Manuscript Title: Do dads make a difference? Family feeding dynamics and child fussy eating

Short title: Family feeding practices and child fussy eating

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Abstract

Objective

Few child feeding studies have focused on family dynamics or disadvantaged families, yet feeding occurs in the complex social, economic and relational context of the family. We examined how the level (high vs. low) and concordance (concordant vs. discordant) of non-responsive feeding practices of mothers and fathers are associated with child fussy eating, in a socioeconomically disadvantaged Australian sample.

Methods

Mother-father pairs (N=208) of children aged 2-to-5-years old independently completed validated questionnaires reporting their 'persuasive feeding', 'reward for eating', 'reward for behaviour' and child's 'food fussiness'. The fussiness scores did not differ between mother-father pairs and were averaged to derive a single dependent variable. *K-means* cluster analyses were used to assign mother-father pairs to clusters for each feeding practice, based on mean scores. Three ANCOVAs, corresponding to each feeding practice outcome, tested differences in child fussiness across clusters while controlling for covariates.

Results

Four clusters were identified for each feeding practice: concordant 1) high (M_{Hi}/F_{Hi}) and 2) low (M_{Lo}/F_{Lo}); and discordant 3) mother high, father low (M_{Hi}/F_{Lo}); and 4) mother low, father high (M_{Lo}/F_{Hi}). For 'persuasive feeding', M_{Lo}/F_{Lo} reported lower levels of fussiness compared with M_{Hi}/F_{Lo}, M_{Hi}/F_{Hi} and M_{Lo}/F_{Hi} (*ps*<0.05). For 'reward for eating', M_{Lo}/F_{Lo} reported lower levels of fussiness compared with M_{Hi}/F_{Hi} (*p*<0.05). Child fussiness did not differ across 'reward for behaviour' clusters.

Conclusion

In socioeconomically disadvantaged families, when parents are concordant in avoiding non-responsive feeding practices less child 'food fussiness' is reported. Findings suggest that feeding interventions should consider inclusion of both parents in two-parent households.

Key terms: Fussy eating – picky eating – feeding practices – socioeconomically disadvantaged – family

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Exposure to a wide variety of foods (flavors and textures) early in life supports the development of healthy food preferences, providing a foundation for balanced diets in adolescence and adulthood.[1] Yet many young children reject foods, whether novel or familiar, and parents may perceive such behavior as 'fussy' or 'picky' eating. Fussy eating is highly heritable[2] and is thought to serve an evolutionarily protective function to avoid potentially toxic foods. However, the protective function of this behavior may be reduced in the current food environment of developed countries where there is ready access to safe, energy-dense and palatable food. The prevalence of fussy eating progressively increases from infancy to early toddlerhood, and peaks at approximately 3-years old[3] as children become more mobile and develop the ability to more clearly communicate their food preferences to caregivers.[4] Overall, the preschool years (2- to 5-years old) appear to be important in the development and expression of fussy eating.

Fussy eaters have poorer health outcomes when measured by dietary quality and weight status. In cross-sectional studies, fussy eating is associated with preschoolers' dislike of fruit and vegetables[5] and low dietary variety intake,[6] which can continue into adulthood.[1] Evidence from twin studies shows a shared heritability between fussy eating and preferences for fruit and vegetables, which may explain fussy eaters' strong dislike of fruit and vegetables.[5] Compromised nutrient diversity may increase fussy eaters' risk of long-term chronic disease.[7] Children from the large birth cohort in the Netherlands, 'Generation R' (N=4191),[8] who were characterized as severe fussy eaters when they were 4-years old (high 'food avoidant' and low 'food approach' behaviors measured on the Children's Eating Behaviour Questionnaire [CEBQ][9]) had a higher risk of being underweight and a lower fat free mass at 6-years old, compared to children who were not severe fussy eaters.

