

## **The relative contributions of parent perceived child characteristics to variation in child feeding behavior**

Around half of all parents are estimated to experience difficulties feeding their child at some time, with problems ranging from relatively minor dietary challenges to clinical avoidant/restrictive food intake disorders (Carruth, Ziegler, Gordon, & Barr, 2004). Because feeding is regarded by many parents as a fundamental parenting responsibility, perceived problems in this area, even at non-clinical levels, can cause considerable concern (Blissett & Harris, 2002; Greer, Gulotta, Masler, & Laud, 2008; Singer, Song, Hill, & Jaffe, 1990), and have a negative impact on parental self-efficacy, perceptions of parenting, and subsequent parenting behavior (Blissett & Harris, 2002; Craig, Scambler, & Spitz, 2003; Crist et al., 1994; Feldman, Keren, Gross-Rozval, & Tyano, 2004; Fraser, 2004; Greer et al., 2008; Levine et al., 2011; Lindberg, 1994; Powers et al., 2002; Robinson, Drotar, & Boutry, 2001; Silverman, 2010; Tarkka, 2003). Concerns around feeding and intake have been associated with the use of maladaptive parent feeding strategies such as coercion, coaxing, bribery, and rewards (Birch, 1999; Burklow, McGrath, & Kaul, 2002; Harris, 1992; Linscheid, 2006; Sanders, Patel, Legrice, & Shepherd, 1993; Wolff, 1994; Woods, Borrero, Laud, & Borrero, 2010), and with deficits in optimal parent problem-solving skills (Martin, Dovey, Coulthard, & Southall, 2013; Robinson et al., 2001); these factors have been importantly linked to the maintenance and exacerbation of child feeding problems (Piazza et al., 2003). These findings suggest that parental perceptions of problematic child behaviors and of their own ability to cope with these behaviors can have a significant impact on subsequent parenting approaches and interactions, and future child feeding problems. Therefore, it is important to try and understand population feeding problems including a profile of key correlates of these problems from the parents' perspective.

Examination of child feeding literature found that the most common non-medical correlates of problematic child feeding behaviors were child temperamental difficulty (Ammaniti, Lucarelli, Cimino, D'Olimpio, & Chatoor, 2010; Hagekull, Bohlin, & Rydell, 1997; Niegel, Ystrom, Hagtvet, & Vollrath, 2008), general child conduct and adjustment problems (Sanders et al., 1993; Wolke, Rizzo, & Woods, 2002), sensory processing issues (Coulthard & Blissett, 2009; Dovey, Isherwood, Aldridge, & Martin, 2010; Smith, Roux, Naidoo, & Venter, 2005), and food neophobia (Pliner & Hobden, 1992). These correlates have typically been examined separately, with various mechanisms for their individual associations with problematic feeding proposed across the literature.

Difficulties in conduct, self-regulation (e.g., hunger, tiredness, emotions), and temperament have been implicated in the development of problematic feeding via the disruptions they can cause to adaptive parent-child feeding interactions (Ammaniti et al., 2010; Farrow & Blissett, 2006; Hagekull et al., 1997; Hane, Fox, Polak-Toste, Ghera, & Guner, 2006). Poor interactions may have

