
RELATIVE CONTRIBUTIONS OF PARENT-PERCEIVED CHILD CHARACTERISTICS TO VARIATION IN CHILD FEEDING BEHAVIOR

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ABSTRACT: Few studies have examined the relative impact of co-occurring child characteristics on problematic feeding behavior. The aim of the current study was to assess the relative contributions of parent-perceived child characteristics in multivariable models of child feeding behavior. One hundred sixty-one mothers reported on their child's feeding behavior and a number of key child characteristics. These characteristics were entered into controlled multivariable models of child feeding behavior, using child and parent frequency domains of the Behavioral Pediatrics Feeding Assessment Scale (BPFAS; W. Crist et al., 1994) as outcome measures. Child feeding problems were positively associated with food neophobia and external behavioral and social issues, but not with most domains of temperamental difficulty or sensory sensitivity. Feeding problem frequency was associated with externalizing symptoms whereas parental perceptions of problems and coping were associated with social-interaction problems in the child. Population feeding problems appear to be external and interactive problems rather than driven by innate or internalizing factors. The association with externalizing symptoms suggests that feeding problems at this level may fall within a wider profile of challenging behavior; however, the existence of problematic feeding behaviors may constitute a challenge for parents only when the child's social interactions also are seen to be deficient.

Keywords: feeding problems, child behavior, temperament, sensory sensitivity, food neophobia

RESUMEN: **Trasfondo:** Pocos estudios han examinado el impacto relativo de características concurrentes del niño sobre conductas de alimentación problemáticas. El objetivo del presente estudio fue evaluar las contribuciones relativas de las características del niño tal como son percibidas por el progenitor en modelos de variables múltiples de conductas de alimentación del niño.

Métodos: 161 mamás reportaron acerca de la conducta de alimentación de sus niños y un número de características claves del niño. Estas características fueron recogidas dentro de controlados modelos de variables múltiples de conducta de alimentación del niño, usando dominios de frecuencia de progenitores y niños de la Escala de Evaluación de Conducta Pediátrica de Alimentación (BPFAS) como medidas de resultado.

Resultados: Los problemas de alimentación del niño fueron positivamente asociados con la neofobia a la comida y asuntos externos sociales y de conducta, pero no con la mayor parte de los dominios de la dificultad temperamental o la sensibilidad sensorial. La frecuencia de los problemas de alimentación fue asociada con los síntomas de externalización, mientras que las percepciones de los progenitores acerca de los problemas y la forma de arreglárselas fueron asociadas con problemas de interacción social en el niño.

Conclusiones: Los problemas de alimentación en la población parecen ser problemas externos e interactivos, en vez de problemas basados en factores innatos o de internalización. La asociación con síntomas de externalización sugiere que los problemas de alimentación a este nivel pudieran encajar

The research reported in the current article was fully funded by Loughborough University. Ethical approval for the research was granted by the Loughborough University Research Ethics Committee.

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INFANT MENTAL HEALTH JOURNAL, Vol. 37(1), 1–10 (2016)

© 2016 The Authors. *Infant Mental Health Journal* published by Wiley Periodicals, Inc. on behalf of Michigan Association for Infant Mental Health.

DOI: 10.1002/imhj.21544

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dentro del perfil más amplio de una conducta desafiante. Sin embargo, la existencia de conductas de alimentación problemáticas pudiera constituir solamente un reto para los progenitores cuando las interacciones sociales del niño son también vistas como deficientes.

Palabras claves: problemas de alimentación, temperamento, sensibilidad sensorial, neofobia a la comida

RÉSUMÉ: **Contexte:** Peu d'étude ont examiné l'impact relatif de caractéristiques simultanées de l'enfant sur le comportement alimentaire problématique. Le but de cette étude était d'évaluer les contributions relatives des caractéristiques perçues par le parent chez des modèles multi-variables de comportement alimentaire.

Méthode: 161 mères ont fait état du comportement alimentaire de leur enfant et d'un nombre de caractéristiques clés de l'enfant. Ces caractéristiques ont été entrées dans des modèles multivariés contrôlés de comportement alimentaire de l'enfant, en utilisant des domaines de fréquence de l'enfant et du parent de l'Echelle d'Évaluation du Comportement Pédiatrique Alimentaire (en anglais *Behavioral Pediatrics Feeding Assessment Scale* [BPFAS]) en tant que mesures de résultat.

Résultats: Les problèmes alimentaires de l'enfant sont liés de manière positive à la phobie de la nourriture et à des problèmes externes de comportement et sociaux, mais non pas à la plupart des domaines de difficultés de tempérament ou de sensibilité sensorielle. La fréquence des problèmes alimentaires est liée à des symptômes externalisant, alors que les perceptions parentales des problèmes et de la manière de les aborder étaient liées à des problèmes sociaux et à des problèmes d'interaction chez l'enfant.

