnosed with ASDs. Our first hypothesis was that maternal depression would be positively and significantly associated with a criterion measure of child ASD behaviors represented by the shared variance of three commonly used measures of ASD behavior – maternal questionnaire report (SRS), maternal semi-structured interview (ADI-R) and semi-structured observational measure (ADOS). Our second hypothesis was that maternal depression scores would be uniquely associated with the residual variance of the maternal measures, reflecting reporting effects.

Mothers of children newly diagnosed with ASD reported elevated rates of depressive symptoms compared to SCL-90 population norms from a non-clinical sample. These findings reiterate those of an earlier study of mothers of children with ASD using the SCL-90 (Firat, Diler, Avci, & Seydaoglu, 2002). Examination of scores on the ASD measures revealed that mothers who rated themselves in the depressed range also rated their children, on average, as having significantly higher scores on the SRS questionnaire with a large effect size of .69. However, children of self-rated depressed mothers did not score more highly on the semi-structured interview (ADI-R) or the independent assessment of child ASD behaviors (ADOS), compared to children of 'nondepressed' mothers (those who scored below the SCL-90 cut-off). Furthermore, results from latent variable modeling failed to support our first hypothesis: There was no evidence of an association between maternal depression and a criterion latent measure representing a quantitative trait of child ASD behaviors. However, in keeping with our second hypothesis, maternal depressive symptoms were positively and significantly associated with the unique variance of the maternal questionnaire report of child ASD behaviors. A gradient effect of strength of association was apparent across the correlations between maternal depressive symptoms and the unique variance terms for ASD behaviors; strongest for the maternal questionnaire, weaker for maternal semi-structured interview and nonsignificant for independent observation. Taken together, these results suggest that mothers who rate themselves as more depressed are more likely to rate their child as exhibiting more ASD behaviors. However, this does not reflect an association with increased child ASD

Table 3 Hypothesized model (N = 214)

Factor loadings	Unstandardized β (*SE*)	Standardized B
Maternal depression		
SCL-90 depression	1.00 (–)	0.95
SCL-90 somatization	0.84 (0.07)	0.73
SCL-90 interpersonal sensitivity	0.96 (0.06)	0.85
ASD behaviors		
SRS total	1.58 (0.56)	0.45
ADI total	1.00 (–)	0.93
ADOS total	0.18 (0.07)	0.40
Associations between maternal depression latent variable and unique variance terms	Covariance	Correlation
Depression → SRS unique variance	75.10 (23.32)	0.36
Depression → ADI-R unique variance	6.99 (10.33), p = .50	0.26
Covariance between latent variables	Covariance	Correlation
Maternal depression to ASD behaviors	4.91 (11.40); p = .67	0.07
Variance		
Maternal depression	90.92 (10.57)	
ASD behaviors	48.72 (17.02)	
SRS unique variance	480.25 (62.67)	
ADI-R unique variance	7.92 (16.12) p = .62	
ADOS unique variance	8.29 (0.96)	
SCL-90 depression unique variance	10.06 (4.17); p = .02	
SCL-90 interpersonal sensitivity unique variance	55.32 (6.12)	
SCL-90 somatization unique variance	32.81 (4.93)	

p < .01 unless otherwise stated.

behavior severity, to the extent to which this construct is represented by the variance common to three frequently used ASD measures. To our knowledge, this is the first study to test whether mothers' self-report of depression symptoms is significantly correlated with a criterion latent variable representing child ASD behaviors. Earlier research has identified associations between maternal depressive symptoms and externalizing behaviors, comorbidity or adaptive functioning of their children with ASD, but not with core ASD behaviors (Abbeduto et al., 2004; Estes et al., 2009; Hastings et al., 2005; Smith et al., 2008).

This study should be regarded as preliminary, with limitations that should be addressed in future work. To begin, a key consideration is the adequacy of the criterion latent variable for ASD behaviors, which is a function of the indicators and their psychometric properties. In this study, the SRS was used in a preschool sample containing many children under 3 years, which may have affected the amount of its shared variance with the other tools. Also, removing items not applicable to both verbal and nonverbal children in the ADI-R and ADOS may have lowered their diagnostic validity or may limit generalizability to older, higher functioning ASD children. However, this did not affect the ability of the ADOS to quantify the number of autistic behaviors. Overall the factor loadings and fit of the model indicate that the three measures did share a significant amount of variance. A more important consideration involves the maternal influence on the SRS and ADI-R, which potentially increased the shared variance between these measures. Although we used this pattern of influence to test for a gradient effect, future studies based on a similar analytic model should use indicators derived from three different informant versions of the same ASD scale (e.g., parent, teacher, clinician). Two, we were unable to partition and explain the unique variance associated with the SRS questionnaire. It is possible that the measure is indexing phenomena other than ASD behaviors in this sample, such as family strain or child aggression; or maternal characteristics such as socioeconomic status. Future studies with larger sample sizes might overcome this limitation by including covariates that could account for the association between mothers' depression and their reporting behaviors (unique variation in ASD assessments). Finally, due to limitations in the measures available, we were unable to rule out shared method effects as contributing to, or accounting for, the association between maternal depression and the unique variance in the maternal reports. In order to tease out method from informant characteristic effects, future studies might also model ASD behavior levels and unique variances as a function of other maternal assessments not expected to exhibit associations with ASD symptoms (e.g., neighborhood quality). Alternatively, constructing latent variable measures of maternal depression and child ASD based on multiple informants (e.g., mothers, clinicians, spouses, teachers) could remove potential method effects from the association.

Conclusion

Regardless of the respective roles of informant versus method effects, the key point is the same; mothers who rated themselves as more depressed appear to rate their children as demonstrating a greater number of ASD behaviors on questionnaire, relative to a clinician-administered interview or direct observation. These findings have important implications for both research and clinical practice. First, while it is important to consider tradeoffs between the cost and time involved in assessing ASDs, combining information from multiple methods and informants mitigates unwanted informant or method bias when measuring child ASD behaviors. Second, in designing studies that investigate the effects of parental depression on their children's behaviors, or vice-versa, it is important to consider how such parental characteristics, as well as measurement effects such as shared method variance, may themselves introduce bias in a given association. Covarying for maternal depression in reports of child ASD, or using latent variable models may improve interpretation of results. In clinical situations involving the assessment of ASD, the use of multiple informants or methods, repeated over time, may be particularly important when the caregiver informant appears to exhibit high levels of depressive symptoms. Clinicians must also recognize how different assessment methods can filter or shape the multi-faceted information provided by parents about their children.

Correspondence to

Peter Szatmari, MD, Offord Centre for Child Studies, Chedoke Site, Patterson Building, 1200 Main St. West, Hamilton, ON, Canada, L8N 3Z5; Tel: (905) 521-2100 X77367; Email: szatmar@mcmaster.ca

Key points

- In this study, mothers who rated themselves as more depressed also rated their children more highly on a questionnaire of ASD behaviors, compared to children of mothers with lower depression scores.
- Maternal depression severity was not found to be associated with increased child ASD behaviors as represented by a criterion latent variable, but was related to increased unique variance in maternal questionnaire reports of child ASD behaviors.
- Maternal depression may influence how mothers report on child ASD behaviors, and questionnaires may be more strongly affected than semi-structured interviews.
- Shared method effects may also bias associations between measures that rely solely on parent informants.
- Clinical assessment and research studies in ASD should use multiple informants and/or methods whenever possible to minimize bias.

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