35 a negative impact on the way that parents perceive their child's behaviors and on their own abilities  
36 to manage challenging behaviors (Ammaniti et al., 2010). Furthermore, children learn a great deal  
37 about what, when, and how to eat via social interactions, so barriers in this area can significantly  
38 hinder appropriate feeding behavior and dietary development (Addessi, Galloway, Visalberghi, &  
39 Birch, 2005; Aldridge, Dovey, & Halford, 2009; Birch, 1999). Externalizing behaviors and  
40 temperamental difficulties may also be more directly associated with the frequency of observable  
41 feeding problems, if the difficulties impinge on feeding and mealtimes (e.g., poor appetite  
42 regulation, restlessness at mealtimes, rigidity around new foods and routines, etc.). Regarding  
43 sensory processing, food selectivity and refusal behaviors are thought to occur via over-sensitivity  
44 or reactivity towards the texture, taste or smell of certain food groups and types (Berlin, Davies,  
45 Lobato, & Silverman, 2009; Chatoor & Ganiban, 2003; Coulthard & Blissett, 2009; Dovey, Farrow,  
46 Martin, Isherwood, & Halford, 2009; Smith et al., 2005), or via under-responsiveness to sensory  
47 stimuli and associated poor oral motor control (Berlin et al., 2009). Sensory processing issues and  
48 the degree of sensitivities may therefore underlie the frequency or strength of observed feeding  
49 problems. Beyond atypical conditions, developmental food neophobia (the reluctance to eat, or  
50 avoidance of new foods during early childhood (Pliner & Hobden, 1992)), has also been associated  
51 with child feeding problems. Despite being a normal stage of early development (Dovey, Staples,  
52 Gibson, & Halford, 2008), persistence of food neophobia beyond expected timeframes is associated  
53 with problematic feeding via poor dietary intake (Carruth & Skinner, 2000; Cooke, 2007; Falciglia,  
54 Couch, Gribble, Pabst, & Frank, 2000; Galloway, Lee, & Birch, 2003).

55 The aforementioned characteristics may represent important risk factors for child feeding  
56 problems; however, little is known about how they exist together in association with problematic  
57 feeding behaviors. It is important to move beyond the simple associations between characteristic  
58 and feeding outcome, towards a combined and controlled model of child feeding problems, which,  
59 to the best of our knowledge has not been assessed in any prior study. This is despite the co-  
60 occurrence of such factors within individual children and despite widespread knowledge that the  
61 role or influence of one factor on an outcome can be attenuated or exacerbated by the presence of  
62 another factor (Baron & Kenny, 1986). Therefore, the primary aim of the current study is to  
63 determine the relative contributions of parent-report child characteristics within multi-variable  
64 models of child feeding behavior. Feeding outcomes will be separated into parent-observed problem  
65 frequency (child scale) and parental perceptions and strategies for coping with feeding problems  
66 (parent scale). The aim is to assess whether factors associated with parental experiences of feeding  
67 challenges differ from those associated with parentally observed problem frequency.

68 Based on existing research, it is hypothesized that the child variables associated with feeding

69 problem frequency will differ from those associated with parental feelings and strategies related to  
70 child feeding problems. Specifically, we hypothesize that innate or underlying factors such as  
71 sensory sensitivities and temperamental difficulties will be associated with observed feeding  
72 problems, while more external characteristics such as generalized conduct and social interaction  
73 problems will be associated with parent perceptions and strategies for coping with child feeding  
74 problems. It is anticipated that child food neophobia will be associated with both feeding outcomes  
75 as it can represent an inherent developmental stage and a behavioral feeding challenge to parents.

## 76 **Methods**

77 **Participants and recruitment.** The overarching study of children's feeding, for which  
78 ethical approval was granted, obtained data from 445 parents of children with no past or present  
79 clinical feeding disorder. The current study focuses only on mothers of children aged 3-6 years  
80 (N=202). Participants were recruited through parent and child social groups and networks. Written  
81 information regarding the study purpose, procedure, and contacts was given to all prospective  
82 participants by the researcher during visits to parent-child groups or via an online invitation posted  
83 on parent forums. The majority of data (97%) were obtained online; recent research suggests that  
84 there are few differences between child feeding questionnaires completed on and offline, and online  
85 responses may produce marginally higher feeding problem outcome scores (Dovey, Jordan,  
86 Aldridge, & Martin, 2013).

87 Individuals with missing feeding behavior outcome data were excluded (N=41), leaving a  
88 final sample of 161. After examination of numerous demographic factors, breastfeeding was found  
89 to be the only factor to differentiate between those who did and did not complete the outcome  
90 measures. Completers had a higher incidence of breastfeeding (79.2%) than non-completers  
91 (62.5%),  $\chi^2 = 4.90$ ,  $p = 0.027$ , and breastfed for notably (though not significantly) longer ( $M = 30.80$ ,  
92  $SD = 43.10$ ) than non-completers ( $M = 18.18$ ,  $SD = 24.92$ )  $t(199) = 1.80$ ,  $p = 0.074$ , 95% CI: -1.22, 26.47.