Conclusions: Les problèmes alimentaires semblent être externes et des problèmes d'interaction, plutôt que des problèmes conduits par des facteurs innés et internalisant. Le lien avec les symptômes externalisants suggère que les problèmes alimentaires à ce niveau pourraient s'avérer du domaine d'un plus grand profil de comportement difficile. Cependant, l'existence de comportements alimentaires problématiques peut également constituer un défi pour les parents lorsque les interactions sociales de l'enfant sont aussi perçues comme étant défectueuses.

Mots clés: problèmes alimentaires, comportement de l'enfant, tempérament, sensibilité sensorielle, phobie de la nourriture

ZUSAMMENFASSUNG: **Hintergrund:** Nur wenige Studien haben den relativen Einfluss von gleichzeitig vorliegenden kindlichen Eigenschaften auf problematisches Fütterungsverhalten untersucht. Das Ziel der Studie war es, die relativen Beiträge der von den Eltern wahrgenommenen kindlichen Eigenschaften in multivariablen Modellen zum Fütterungsverhalten zu bewerten.

Methoden: 161 Mütter berichteten über das Fütterungsverhalten bei ihren Kindern und über eine Reihe wichtiger Eigenschaften der Kinder. Diese Eigenschaften wurden in kontrollierten multivariablen Modellen zum Fütterungsverhalten bei Kindern eingeschlossen. Für die Erfassung der abhängigen Variable wurden die Häufigkeitsskalen für Kinder und Eltern aus der Behavioral Pediatrics Feeding Assessment Scale (BPFAS) verwendet.

Ergebnisse: Fütterungsprobleme bei Kindern waren positiv mit Lebensmittelneophobie und externalen Verhaltens- und sozialen Aspekten assoziiert, jedoch nicht mit den meisten problematischen Temperamentscharakteristika oder sensorischer Empfindlichkeit. Die Häufigkeit der Fütterungsprobleme wurde mit Externalisierungssymptomen assoziiert, während die elterlichen Problemwahrnehmungen und die Bewältigung mit sozialen Interaktionsproblemen beim Kind assoziiert wurden.

Schlussfolgerungen: Fütterungsprobleme in der Bevölkerung scheinen externe und interaktive Probleme zu sein und sich eher weniger durch angeborene oder internalisierende Faktoren erklären lassen. Die Assoziation mit Externalisierungssymptomen legt nahe, dass Fütterungsprobleme in diesem Ausmaß mit einem größeren Umfang an herausforderndem Verhalten einhergehen. Allerdings stellt das Vorhandensein von problematischem Fütterungsverhalten nur dann eine Herausforderung für die Eltern dar, wenn die soziale Interaktion des Kindes als mangelhaft erachtet wird.

Keywords: Fütterungsprobleme/Fütterstörungen, kindliches Verhalten, Temperament, sensorische Empfindlichkeit, Lebensmittelneophobie

抄録: 背景: 同時に生じる子どもの特徴が、問題のある摂食行動に与える相対的な影響を調査した研究は、ほとんど無かった。この研究の目的は、親が知覚したperceived子どもの特徴の相対的な寄与を、子どもの摂食行動の多変量モデルで評価することであった。

方法: 161人の母親が、子どもの摂食行動と主要な子どもの特徴の数を報告した。これらの特徴は、コントロールされた子どもの摂食行動の多変量モデルに入れられ、行動小児科摂食評価尺度the Behavioral Pediatrics Feeding Assessment Scale (BPFAS)の子どもと親の頻度の領域を結果測定として用いた。

結果: 子どもの摂食問題は、新しい食べ物への恐怖症、および外的な行動上と社会的な問題とポジティブに関連していたが、気質的な難しさの大部分の領域、あるいは知覚過敏とは関連していなかった。摂食問題の頻度は、外在化症状と関連したが、その一方問題と対処についての親の知覚は、子どもの社会-相互交流問題に関連していた。

結論: 集団の摂食問題は、生得的なあるいは内在化問題によって動かされるのではなく、むしろ外在化および相互交流の問題のようにみえる。外在化症状との関連から、このレベルの摂食問題が、挑戦的行動の広範なプロフィールのどこかに位置するだろうことが示唆される。しかし、子どもの社会的相互交流も不十分に見えるとき、問題のある摂食行動の存在は親への挑戦だけを構成するだろう。