Fussy eating is a major concern and frustration for parents, who may attempt to reduce a child's fussiness by using a variety of behavioral strategies, generally termed 'feeding practices'. Feeding practices such as pressuring a child to eat, using food rewards and restricting certain foods have been conceptualized as 'non-responsive' to a child's hunger and satiety cues.[10] A healthy child's refusal of *familiar* food may be an expression of emerging agency over food preferences (what)[11] or a reflection of satiety (how much).[12] Parents may interpret this rejection as the child being 'fussy' and may use non-responsive feeding practices to counteract a child's food rejection. Parents report using an increasing frequency of non-responsive feeding practices from toddlerhood through to the preschool years,[12] which has been shown to predict poor child food preferences[13] and increased weight gain.[14]

The direction of the association between non-responsive feeding practices and child fussy eating is unclear, although recent research suggests this relationship is bidirectional. In another analysis from the 'Generation R' cohort (N=4845), Jansen et al.[15] used cross-lagged models to show that the relationship between maternal pressuring and child fussy eating is bidirectional. A cross-sectional analysis of twin toddlers (N=247) showed that mothers respond to differences in twins' fussy eating by using more pressure and food rewards with the fussier twin, also demonstrating bi-directionality of the relationship.[16] However, this study[16] did not differentiate between two conceptually different rewarding constructs: using food rewards in exchange for i) eating (more disliked but generally healthy) foods or ii) good behavior. Finnane et al.[17] distinguished these two constructs and found a positive cross-sectional association between fussy eating in 1- to 10-year olds (N=413) and parents' reward for eating, but no relationship with reward for behavior. Further understanding how parents use pressure and food rewards in response to preschool children's fussy eating could inform interventions aimed to improve children's mealtime behaviors.

Child feeding studies have limited their focus to mother-child feeding relationships in homogenous, often well-educated samples.[12] However, maternal education is inversely associated with pressuring a child to eat[18] and using food reward as a behavioral incentive.[19] Furthermore, mothers from low-income backgrounds who report higher frequencies of depressive symptoms have been found to verbally pressure their preschool-aged child to eat more.[20] Low-income mothers also are twice as likely to report their child as a persistent fussy eater compared to mothers from high-income backgrounds.[3] An additional consideration is that familial economic limitations may impact the foods available to both parents and children.[21] For example, parents may strategically purchase and offer foods that the child prefers and is unlikely to reject, to avoid waste. Narrowing foods offered may unintentionally limit their child's exposure and familiarity with diverse food appearances, flavors and textures necessary to increase food acceptance.[22] Despite established associations between parental socioeconomic status, non-responsive feeding practices and fussy eating in the literature, research investigating socioeconomically disadvantaged families is scarce.

Although feeding interactions operate within a complex family system, fathers are underrepresented in child feeding research.[23] Neglecting the role of fathers limits understanding of feeding dynamics, as fathers are involved in feeding children and family mealtimes and report using more pressuring and food to control behavior than mothers in some but not all studies.[23] Examining feeding practices of both mothers and fathers is key to understanding how couples co-parent[24] in the feeding context, and respond to or manage fussy eating together. In the wider parenting literature, parents who are concordant in positive parenting practices report better child health outcomes (including lower depression,[25] and higher social and academic self-efficacy[26]). A recent qualitative study found that fathers (N=37, children aged 2-to-10-years old) who described feeding practices discordant with their partners reported greater instances of child food refusal.[27] More research on the specific

type of non-responsive feeding practices and concordance between mothers and fathers is necessary to establish associations with fussy eating. Understanding parenting concordance in the feeding context, particularly within families facing greater economic constraints, can provide insight into the complexity of fussy eating behavior.

The aim of the current study was to identify how level (high vs. low) and concordance (concordant vs. discordant) of non-responsive feeding practices ('persuasive feeding', 'reward for eating' and 'reward for behaviour')[28] between mothers and fathers are associated with child fussy eating in a cross-sectional sample of mother-father pairs recruited from a socioeconomically disadvantaged community in Australia. It was hypothesized that mother-father pairs who were concordantly high in non-responsive feeding practices would rate their child higher in fussy eating compared to mothers-father pairs who were concordantly low in non-responsive feeding practices. Furthermore, it was hypothesized that mother-father pairs who were discordant (i.e., mother high/father low or mother low/father high) in non-responsive feeding practices would report higher child fussy eating compared to concordantly low mother-father pairs, and lower child fussy eating compared to concordantly high mother-father pairs.