93 **Sample Mothers.** Maternal age ranged from 19 to 46 years ( $M = 32.68$ ,  $SD = 5.62$ ). 75.60% of  
94 the sample were married, 16.9% cohabiting, and 7.5% defined themselves as single, separated, or  
95 divorced. Finally, 81% of mothers considered their pregnancy planned and 19% unplanned.

96 **Study Children.** Children were 51.6% female, with a mean age of 53.80 months ( $SD = 11.38$ ,  
97 range 36-83). 48.1% of the children were born on time, 45% were post-due date, and 6.9%  
98 premature (<37 weeks), with an average birth weight of  $3.44\text{kg} \pm 0.57$  (range 1.26-4.63kg). Most  
99 children were breastfed at some time with duration ranging from 0 days (20.8%) to 212 weeks  
100 ( $M = 30.80$ ,  $SD = 43.10$  weeks). The majority of children had at least one sibling (76.4%; range 0-5  
101 siblings); 67.7% were the first born child, 24.8% were second born and the remaining ranged from  
102 third to fifth born. Finally, 83.2% of the sample had no known allergies or intolerances.

103           **Measures and procedure.** Following informed consent, participants completed five parent-  
104 report psychometric measures assessing child feeding behaviour, food neophobia, temperament,  
105 sensory sensitivities, and general behavior/conduct. The measures were completed in the order  
106 presented below. Information was also collected regarding parent and child age, child sex,  
107 birthweight, breastfeeding duration, presence of food allergies/intolerances, and number of older  
108 and younger siblings.

109           *Behavioral Pediatrics Feeding Assessment Scale [BPFAS] (Crist et al., 1994).* The BPFAS  
110 assesses child feeding behaviors (25 items) e.g., “Spits out food”, “Tantrums at mealtimes”, and  
111 parent feelings about and strategies for dealing with child feeding behaviors (10 items) e.g., “I coax  
112 my child to get him/her to take a bite”. All items are scored on a five point likert scale and require a  
113 yes/no response to indicate if the item is considered a problem or not. Ten items are reverse scored  
114 (e.g., “Eats vegetables”) so that high scores indicate greater problem frequency. This BPFAS yields  
115 four domain scores: *child behaviour frequency* (sum of Likert scores; range 25-125); *child*  
116 *behaviour problems* (count of items rated “yes”; 0-25); *parent feelings/strategies frequency* (10-50);  
117 and *parent feelings/strategies problems* (0-10). Due to incomplete reporting for problem domains  
118 ( $\approx$  50-66% did not complete them fully), only frequency domains were used in the current study.  
119 The BPFAS has demonstrated good psychometric properties; showing sensitivity to feeding  
120 behaviors across clinical and non-clinical child samples, sensitivity to change over time and  
121 intervention, and excellent test-retest reliability (Crist et al., 1994; Dovey & Martin, 2012; Dovey,  
122 Martin, Aldridge, Haycraft, & Meyer, 2011; Haywood & McCann, 2009). Cronbach’s alpha  
123 coefficients ( $\alpha$ ) of 0.88 (child), and 0.82 (parent) were identified in the current study.

124           *Child Food Neophobia Scale [CFNS] (Pliner, 1994).* The CFNS was adapted by Pliner  
125 (1994) from the adult Food Neophobia Scale (Pliner & Hobden, 1992), to assess food neophobia,  
126 the tendency to avoid/reject new and unfamiliar foods, in children. The 6 items of the CFNS are  
127 scored on a seven point likert scale, with high scores representing stronger neophobia. The FNS (on  
128 which the CFNS is based) demonstrates strong test-retest reliability ( $p < 0.01$ ), and reasonable  
129 concurrence with observed food selection behavior (Hobden & Pliner, 1995). In the current study,  
130 the CFNS exhibited excellent internal reliability ( $\alpha = 0.95$ ).