キーワード: 摂食問題, 子どもの行動, 気質, 知覚過敏, 新しい食べ物への恐怖症

摘要: 背景: 很少研究探討共現的孩子特點對有問題的餵食行為之相對影響。這研究的目的是在兒童餵食行為的多變數模型中, 評估父母感覺到的孩子特點之相對貢獻。

方法: 161名母親報告了他們孩子的餵食行為和一些關鍵的兒童特點。這些特點被輸入到一個控制的兒童餵食行為的多變數模型中, 使用行為兒科餵食定量表 (BPFAS) 中的兒童和父母頻域, 作為成果的測量。

結果: 兒童餵食問題分別與食物恐新症和外部行為和社會問題有正面關係, 但與大部份性格困難或感官靈敏度的領域無關。餵食問題的頻率與外化症狀有關, 而有問題的家長之看法和應對, 與兒童社會交往問題有關。

結論: 人口餵食問題似乎是外部和互動的問題, 而不是被先天或內化因素推動。與外化症狀的關連意味著, 在這個級別的餵養問題可能會落在更廣泛的具有挑戰性行為的範圍裏。然而, 問題的餵食行為的存在, 可能只在孩子的社會交往也被視為是有缺陷時, 構成對父母的挑戰。

關鍵詞: 餵養問題, 兒童行為, 氣質, 感官的靈敏度, 食物恐新症

ملخص: خلفية: هناك دراسات قليلة تناولت التأثير النسبي للسمات المشتركة للطفل على سلوكيات تناول الطعام. والهدف من هذه الدراسة هو تقييم الأثر النسبي لطبيعة إدراك الآباء لهذه السمات على سلوك التغذية لدى الطفل. التجربة: قام 161 أم بتقرير عن سلوكيات التغذية لدى أطفالهم وتم إدخال هذه البيانات في نموذج متعدد المتغيرات بحيث مقياس التقييم السلوكي لتغذية الطفل هو المتغير الناتج.

النتائج: أظهرت النتائج أن مشكلات تغذية الطفل كانت مرتبطة إيجابياً بحالة الخوف من الطعام الجديد ومشاكل سلوكية خارجية واجتماعية أخرى ولكن لم تكن لها علاقة بعوامل صعوبة المزاج أو الحساسية. وارتبط تكرار مشاكل التغذية بأعراض التجسيد بينما كان إدراك الآباء للمشاكل والتكيف معها مرتبطاً بمشاكل التفاعل الاجتماعي لدى الطفل. الاستنتاجات: مشاكل التغذية يبدو أنها في الغالب مشاكل خارجية وتفاعلية في الأساس وليست منبعثة من عوامل فطرية أو داخلية. الارتباط بأعراض التجسيد يشير إلى أن مشاكل التغذية في هذا المستوى يمكن أن تكون ضمن تصنيف أكبر للسلوك الصعب. ومع ذلك يمكن القول أن وجود سلوكيات تغذية صعبة يمكن أن تكون مشكلة بالنسبة للآباء في حالة إذا كان هناك قصور في التفاعلات الاجتماعية للطفل.

كلمات مفتاحية: مشاكل التغذية - سلوك الطفل - المزاج - الحساسية الحسية - رهاب الجديد في الطعام

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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 nonclinical 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, Wallis, & St John, 2004; Greer et al., 2008; Levine et al., 2011; Lindberg, Bohlin, & Hagekull, 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 & Booth, 1992; Linscheid, 2006; Sanders, Patel, Legrice, & Shepherd, 1993; Wolff & Herman, 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 have suggested 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 on future child feeding problems. Therefore, it is important to try to understand population feeding problems, including a profile of key correlates of these problems from the parents' perspective.

An examination of child feeding literature revealed that the most common nonmedical 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 that 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 a negative impact on the way that parents perceive their child's behaviors and on their own abilities to manage challenging behaviors (Ammaniti et al., 2010). Furthermore, children learn a great deal about what, when, and how to eat via social interactions, so barriers in this area can significantly hinder appropriate feeding behavior and dietary development (Addessi, Galloway, Visalberghi, & Birch, 2005; Aldridge, Dovey, & Halford, 2009; Birch, 1999). Externalizing behaviors and temperamental difficulties may also be more directly associated with the frequency of observable feeding problems, if the difficulties impinge on feeding and meal-times (e.g., poor appetite regulation, restlessness at mealtimes, rigidity around new foods and routines, etc.). Regarding sensory