METHODS

Setting

The *Mums and Dads (MAD) for Mealtimes* study sought to target socioeconomically disadvantaged families. The study recruited from a geographical area in Queensland, Australia, with both a high proportion (1:3) of children with a "developmental vulnerability"[29] and a low Socio-Economic Index for Area (SEIFA).[30] Developmental vulnerability is measured using the Australian Early Development Census (AEDC), a

population-based measure of children's development at the time of commencing their first year of compulsory schooling (at age 5-years old). Developmental vulnerability is derived from measurement of five domains of a child's health, wellbeing and skills; including (1) physical health, (2) social competence, (3) emotional maturity, (4) language and cognitive skills and (5) communication and general knowledge. At the time of recruitment, the 2012 AEDC data indicated that the Logan community had 33% of children who were developmentally vulnerable, compared to 26% in Queensland and 22% in Australia.[29] Integration of the 2011 Australian Census and 2012 AEDC data show a strong inverse relationship between the socioeconomic status of an area (measured via SEIFA) where a child resides and their likelihood of being developmentally vulnerable.[30] SEIFA systematically ranks socioeconomic features of a geographical area, with lower SEIFA indicating more disadvantage, based on the distribution of average income, education, occupation and employment, among others. Recruitment took place from February to September 2016 via face-to-face contact at child care centers, playgroups, a local family fun day and an immunization clinic. Cohabiting mother-father pairs of a child aged 2-to 5-years old were invited to participate in the survey. Mothers and fathers were defined as biological-, adoptive-, or step-parents/ partner of the child's father/mother or grandparents. Inclusion criteria for mother-father pairs included both parents >18 years old, child born >32 weeks gestation, child born with weight >2500g, child born as a single birth and without a diagnosed chronic condition including food-related allergy/sensitivity that may adversely affect their appetite or dietary intake. To acknowledge participation, each parent was offered a choice of gift vouchers valued at $AU15. The study was approved by the Queensland University of Technology Human Research Ethics Committee (1600000045).

Measures

Participants completed “Mother” and “Father” questionnaires, which were identical except for the use of gender pronouns. Completion options were online or hardcopy, with the latter returned via a reply-paid envelope. If parents had more than one child in the 2- to 5-year old age group, they were asked to report on their eldest child.

Socio-demographic characteristics. Parents were asked to report their date of birth, weight and height, highest level of education attained, relationship to child, employment status, hours worked per week, number of meals (i.e., breakfast, lunch and dinner) eaten per week with the child (out of 21), country of birth and their Aboriginal/ Torres Strait Islander (ATSI) status. Parental distress was measured using the Kessler-10 and item scores were summed to give an individual “parent distress” score.[31] Household food security was measured with a single item used in Australia’s National Nutrition Survey: “In the last 12 months, were there any times that you ran out of food and you couldn’t afford to buy more?”[32] Mother-father pairs were coded as “food insecure” if at least one parent answered this item with a “yes”, otherwise the families were coded as “food secure”. Body Mass Index (BMI) was calculated using parents’ self-reported weight and height (weight [kg]/ height $[m]^2$), and categorized into “healthy weight” (BMI <25), “overweight” (25≤ BMI > 30) and “obese” (BMI ≥ 30).

Both parents reported on child age, gender, height and weight. Maternal and paternal reports for child height and weight were not significantly different, therefore maternal reports were used to ensure consistency. Child BMIz score was calculated, however, 31% (*n*=65) of children had missing data and a further three cases were excluded due to biologically implausible values.

Parental feeding practices. Maternal and paternal feeding practices were assessed using the self-reported Feeding Practices and Structure Questionnaire-28 (FPSQ-28).[28] The FPSQ-28 measures eight feeding constructs relating to non-responsive and mealtime structure-

related feeding practices. This questionnaire has been validated in first-time mothers of children aged 2-, 3.7 and 5-years old,[28] showing longitudinal measurement invariance between 2- to 5-years of age, robust factorial validity and good internal reliability.[33] Furthermore, the FPSQ-28 has been validated in the current sample of mothers and fathers, and shows that feeding constructs are invariant across parent gender.[34] The current study used three subscales: 'persuasive feeding' (6 items; e.g., *When your child refuses food they usually eat, do you insist your child eats it?*), 'reward for eating' (4 items; *When your child refuses food they usually eat, do you encourage to eat by offering a reward other than food?)* and 'reward for behaviour' (4 items; *I offer my child his/her favourite foods in exchange for good behaviour*). These three subscales were chosen because mothers appear to respond to fussy eating using pressure and food as a reward.[16] However, these associations have not been explored in with fathers' feeding practices, or separated food as a reward for eating and food as a reward for good behavior. Items were anchored on a 5-point Likert scale measuring how often they used or agreed with using a certain feeding strategy from "never" (1) to "always" (5) or "agree" (1) to "disagree" (5). Mean scores for each subscale were calculated for mothers and fathers, with higher mean scores indicating more frequent use of the feeding practice. Internal consistency reliabilities for the subscales were acceptable for mothers and fathers (α>0.72).