131           *Emotionality, Activity and Shyness [EAS] (Buss, 1984).* The EAS was developed to  
132 examine parental report of child temperament at around 1-9 years. Temperament is assessed via 20  
133 items comprising the subscales *emotionality*, *activity*, *shyness* and *sociability*. Items are scored on a  
134 five point likert scale with high scores indicating greater difficulty (*sociability* reverse scored). EAS  
135 subscales have demonstrated good tests-retest and inter-rater reliability (Boer & Westenberg, 1994),  
136 with internal reliability confirmed in the current study ( $\alpha$  coefficients ranged from 0.73-0.87).

137 *Strengths and Difficulties Questionnaire [SDQ]* (R. Goodman, 1997). The SDQ assesses  
138 attributes of psychological adjustment, and was used in the current study to suggest dimensions of  
139 child behavior problems. The scale comprises 25 items across five subscales (*emotional symptoms*,  
140 *conduct problems*, *hyperactivity-inattention*, *peer problems*, and *pro-social behavior*), with high  
141 scores reflecting increased behavior/adjustment problems (*prosocial* reverse scored). Construct  
142 validity, test-retest stability, and adequate subscale internal consistency ( $\alpha$  ranged from 0.57 - 0.85)  
143 have been previously identified (R. Goodman, 1997, 2001); the latter was supported in the current  
144 study ( $\alpha$  range 0.64 - 0.76).

145 *Infant Toddler Sensory Profile/ Sensory Profile [ITSP/SP]* (Dunn, 1994, 1999; Dunn &  
146 Daniels, 2002). The 38 item SSP for children over 3 years was used in the current study. This scale  
147 comprises subscales for a number of sensory domains, though only *Tactile* and *Taste/Smell*  
148 sensitivity were used in the current study. Items are scored on a five point likert, where low scores  
149 indicate sensory processing problems. The Sensory Profile measures are used widely in research  
150 and clinical practice to examine sensory processing abilities (Ahn, Miller, Milberger, & McIntosh,  
151 2004; Miller, Coll, & Schoen, 2007); the current study confirmed internal reliability in the total  
152 scale ( $\alpha=0.93$ ), the tactile domain ( $\alpha=0.71$ ) and the taste/smell domain ( $\alpha=0.94$ ).

153 **Data Analyses.** Up to four missing data items within the BPFAS outcome scale were  
154 imputed to permit calculation of total scores (Crist et al., 1994). For all other measures, scale mean  
155 scores (calculated if  $\geq 90\%$  items completed) were used in analyses. Across all covariates missing  
156 data ranged from 0.04% - 25.5%, so a multiple imputation model comprising all child  
157 characteristics, feeding outcomes, and demographic variables, was used to impute five iterations of  
158 missing values (Rubin, 1987). Very few differences were observed in variable scores or model  
159 outcomes between pooled imputation results and the original data, suggesting that data were  
160 missing at random. To maximize the precision of final estimates, results in the current paper are  
161 reported from pooled imputation data. Where pooled results are unavailable, the average of values  
162 across imputations is given.

163 Most predictor variables were approximately normally distributed, and mild skew observed  
164 in the child and parent frequency scores of the BPFAS did not affect data summaries. Multiple  
165 linear regression analyses were used to assess the significance of child variables in combined  
166 models of the BPFAS child and parent feeding behavior scores. Collinearity and influence statistics  
167 were examined and all fell well within acceptable ranges. Residual statistics were also examined for  
168 each model and were found to be normally distributed in each case.

169 Child feeding literature informed the selection of 12 variables from four main child  
170 characteristics (food neophobia, temperament, conduct/adjustment, and sensory sensitivity) for

171 analysis; however, little theory exists regarding the temporal importance of these variables within a  
172 multi-element model of feeding outcomes. Therefore, enter method regression models were used to  
173 examine the relative importance of all child characteristics to the child feeding outcomes. All  
174 models were adjusted for parent and child demographic factors and only those found to have no  
175 material influence on the model were removed to improve model parsimony.