processing, food selectivity and refusal behaviors are thought to occur via oversensitivity or overreactivity towards the texture, taste, or smell of certain food groups and types (Berlin, Davies, Lobato, & Silverman, 2009; Chatoor & Ganiban, 2003; Coulthard & Blissett, 2009; Dovey, Farrow, Martin, Isherwood, & Halford, 2009; Smith et al., 2005), or via underresponsiveness to sensory stimuli and associated poor oral motor control (Berlin et al., 2009). Sensory-processing issues, and the degree of sensitivities, may therefore underlie the frequency or strength of observed feeding problems. Beyond atypical conditions, developmental food neophobia (the reluctance to eat, or avoidance of new foods during early childhood; Pliner & Hobden, 1992) also has been associated with child feeding problems. Despite being a normal stage of early development (Dovey, Staples, Gibson, & Halford, 2008), persistence of food neophobia beyond expected time frames is associated with problematic feeding via poor dietary intake (Carruth & Skinner, 2000; Cooke, 2007; Falciglia, Couch, Gribble, Pabst, & Frank, 2000; Galloway, Lee, & Birch, 2003).

The aforementioned characteristics may represent important risk factors for child feeding problems; however, little is known about how they exist together in association with problematic feeding behaviors. It is important to move beyond the simple associations between characteristics and feeding outcomes toward a combined and controlled model of child feeding problems, which, to the best of our knowledge, has not been assessed in any prior study despite the co-occurrence of such factors within individual children and despite widespread knowledge that the role or influence of one factor on an outcome can be attenuated or exacerbated by the presence of another factor (Baron & Kenny, 1986). Therefore, the primary aim of the current study is to determine the relative contributions of parent-report child characteristics within multivariable models of child feeding behavior. The majority of past research has focused on mothers and maternal report, for practical (highest response rates) and theoretical (Mothers frequently are the primary caregiver.) reasons, and hence, the current study will do the same. Feeding outcomes will be separated into maternally observed problem frequency (child scale) and mothers' perceptions and strategies for coping with feeding problems (parent scale). The aim is to assess whether factors associated with maternal experiences of feeding challenges differ from those associated with maternally observed problem frequency.

Based on existing research, we hypothesize that the child variables associated with feeding problem frequency will differ from those associated with maternal feelings and strategies related to child feeding problems. Specifically, we hypothesize that innate or underlying factors such as sensory sensitivities and temperamental difficulties will be associated with observed feeding problems whereas more external characteristics such as generalized conduct and social interaction problems will be associated with maternal perceptions and strategies for coping with child feeding problems. It is anticipated that child food neophobia will be associated with both feeding outcomes, as it can represent an inherent developmental stage and a behavioral feeding challenge to parents.

METHOD

Participants and Recruitment

The overarching study of children's feeding, for which ethical approval was granted by the Loughborough University Research Ethics Committee, obtained data from 445 parents of children with no past or present clinical feeding disorder; the vast majority of the parents were mothers of the child. The current study focuses only on mothers of children aged 3 to 6 years ($N = 202$). Participants were recruited through parent and child social groups and networks. Written information regarding the study purpose, procedure, and contacts was given to all prospective participants by the researcher during visits to parent-child groups or via an online invitation posted on parent forums. Mothers provided informed consent prior to the completion of any study materials. The majority of data (97%) were obtained online; recent research has suggested that there are few differences between child feeding questionnaires completed online and offline, and online responses may produce marginally higher feeding problem outcome scores (Dovey, Jordan, Aldridge, & Martin, 2013).

Individuals with missing feeding behavior outcome data were excluded ($n = 41$), leaving a final sample of 161. After examination of numerous demographic factors, breast-feeding was found to be the only factor to differentiate between those who did and did not complete the outcome measures. Completers had a higher incidence of breast-feeding (79.2%) than did noncompleters (62.5%), $\chi^2 = 4.90$, $p = .027$, and completers breast-fed for notably (though not significantly) longer in months ($M = 30.80$, $SD = 43.10$) than did noncompleters ($M = 18.18$, $SD = 24.92$), $t(199) = 1.80$, $p = .074$, 95% CI = $-1.22, 26.47$. Breastfeeding was not found to be associated with the study feeding-behavior outcomes, but it was adjusted for in further analyses where required.

Sample mothers. Maternal age ranged from 19 to 46 years ($M = 32.68$, $SD = 5.62$). 75.6% of the sample were married, 16.9% cohabiting, and 7.5% defined themselves as single, separated, or divorced. Finally, 81% of mothers considered their pregnancy planned and 19% unplanned.