Fussy eating. Parent perception of child fussy eating was measured using the 'food fussiness' subscale (6 items) on the CEBQ.[9] The CEBQ[9] is a parent-reported psychometric instrument used to measure eight dimensions of child eating behavior. Mothers and fathers rated their child's 'food fussiness' on a 5-point Likert scale ranging from "never" (1) to "always" (5). Mean scores of 'food fussiness' were calculated for both mother and father, with higher mean scores indicating higher levels (more frequent) of fussy eating. The 'food

fussiness' subscale showed excellent internal consistency reliability for mothers (α=0.91) and fathers (α=0.92).

Analysis

Data Cleaning. A total of 504 surveys were returned. Sixty surveys did not have a corresponding partner survey and were therefore excluded from the analysis. A further 16 participants (8 pairs) were excluded due to >20% data missing on at least one of the paired surveys, or because the families did not meet inclusion criteria. A portion of parent-pairs (*n*=12) with returned surveys had reported on children under the age of 24-months (range: 17- to 23-months). To maximize the available data, we retained children at least 20-months old (*n*=6). A total of N=208 mother-father pairs were included in the final analyses. The preliminary and primary analyses, outlined below, were rerun excluding all of the children under 24-months old, and this did not significantly change the results.

Preliminary analyses. All analyses were completed with IBM SPSS Statistics version 23. Missing item scores within the subscales were imputed using Expectation Maximization, as there was only a small proportion of missing values for the feeding practice and 'food fussiness' subscales (0-3.6% missing values for all items). To describe the sample, mothers and fathers were compared on self-reported socio-demographic variables using independent samples t-tests for continuous variables and chi-square tests for categorical variables. Differences between mother-father pairs' perception of child 'food fussiness' and feeding practices were explored using paired-samples t-tests. Preliminary analyses showed that mother-father pairs did not perceive their child's 'food fussiness' differently (*p*=0.744). Therefore, the 'food fussiness' subscale was averaged between mother-father pairs to create a composite child 'food fussiness' score for the remaining analyses. Bivariate Pearson correlations were then used to explore associations between the composite child 'food fussiness' score and mothers' and fathers' feeding practices.

Primary Analyses. Data-driven methods were used to identify and assign mother-father pairs to clusters based on the level (high vs. low) and concordance (concordant vs. discordant) of each feeding practice of interest. The composite 'food fussiness' score was then planned to be compared across feeding clusters, using ANCOVAs and controlling for significant covariates. Firstly, a similar method to that applied by Shoeppe and Trost[35] was used to identify the appropriate number of clusters for each feeding practice. For each feeding practice, a hierarchical cluster analysis was performed using Ward's method with the squared Euclidean distance as a proximity measure. Inspection of the coefficients from the agglomeration schedules, proximity matrices and dendrograms were used to inform the suitable number of clusters for each feeding practice. Secondly, *K-means* cluster analyses were used to assign mother-father pairs into feeding clusters, based on their reported feeding practice mean. Final clusters were compared using one-way ANOVAs and Chi-Square tests on potential confounding parent (age, BMI, education, relationship to the child, country of birth, ATSI status, number of hours worked per week, food insecurity, distress and number of meals eaten per week with the child) and child (age, gender and BMIz score) variables using a conservative cut-off of $p<0.1$. Given the cross-sectional design, causality could not be assessed and therefore for ease of interpretation of results, feeding clusters were considered as the independent variable and 'food fussiness' score as the dependent variable. ANCOVAs were run for each feeding practice to determine if the composite child 'food fussiness' score differed significantly between clusters, controlling for significant covariates. Where appropriate, Sidak *post-hoc* comparisons between clusters are reported. Significance was set at $p<0.05$.

RESULTS

Preliminary analyses

Mothers' and fathers' self-reported and parent-reported child socio-demographic characteristics are presented in Table 1. A total of 8% of households reported experiencing food insecurity in the last 12 months. In comparison to mothers, fathers were older (p<0.001), more likely to be obese (based on self-reported height and weight; p<0.001) and work longer hours (p<0.001), but were less likely to be university educated (p<0.05) and reported lower levels of parental distress (p<0.01). There were small to medium correlations (rs=0.15-0.33) between the composite child 'food fussiness' score and maternal and paternal feeding practices except mothers' 'reward for behaviour' (Table 2). Paired-samples t-tests showed that fathers reported using higher levels of 'reward for behaviour' than mothers (Table 3). There were no significant differences between mother-father pairs for 'persuasive feeding' and 'reward for eating'.