## 176 **Results**

177 **Sample Child Behavior Characteristics. :**

178 **Multi-element models of child feeding behaviors and problems.**

179 *Child feeding problems (BPFAS Child frequency scale).* The model of 12 child  
180 characteristics explained a substantial and highly significant proportion (Adjusted  $R^2=0.67$ ) of  
181 variability in BPFAS child feeding problem frequency score,  $F(16,160)=21.27$ ,  $p<0.001$ . This  
182 model was adjusted for parent and child age, child sex, and number of older siblings. Child food  
183 neophobia, and behavioral problems associated with conduct and hyperactivity were significant  
184 predictors in the model; the data also suggested an inverse relationship between feeding problems  
185 and prosocial behavior (result italicized in table 1), though this association was not significant at  
186 5%. Beta coefficients, 95% confidence intervals, and p-values for all covariates are given in table 1.  
187 Although no account is taken for any shared variance observed in the full model, notably, a model  
188 containing only the significant predictors and prosocial behavior accounted for 64% of the  
189 variability in the BPFAS child frequency score.

190 *al problems in child-feeding (BPFAS Parent frequency scale).* The model of 12 child  
191 characteristics again explained a considerable proportion (Adjusted  $R^2=0.52$ ) of variability in  
192 BPFAS parent feeding problem frequency score,  $F(16,160)=10.84$ ,  $p<0.001$ . This model was  
193 adjusted for parent and child age, child sex, breastfeeding duration, birthweight, and number of  
194 younger siblings. In this model, child food neophobia, and problems associated with hyperactivity  
195 and decreased prosocial behaviors were significant predictors in the model; the confidence interval  
196 also suggested a potential inverse relationship between sociability and feeding problems, but this  
197 finding was not significant at 5% (result italicized in table 1). Beta coefficients, confidence intervals  
198 and p-values for all covariates are given in table 1. A model containing only the significant  
199 predictors and sociability was found to explain 50% of the variability in BPFAS parent frequency  
200 scores.

201

202

*Table 1.*

## 203 **Discussion**

204 The current study examined the relative associations between several child characteristics

205 and problematic child feeding behavior. It also examined whether or not there were differences in  
206 the profiles of correlates of child feeding problems when assessed via parentally-observed behaviors  
207 (BPFAS Child) and parentally-reported feelings and strategies for coping with child feeding  
208 problems (BPFAS Parent). Notably, the current study found that models comprising only a small  
209 number of significant child characteristics, could explain over half of all variability in BPFAS  
210 parent frequency scores and a remarkable two thirds of the variability in BPFAS child frequency  
211 scores. Follow-up analyses suggested that the vast majority of the variance accounted for in each  
212 model could be attributed to these significant predictors. While the cross-sectional nature of the  
213 current study precludes inferences around cause and effect between child characteristics and  
214 feeding, the strength of the results suggests that the models uncovered in this study represent key  
215 profiles of characteristics to focus on in the reduction or prevention of population-level child  
216 feeding problems. Given that the characteristics were maternally reported, such methods of  
217 reduction/prevention would likely need to focus on both the child's behaviors and the parent's  
218 perceptions of those behaviors. Our hypotheses that the models of child and parent outcomes would  
219 differ, and that different child characteristics would prevail for each outcome, was partially  
220 supported by the data. The specific pattern of predictors and the total model explanatory values  
221 differed slightly between the models of child and parent feeding outcomes, and certain  
222 characteristics were found to play a greater role in BPFAS child scores, while others were more  
223 highly associated with BPFAS parent scores.