Subjects. Children were 51.6% female, with a mean age of 53.80 months ($SD = 11.38$, range = 36–83). Of the sample, 48.1% of the children were born on time (37–40 weeks), 45% were 3+ days past the due date, and 6.9% were premature (<37 weeks), with a mean birth weight of $3.44 \text{ kg} \pm 0.57$, range = 1.26–4.63 kg. Most children were breast-fed at some time, with duration ranging from 0 days (20.8%) to 212 weeks ($M = 30.80$, $SD = 43.10$ weeks). The majority of children had at least one sibling (76.4%; range = 0–5 siblings); 67.7% were the firstborn child, 24.8% were second-born, and the remaining ranged from third- to fifth-born. Finally, 83.2% of the sample had no known allergies or intolerances.

Measures and Procedure

Mothers completed five parent-report psychometric measures assessing child feeding behavior, food neophobia, temperament,

sensory sensitivities, and general behavior/conduct. The measures were completed in the order presented next. Information also was collected regarding mother and child age, child gender, birth weight, breast-feeding duration, presence of food allergies/intolerances, and number of older and younger siblings.

The Behavioral Pediatrics Feeding Assessment Scale (BPFAS; Crist et al., 1994). The BPFAS assesses child feeding behaviors (25 items) such as “Spits out food” and “Tantrums at mealtimes” as well as parent feelings about, and strategies for dealing with, child feeding behaviors (10 items), such as “I coax my child to get him/her to take a bite.” All items are first scored on a Likert scale of 1 (Never) to 5 (Always) and then also scored as “yes” to indicate if the item is considered a problem or “no” to indicate that it is not a problem. Ten items are reverse-scored (e.g., “Eats vegetables”), so that high scores indicate greater problem frequency. The BPFAS yields four domain scores: *child behavior frequency* (sum of Likert scores; range = 25–125); *child behavior problems* (count of items rated “yes;” range = 0–25); *parent feelings/strategies frequency* (range = 10–50); and *parent feelings/strategies problems* (range = 0–10). Due to incomplete reporting for problem domains (i.e., ~50–66% did not fully complete them), only frequency domains (hereafter referred to as child frequency and parent frequency) were used in the current study. The BPFAS has demonstrated good psychometric properties, showing sensitivity to feeding behaviors across clinical and nonclinical child samples, sensitivity to change over time and intervention, and excellent test-retest reliability (Crist et al., 1994; Dovey & Martin, 2012; Dovey, Martin, Aldridge, Haycraft, & Meyer, 2011; Haywood & McCann, 2009). Cronbach’s α coefficients of 0.88 (child frequency) and 0.82 (parent frequency) were identified in the current study.

The Child Food Neophobia Scale (CFNS; Pliner, 1994). The CFNS was adapted by Pliner (1994) from the adult Food Neophobia Scale (Pliner & Hobden, 1992) to assess food neophobia, the tendency to avoid/reject new and unfamiliar foods, in children. The six items of the CFNS are scored on a Likert scale of 1 (Strongly Disagree) to 7 (Strongly Agree), with high scores representing stronger neophobia. The FNS (on which the CFNS is based) has demonstrated strong test-retest reliability ($p < .01$) and reasonable concurrence with observed food-selection behavior (Hobden Pliner, 1995). In the current study, the CFNS exhibited excellent internal reliability ($\alpha = 0.95$).

The EAS Temperament Questionnaire (Buss & Plomin, 1984; Mathiesen & Tambs, 1999). The EAS was developed to examine parental report of child temperament at around 1 to 9 years. Temperament is assessed via 20 items comprising the subscales Emotionality, Activity, Shyness, and Sociability. Items are scored on a Likert scale of 1 (Not at all) to 5 (Very much), with high scores indicating greater difficulty (The Sociability subscale was reverse-scored.) The EAS subscales have demonstrated good tests-retest and interrater reliability (Boer & Westenberg, 1994), and internal

reliability was confirmed in the current study (α s range = 0.73–0.87).

The Strengths and Difficulties Questionnaire (SDQ; R. Goodman, 1997). The SDQ assesses attributes of psychological adjustment, and was used in the current study to suggest dimensions of child behavior problems. The scale comprises 25 items across five subscales (Emotional Symptoms, Conduct Problems, Hyperactivity-Inattention, Peer Problems, and Pro-Social Behavior), with high scores reflecting increased behavior/adjustment problems (The Prosocial subscale was reverse-scored.) Construct validity, test-retest stability, and adequate subscale internal consistency (α s range = 0.57–0.85) have been previously identified (R. Goodman, 1997, 2001); the latter was supported in the current study (α range = 0.64–0.76).