Primary analyses

The hierarchical cluster analyses showed that four clusters of mother-father pairs were appropriate for each feeding practice. From the *K-means* cluster analyses, mother-father pairs were assigned to one of four clusters based on their final cluster centers: concordant 1) with both parents above the mean (M_{Hi}/F_{Hi}) or 2) both parents below the mean (M_{Lo}/F_{Lo}); or discordant 3) with the mother above the mean and the father below the mean (M_{Hi}/F_{Lo}); or 4) with mothers below the mean and fathers above the mean (M_{Lo}/F_{Hi}) (Table 3). However, two clusters did not comply with this pattern: mothers' 'persuasive feeding' cluster center in the M_{Hi}/F_{Lo} cluster was marginally lower than the maternal mean score (mean difference=-0.11), and mothers' 'reward for behaviour' cluster center in the M_{Lo}/F_{Hi} cluster was marginally higher than the maternal mean score (mean difference=0.24).

Composite child 'food fussiness' was significantly different across 'persuasive feeding' clusters, controlling for significant covariates (parental distress and child age), $F_{3,194}$=6.00, p=0.001 (Figure 1A). *Post-hoc* analyses showed that the M_{Lo}/F_{Lo} cluster reported less 'food

fussiness' compared to the M_{Hi}/F_{Lo} cluster (Mean Difference [MD]= -0.65, p=0.038, 95% Confidence Interval [CI]: -1.22, -0.22), the M_{Lo}/F_{Hi} cluster (MD= -0.74, p=0.017, CI: -1.39, -0.08) and the M_{Hi}/F_{Hi} cluster (MD= -1.00, p<0.001, CI: -1.64, -0.35). There were no significant differences in child 'food fussiness' between the latter three clusters. Composite child 'food fussiness' was also significantly different across 'reward for eating' clusters, controlling for significant covariates (parental distress and child age), $F_{3,194}$=3.70, p=0.013 (Figure 1B). *Post-hoc* analyses showed that the only significant difference was that the M_{Lo}/F_{Lo} cluster reported less 'food fussiness' compared to the M_{Hi}/F_{Hi} cluster (MD= -0.53, p=0.011, CI: -0.98, -0.09). Child 'food fussiness' did not significantly differ across 'reward for behaviour' clusters when controlling for significant covariates (parent distress, education, number of meals eaten with child and household food insecurity), p=0.30.

DISCUSSION

This is one of the first studies to examine the complex family system, considering the interplay of feeding practices of both parents and child fussy eating. We examined the association between the level and concordance of maternal and paternal feeding practices and child fussy eating in a sample recruited from a socioeconomically disadvantaged community in Australia. Mother-father concordance in rating their child's fussy eating suggests that they interpret their child's food refusal behavior similarly. We identified four clusters, characterized by variation in parent concordance (concordant vs. discordant) and level (high vs. low) of three selected non-responsive feeding practices ('persuasive feeding', 'reward for eating' and 'reward for behaviour').[28] Our first hypothesis that mother-father pairs who reported concordantly high non-responsive feeding practices would rate their child as fussier than mothers-father pairs who reportedly concordantly low non-responsive feeding practices

was supported for ‘persuasive feeding’ and ‘reward for eating’. Our second hypothesis, that mother-father pairs who were discordant in non-responsive feeding practices would rate their child as fussier compared to concordantly low mother-father pairs, but less fussy compared to concordantly high mother-father pairs was partially supported for ‘persuasive feeding’. Parents who were discordant in ‘persuasive feeding’ rated their child higher in fussy eating compared to the concordantly low cluster. We found no differences in child fussy eating across ‘reward for behaviour’ clusters. This study adds to the growing body of evidence which suggests engaging both parents in feeding interventions and research.[27]