224         The current study found that child food neophobia and behavioral hyperactivity were  
225 strongly and positively associated with both domains of problematic child feeding behavior  
226 (observed behaviour and parental perceptions and management). Accounting for the relative scales  
227 of measurement, the strength of these predictors was similar and noteworthy for each outcome  
228 scale. A single unit increase in food neophobia was associated with a 16.7% (minimum 11.8%)  
229 increase in BPFAS Child scores, and a 17.1% (min 10.6%) increase in BPFAS parent scores.  
230 Similarly, a unit increase in hyperactivity was associated with a 26.6% (min 13.1%) increase in  
231 child scores, and a more variable 29.5% (min 2.6%) increase in parent scores. The frequency of  
232 observed problematic feeding behaviors (BPFAS child) was also positively associated with  
233 behavioral conduct problems, which coupled with hyperactivity reflect a profile of externalizing  
234 behaviors (A. Goodman, Lamping, & Ploubidis, 2010; Liu, 2004). Rather than conduct problems,  
235 the parental problem scale (BPFAS parent) was significantly negatively associated with prosocial  
236 child behavior, and distinctly but non-significantly negatively associated with sociability. Prosocial  
237 deficits were marked, but not significant, in relation to the frequency of observed child feeding  
238 problems. Aside from social domains, no other facets of temperamental difficulty were associated

239 with problematic feeding behavior. The absence of emotional symptoms (either behavioral or  
240 temperamental) alongside social deficits in models of problematic feeding behavior, suggests that it  
241 is social interaction deficits specifically that correlate with feeding issues, rather than signifying  
242 broader internalizing behavior profiles. The additional absence of sensory sensitivities from the  
243 predictive models also suggests that psychophysiological factors do not routinely underpin  
244 population feeding problems.

245         These key findings suggest that population level child feeding problems are predominantly  
246 active and interactive issues for the parent and child, co-occurring or perhaps falling within other  
247 externalizing-type behavior profiles; rather than underlying emotional, temperamental, or  
248 physiological issues. The findings also suggest that parents may observe a range of problems with  
249 their child's feeding and general interaction with their environment (Liu, 2004), but the presence of  
250 child social problems may be the distinguishing marker for the perception of problematic feeding  
251 behaviors as a challenge to parenting. This ties-in with a body of research, which advocates the  
252 importance of socialization, throughout feeding/eating development, as a means for teaching and  
253 learning about what, where, when, and how to eat (e.g., (Addessi et al., 2005; Birch, 1998, 1999;  
254 Nestle et al., 1998)). Difficulties in this area can therefore hinder natural learning techniques and  
255 impact on the parent's ability to manage or overcome feeding problems. It was identified earlier in  
256 the paper that parental perception of feeding problems can have significant negative impact on the  
257 parent's subsequent actions, feeding strategies, and parental self-efficacy. As such, the current  
258 results suggest that deficits to social interactions may represent a key risk factor to this negative  
259 association and potential downward spiral of feeding behavior. Advice, support, and interventions  
260 for poor feeding, based around improvement of socialization and interaction may therefore be  
261 beneficial to the parent and child in the general population, though more research would be needed  
262 to test this supposition. The absence of sensory and temperament or regulatory factors in the models  
263 of child feeding may also have important implications for the differentiation of clinical and non-  
264 clinical feeding problems, though further research would again be required to test this assertion.

265         A limitation to the current study was that ethnicity and socioeconomic data was incomplete  
266 and thus not reported. However, estimates available from the overarching child feeding study  
267 suggest that a predominantly white British sample was obtained, but a reasonably broad spectrum of  
268 socioeconomic backgrounds was represented via paid, voluntary, or full-time parenting roles,  
269 though very few individuals were identified as unemployed. In future research, more detailed  
270 information should be collected on these factors to control for their potential influence on child  
271 feeding outcomes.

272         The strength and nature of the current study findings are noteworthy. The study gives a clear



273 profile of child characteristics that explain a huge amount of the variability in poorer feeding  
274 behaviors in the population. Two thirds of the variability in problematic feeding behavior frequencies  
275 was explained by associated negative external behaviours and food neophobia in the child. Parental  
276 perceptions of child feeding problems as challenging were not associated with child conduct  
277 problems, but were instead significantly associated with child social deficits. This key correlate  
278 amplifies the importance of social interaction within feeding development and behavior, and may  
279 indicate a crucial focus for parental support in overcoming feeding problems.

280

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