The Short Sensory Profile (SSP; Dunn, 1994, 1999; Dunn & Daniels, 2002). The 38-item SSP for children over 3 years was used in the current study. This scale comprises subscales for a number of sensory domains, but only tactile and taste/smell sensitivity were used in the current study. Items are scored on a Likert scale of 1 (Always) to 5 (Never), where low scores indicate sensory processing problems. The SSP measures are used widely in research and clinical practice to examine sensory processing abilities (Ahn, Miller, Milberger, & McIntosh, 2004; Miller, Coll, & Schoen, 2007); the current study confirmed internal reliability in the Total scale ($\alpha = 0.93$), the tactile domain ($\alpha = 0.71$), and the taste/smell domain ($\alpha = 0.94$).

Data Analyses

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

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

TABLE 1. Child Behavior Characteristics [*M*, *SD*, and 95% Confidence Interval (*CI*)] of the Total Sample and of Boys and Girls Individually

Child Variable	Total Sample		Girls	Boys
	<i>M</i> (<i>SD</i>)	95% <i>CI</i>	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)
BPFAS Child Frequency	48.87 (13.37)	46.79, 50.95	47.99 (13.11)	49.78 (13.67)
BPFAS Parent Frequency	17.79 (5.96)	16.86, 18.72	17.09 (5.78)	18.48 (6.01)
CFNS	3.88 (1.73)	3.61, 4.15	3.73 (1.65)	4.06 (1.82)
Emotionality	2.72 (0.95)	2.56, 2.88	2.71 (0.85)	2.72 (1.06)
Activity	4.19 (0.63)	4.08, 4.29	4.18 (0.54)	4.18 (0.72)
Shyness	2.52 (0.83)	2.37, 2.66	2.51 (0.83)	2.50 (0.81)
Sociability	3.86 (0.64)	3.75, 3.97	3.90 (0.64)	3.81 (0.65)
Emotional Symptoms	0.38 (0.40)	0.31, 0.45	0.40 (0.43)	0.36 (0.37)
Conduct Symptoms	0.45 (0.38)	0.38, 0.51	0.41 (0.34)	0.49 (0.42)
Hyperactivity	0.81 (0.51)	0.72, 0.89	0.76 (0.49)	0.85 (0.53)
Peer Problems	0.33 (0.36)	0.26, 0.39	0.29 (0.31)	0.38 (0.42)
Prosocial Behavior	0.45 (0.37)	0.39, 0.52	0.36 (0.33)	0.55 (0.39)*
Tactile Sensitivity	4.36 (0.59)	4.25, 4.47	4.41 (0.47)	4.32 (0.71)
Taste/Smell Sensitivity	4.11 (1.15)	3.90, 4.32	4.16 (1.14)	4.09 (1.15)

Note. BPFAS = Behavioral Pediatrics Feeding Assessment Scale; CFNS = Child Food Neophobia Scale. *Significant difference between girls and boys.

Child feeding literature informed the selection of 12 variables from four main child characteristics (food neophobia, temperament, conduct/adjustment, and sensory sensitivity) for analysis; however, little theory exists regarding the temporal importance of these variables within a multi-element model of feeding outcomes. Therefore, Enter method regression models were used to examine the relative importance of all child characteristics to the child feeding outcomes. All models were adjusted for parent and child demographic factors, and only those found to have no material influence on the model were removed to improve model parsimony.

RESULTS

Sample Child Behavior Characteristics

Characteristics of the sample for each of the child behavior outcomes assessed in the current study are presented in Table 1, including summaries for the total sample of completers and for girls and boys independently. All outcome variables were assessed for significant differences between girls and boys, and only prosocial behavior was found to show a significant difference at 5%, $t(115.75) = 3.07$, $p = .003$, 95% *CI*: -0.32 , -0.069 . *P* values for all other comparisons ranged from 0.15 to 0.99. To avoid confounding, child gender was adjusted for in subsequent analyses.

Multi-Element Models of Child Feeding Behaviors and Problems

Child feeding problems (BPFAS Child Frequency subscale). The model of 12 child characteristics explained a substantial and highly significant proportion (adjusted $R^2 = 0.67$) of variability in the BPFAS Child Frequency score, $F(16, 160) = 21.27$, $p < .001$. This model was adjusted for mother and child age, child gender, and number of older siblings. Child food neophobia, and behavioral problems associated with conduct and hyperactivity, were significant predictors in the model; data also suggested an

inverse relationship between feeding problems and prosocial behavior (see Table 2), although this association was not significant at 5%. Beta coefficients, 95% confidence intervals, and *p* values for all covariates are given in Table 2. Although no account is taken for any shared variance that may be observed in the full model, a model containing only the significant predictors and prosocial behavior accounted for a notable 64% of the variability in the BPFAS Child Frequency scores.