Within families, whether the mother, father, or both parents reported using high levels of ‘persuasive feeding’, children were reported as fussier in comparison to parents who were concordantly low in pressuring. In light of a recent qualitative study on fathers’ perception of food coparenting,[27] mothers and fathers who are discordant in their feeding may result in one parent ‘undermining’ or ‘overcompensating’ for the other parent’s feeding practices. This could explain why we found that, regardless of parent gender, at least one parent engaging in higher pressuring was associated with higher reported fussy eating. Parents from socioeconomically disadvantaged backgrounds who experience economic constraints may push for their child to eat to avoid food – and monetary – waste. While seemingly intuitive to parents, pressuring to eat may have counterproductive effects on the child’s food intake. In an early experimental study, children (N=27, aged 3- to 5-years old) exposed to verbal pressure to eat by an adult (experimental condition) ate significantly less vegetable soup and made more negative comments about the food in comparison to the control condition when they were not pressured.[36] Longitudinal bidirectional associations between maternal pressuring to eat and child fussy eating have been reported in the literature, suggesting that parent and child mutually influence each other.[15] Adding fathers into this model raises an important question about how both parents’ level of pressuring is associated with fussy eating over

time. To address such question, future research is required to examine longitudinal relationships between level and concordance of mother-father pairs' pressure and child fussy eating.

Distinction between parents' use of food rewards for eating *and* behavior yielded differential associations with child fussy eating. This finding supports that these feeding practices are distinct constructs, at least in the fussy eating context. Mother-father pairs who were concordantly low in 'reward for eating' reported lower levels of child fussy eating than pairs who were concordantly high. There were no differences in child fussy eating between the concordantly high or low and the discordant clusters. Although offering a child a preferred food (e.g. dessert) to encourage a child to eat a less preferred food (e.g. vegetables) may be effective in the short term, employing a means-end strategy may negatively shift a child's preference for the target food (e.g vegetables) and increase the value of the contingent food (e.g. dessert).[37] Conversely, offering tangible non-food rewards (e.g. a sticker) as an incentive to eat has been shown to increase a child's intake and preference for the target food.[38] Across 'reward for behaviour' clusters, there was no difference reported in child fussy eating. Parents promising food (typically nutrient-poor and energy-dense) in exchange for good behavior may not intend to directly increase a child's intake or liking of particular foods. In the current study, mothers' 'reward for behaviour' was not associated with children's fussy eating, while a positive correlation was found in fathers. Previous findings in a sample with mostly mothers (N=413, 6% fathers)[17] found no association between 'reward for behaviour' and fussy eating, while a sample with a greater proportion of fathers (N= 495, 24% fathers)[39] found a positive correlation. Combined with the current findings, this emerging pattern in the literature is interesting. Given that fathers in the current sample reported using significantly more food rewards for good behavior than mothers (Table 3),

further exploration of fathers' use of food rewards, and how this is related to child fussy eating, is warranted.

Implications

This study highlights important implications for encouraging both mothers and fathers to use lower non-responsive feeding practices to enhance the impact of feeding interventions. In our sample, only 6% of families were concordantly low in all three of the non-responsive feeding practices examined. Concordant health-promoting practices between mothers and fathers have been previously associated with children's healthy dietary quality in cross-sectional analyses. Schoeppe and Trost[35] found that mothers' and fathers' (N=173 pairs) endorsement of healthy eating was associated with preschoolers' higher intake of fruits and vegetables. In our sample, mother-father pairs who reported using concordantly high levels of 'persuasive feeding' and 'reward for eating' also reported their child as well above the recently developed clinical cut-off for moderate and severe cases of fussy eating on the 'food fussiness' subscale (>3.00).[40] Severe fussy eating in preschool-aged children is a risk factor for future underweight and lower fat free mass.[8] Therefore, clinicians working with children reported to exhibit pronounced fussy eating should aim to include both mothers and fathers when planning and implementing interventions.

The current study presents implications for future research. In this cross-sectional sample, children were scored lower in 'food fussiness' when both mothers and fathers did not force or incentivize their child's intake of food. To build on these findings, longitudinal research design is recommended to examine the ongoing dynamics of parent feeding practices while tracking developmental trajectory of fussy eating. Qualitative studies could also assist the understanding of mechanisms underlying mothers' and fathers' use of non-responsive feeding practices. Together, such evidence could inform the development of interventions, inclusive of both mothers and fathers. Although the research community have

previously perceived fathers as challenging to engage in child health research, efforts to explicitly invite fathers to participate in research are required, regardless of socioeconomic status. Meaningful strategies to engage fathers in research such as those employed in the current study could promote uptake in child health interventions. Further exploring how economic constraints affect the food offered to fussy eaters using interview and observational methodologies presents another important direction for future research.

Strengths and Limitations

This study presents several strengths that advance understanding of family feeding dynamics. The sample of more than 200 families from a socioeconomically disadvantaged community exceeds that previously reported studies of fussy eating. Parental education was used as an indicator for level of advantage and is commonly used in child health research.[18,19] The current sample had a lower proportion of university educated parents (mothers: 33%; fathers: 23%) compared to 2016 Australian Bureau of Statistics data,[41] indicating 42% of females (aged 25-to 35-years old) and 33% of males (aged 35-to 44-years old) had completed a university degree, nationally. Our sample also represented a population experiencing more food insecurity compared to the national Australian population prevalence (8% vs. 5%).[32] However, only one aspect of food insecurity was measured via a single indicator item, and this is likely to underestimate food insecurity in households.[42] Independent reporting of both feeding practices and child fussiness by both mother and father strengthens the validity of reports compared with studies in which one parent reports on behalf of other family members.[35] Our method suggests that parents interpret their child's food refusal similarly, further supporting the reliability of the 'food fussiness' scale from the CEBQ.[9] We also adjusted for significant covariates in our analyses, such as parental destress and child age.

Some limitations must be considered in the interpretation of our findings. The cross-sectional design limits findings to association rather than causation or directionality between

variables. For the statistical tests, 'food fussiness' score was set as the dependent variable, while feeding clusters were set as the independent variable, simply to assist the interpretation of results. However, we acknowledge that child fussy eating may not necessarily be an outcome of feeding practices, and that this relationship is likely to be bidirectional.[15] The reporting of feeding practices and fussy eating are parent-reported and may be subject to social desirability bias, however responses were anonymous. Although parent reports may be driven by factors other than child behavior such as household stress or parent mental health, we attempted to control for potential confounders in the analyses. However, parents' role modelling of eating behaviors or food preferences were not measured and, therefore, not controlled in the analyses. An important limitation is the self-reported nature of weight and height for parents and their children. Adults have been shown to under-report their own weight and over-report height,[43] and parents have been shown to underreport their child's weight status.[44] Furthermore, a large proportion of child/parent height and/or weight values was missing. Inaccurate reporting of weight status may have attenuated associations in the analyses, and missing data may have reduced the statistical power in the analyses and introduced Type II errors. Therefore, we did not adjust for weight status in our analyses. The focus of the study is also limited to families with co-habiting parents. In the current study, we could not control for a child's exposure to alternative feeding practices outside of the family (e.g. child care educator, other carers). Although the feeding clusters derived from the *k-means* cluster analysis followed a general pattern of concordance and level of feeding practices between mothers and fathers relative to mean scores in the sample, two clusters did not strictly comply with this pattern. However, these differences were small and did not appear to have a significant impact on the results.

CONCLUSION

This study considered triadic feeding interactions between mother, father and child, and hence, extends the understanding beyond the commonly reported dyadic feeding and eating interactions. Although mothers and fathers perceived their child's fussy eating similarly, parents in this sample responded to or managed fussy eating using non-responsive feeding practices of differing levels of concordance. Parents who reported concordantly lower levels of pressuring and using food rewards to incentivize the child's eating also reported lower levels of child fussy eating. Future feeding interventions should include both mothers and fathers to promote concordant and positive feeding practices.

References

1. Nicklaus S, Boggio V, Chabanet C, et al. A prospective study of food variety seeking in childhood, adolescence and early adult life. *Appetite*. 2005;44(3):289-297.
2. Smith AD, Herle M, Fildes A, et al. Food fussiness and food neophobia share a common etiology in early childhood. *J Child Psychol Psychiatry*. 2017;58(2):189-196.
3. Cardona Cano S, Tiemeier H, Van Hoeken D, et al. Trajectories of picky eating during childhood: A general population study. *Int J Eat Disord*. 2015;48(6):570-579.
4. Dovey TM, Staples PA, Gibson EL, et al. Food neophobia and 'picky/fussy' eating in children: A review. *Appetite*. 2008;50(2-3):181-193.
5. Fildes A, van Jaarsveld CH, Cooke L, et al. Common genetic architecture underlying young children's food fussiness and liking for vegetables and fruit. *Am J Clin Nutr*. 2016;103(4):1099-1104.
6. Carruth BR, Skinner J, Houck K, et al. The phenomenon of “picky eater”: a behavioral marker in eating patterns of toddlers. *J Am Coll Nutr*. 1998;17(2):180-186.
7. Boeing H, Bechthold A, Bub A, et al. Critical review: vegetables and fruit in the prevention of chronic diseases. *Eur J Nutr*. 2012;51(6):637-663.
8. de Barse LM, Tiemeier H, Leermakers ET, et al. Longitudinal association between preschool fussy eating and body composition at 6 years of age: The Generation R Study. *Int J Behav Nutr Phys Act*. 2015;12(1):153.