Maternal problems in child feeding (BPFAS Parent Frequency subscale). The model of 12 child characteristics again explained a considerable proportion (adjusted $R^2 = 0.52$) of variability in the BPFAS Parent Frequency score, $F(16, 160) = 10.84$, $p < .001$. This model was adjusted for mother and child age, child gender, breast-feeding duration, birth weight, and number of younger siblings. In this model, child food neophobia and problems associated with hyperactivity and decreased prosocial behaviors were significant predictors in the model; the confidence interval also suggested a potential inverse relationship between sociability and feeding problems, but this finding was not significant at 5% (see Table 2). Beta coefficients, confidence intervals, and *p* values for all covariates are given in Table 2. A model containing only the significant predictors and sociability was found to explain 50% of the variability in the BPFAS Parent Frequency scores.

DISCUSSION

The current study examined the relative associations between several child characteristics and problematic child feeding behavior frequency. It also examined whether there were differences in the profiles of correlates of child feeding problems when assessed via maternally observed behaviors (BPFAS Child Frequency subscale) and maternally reported feelings and strategies for coping with child feeding problems (BPFAS Parent Frequency subscale).

TABLE 2. Coefficients, 95% Confidence Intervals (CI), and P Values for Child Characteristics Contributing to Multiple Linear Regression Models of Child Feeding Problems (BPFAS Child and Parent Frequency Outcomes)

Child Variable	BPFAS Child Frequency ^a			BPFAS Parent Frequency ^b		
	β	95% CI	<i>p</i>	β	95% CI	<i>p</i>
CFNS	4.18	2.96, 5.40	<.001	1.71	1.06, 2.365	<.001
Emotionality	0.023	-2.14, 2.19	.983	0.73	-0.34, 1.80	.179
Activity	0.20	-2.48, 2.88	.885	1.15	-0.45, 2.75	.156
Shyness	-1.033	-3.20, 1.14	.347	-0.73	-2.09, 0.64	.285
Sociability	-1.96	-5.59, 1.68	.288	-2.13	-4.34, 0.07	.058
Emotional Symptoms	0.98	-5.34, 7.31	.749	0.58	-1.88, 3.04	.643
Conduct Symptoms	5.56	0.36, 10.76	.036	0.56	-1.93, 3.05	.658
Hyperactivity	6.64	3.28, 10.00	<.001	2.95	0.26, 5.63	.034
Peer Problems	1.80	-3.42, 7.01	.497	0.09	-2.88, 3.06	.951
Prosocial Behavior	-3.72	-7.65, 0.20	.063	-2.62	-4.98, -0.25	.031
Tactile Sensitivity	-0.24	-3.24, 2.77	.877	0.82	-.86, 2.51	.333
Taste/Smell Sensitivity	-1.62	-3.51, 0.26	.090	-0.41	-1.40, 0.57	.408
Adjusted R ²	0.67	0.52				

Note.

Coefficients in italics demonstrated a large effect size, but were not significant at 5%. BPFAS = Behavioral Pediatrics Feeding Assessment Scale; CFNS = Child Food Neophobia Scale.

^aModel adjusted for mother and child age, child gender, and number of older siblings.

^bModel adjusted for mother and child age, child gender, breast-feeding duration, birth weight, and number of younger siblings.

Notably, the current study found that models comprising only a small number of significant child characteristics could explain over half of all variability in the BPFAS Parent Frequency scores and a remarkable two thirds of the variability in BPFAS Child Frequency scores. These models were controlled for a number of demographic variables, but follow-up analyses suggested that the vast majority of the variance accounted for in each model could be attributed to the significant predictors. While the cross-sectional nature of the current study precludes inferences around cause and effect between child characteristics and feeding, the strength of the results suggests that the models uncovered in this study represent key profiles of characteristics to focus on in the reduction or prevention of population-level child feeding problems. Given that the characteristics were maternally reported, such methods of reduction/prevention would likely need to focus on both the child's behaviors and the parent's perceptions of those behaviors. Our hypotheses that the models of child and parent outcomes would differ and that different child characteristics would prevail for each outcome were partially supported by the data. The specific pattern of predictors and the total model explanatory values differed slightly between the models of child and parent feeding outcomes, and certain characteristics were found to play a greater role in the BPFAS Child Frequency scores while others were more highly associated with the BPFAS Parent Frequency scores.

The current study found that child food neophobia and behavioral hyperactivity were strongly and positively associated with both child and parent frequency domains of problematic child feeding behavior. Accounting for the relative scales of measurement, the strength of these predictors was similar and noteworthy for each outcome scale. A single unit increase in food neophobia was associated with a 16.7% (minimum 11.8%) increase in the

BPFAS Child Frequency scores and a 17.1% (minimum 10.6%) increase in the BPFAS Parent Frequency scores. Similarly, a unit increase in hyperactivity was associated with a 26.6% (minimum 13.1%) increase in child scores and a more variable 29.5% (minimum 2.6%) increase in parent scores. The frequency of observed problematic feeding behaviors (BPFAS Child Frequency subscale) also was positively associated with behavioral conduct problems, which, coupled with hyperactivity, reflect a profile of externalizing behaviors (A. Goodman, Lamping, & Ploubidis, 2010; Liu, 2004). Rather than conduct problems, the parental problem scale (BPFAS Parent Frequency subscale) was significantly negatively associated with prosocial child behavior, and distinctly, but nonsignificantly, negatively associated with sociability. Prosocial deficits were marked, but not significant, in relation to the frequency of observed child feeding problems. Aside from social domains, no other facets of temperamental difficulty were associated with problematic feeding behavior frequency. The absence of emotional symptoms (either behavioral or temperamental) alongside social deficits in models of problematic feeding behavior suggests that it is social-interaction deficits specifically that correlate with feeding issues rather than signifying broader internalizing-behavior profiles. The additional absence of sensory sensitivities from the predictive models also suggests that psychophysiological factors do not routinely underpin population feeding problems.

These key findings suggest that population-level child feeding problems are predominantly active and interactive issues for the mother and child, co-occurring or perhaps falling within other externalizing-type behavior profiles rather than underlying emotional, temperamental, or physiological issues. The findings also suggest that mothers may observe a range of problems with their child's feeding and general interaction with their environment (Liu,

2004), but the perceived presence of child social problems may be the distinguishing marker for the perception of problematic feeding behaviors as a challenge to parenting. This ties in with a body of research which advocates the importance of socialization throughout feeding/eating development as a means for teaching and learning about what, where, when, and how to eat (e.g., Addessi et al., 2005; Birch, 1998, 1999; Nestle et al., 1998). Difficulties in this area therefore can hinder natural learning techniques and impact on the parent's ability to manage or overcome feeding problems. It was identified earlier in the article that parental/maternal perception of feeding problems can have a significant negative impact on the parent's subsequent actions, feeding strategies, and parental self-efficacy. As such, the current results suggest that deficits to social interactions may represent a key risk factor to this negative association and potential downward spiral of feeding behavior. Advice, support, and interventions for poor feeding, based around improvement of socialization and interaction, therefore may be beneficial to the mother and child in the general population, although more research would be needed to test this supposition. The absence of sensory and temperament or regulatory factors in the models of child feeding also may have important implications for the differentiation of clinical and nonclinical feeding problems; again, further research would be required to test this assertion.

It is recognized that all outcome variables in this current study were maternally reported, and as such, reflect the mother's perceptions of her child's behaviors and actions. While parental-reports can represent over- or underreporting biases, as compared to objective measures of the child, all chosen measures in this study have been positively validated against objectively observed behaviors and characteristics, which helps ensure that bias has been minimized. Notably, parental perceptions of child behavior are of practical importance to the current study since it is these perceptions of a child's behaviors, and a parent's ability to manage those behaviors, which can influence the parent's own behaviors and strategies. The study also observed that mothers who did not complete the feeding-outcome measures had a lower incidence of breast-feeding. In the current study, breast-feeding duration was not found to be associated with feeding-behavior outcomes, and importantly, a notable proportion of the mothers who did complete the feeding measures did not breast-feed. These factors help to suggest that the results of the study were not confounded by breast-feeding status or duration. However, the difference between groups does suggest that mothers who did not breast-feed their child were more reluctant to report on their child's feeding, which could be a very interesting factor to investigate in future research.

A limitation to the current study was that ethnicity and socioeconomic data were incomplete and thus not reported. However, estimates available from the overarching child feeding study have suggested that a predominantly White British sample was obtained, but a reasonably broad spectrum of socioeconomic backgrounds was represented via paid, voluntary, or full-time parenting roles, although very few mothers were identified as unemployed. In future research, more detailed information should be collected on these

factors to control for their potential influence on child feeding outcomes.

The strength and nature of the current study findings are noteworthy. The study gives a clear profile of child characteristics that explain a huge amount of the variability in poorer feeding behaviors in the population. Two thirds of the variability in problematic feeding behavior frequency was explained by a multivariable regression model in which only child hyperactivity, conduct symptoms, and food neophobia were significant predictors. Maternal perceptions of child feeding problems as challenging were not associated with child conduct problems, but instead were significantly associated with child social deficits. This key correlate amplifies the importance of social interaction within feeding development and behavior, and may indicate a crucial focus for parental support in overcoming feeding problems.

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