9. Wardle J, Guthrie CA, Sanderson S, et al. Development of the Children's Eating Behaviour Questionnaire. *J Child Psychol Psychiatry*. 2001;42(7):963-970.
10. Birch LL, Fisher J, Grimm-Thomas K, et al. Confirmatory factor analysis of the Child Feeding Questionnaire: a measure of parental attitudes, beliefs and practices about child feeding and obesity proneness. *Appetite*. 2001;36(3):201-210.
11. Walton K, Kuczynski L, Haycraft E, et al. Time to re-think picky eating?: a relational approach to understanding picky eating. *Int J Behav Nutr Phys Act*. 2017;14(1):62.
12. Daniels LA, Mallan KM, Nicholson JM, et al. An Early Feeding Practices Intervention for Obesity Prevention. *Pediatrics*. 2015;136(1):e40-49.
13. Yuan WL, Rigal N, Monnery-Patris S, et al. Early determinants of food liking among 5y-old children: a longitudinal study from the EDEN mother-child cohort. *Int J Behav Nutr Phys Act*. 2016;13.
14. Hughes SO, Power TG, O'Connor TM, et al. Maternal Feeding Styles and Food Parenting Practices as Predictors of Longitudinal Changes in Weight Status in Hispanic Preschoolers from Low-Income Families. *J Obes*. 2016;2016:7201082.
15. Jansen PW, de Barse LM, Jaddoe VWV, et al. Bi-directional associations between child fussy eating and parents' pressure to eat: Who influences whom? *Physiol Behav*. 2017;176:101-106.
16. Harris HA, Fildes A, Mallan KM, et al. Maternal feeding practices and fussy eating in toddlerhood: a discordant twin analysis. *Int J Behav Nutr Phys Act*. 2016;13(1):81.

17. Finnane JM, Jansen E, Mallan KM, et al. Mealtime Structure and Responsive Feeding Practices Are Associated With Less Food Fussiness and More Food Enjoyment in Children. *J Nutr Educ Behav*. 2017;49(1):11-18 e11.
18. Francis LA, Hofer SM, Birch LL. Predictors of maternal child-feeding style: maternal and child characteristics. *Appetite*. 2001;37(3):231-243.
19. Musher-Eizenman D, de Lauzon-Guillain B, Holub SC, et al. Child and parent characteristics related to parental feeding practices. A cross-cultural examination in the US and France. *Appetite*. 2009;52(1):89-95.
20. Elias CV, Power TG, Beck AE, et al. Depressive Symptoms and Perceptions of Child Difficulty Are Associated with Less Responsive Feeding Behaviors in an Observational Study of Low-Income Mothers. *Childhood Obesity*. 2016;12(6):418-425.
21. Daniel C. Economic constraints on taste formation and the true cost of healthy eating. *Soc Sci Med*. 2016;148:34-41.
22. Wardle J, Herrera ML, Cooke L, et al. Modifying children's food preferences: the effects of exposure and reward on acceptance of an unfamiliar vegetable. *Eur J Clin Nutr*. 2003;57(2):341-348.
23. Khandpur N, Blaine RE, Fisher JO, et al. Fathers' child feeding practices: A review of the evidence. *Appetite*. 2014;78(0):110-121.
24. Minuchin S. Families & family therapy. Cambridge, MA: Harvard University Press; 1974.
25. Simons LG, Conger RD. Linking Mother-Father Differences in Parenting to a Typology of Family Parenting Styles and Adolescent Outcomes. *J Fam Issues*. 2007;28(2):212-241.

26. Graziano F, Bonino S, Cattelino E. Links between maternal and paternal support, depressive feelings and social and academic self-efficacy in adolescence. *Eur J Dev Psychol*. 2009;6(2):241-257.
27. Khandpur N, Charles J, Davison KK. Fathers' Perspectives on Coparenting in the Context of Child Feeding. *Child Obes*. 2016;12(6):455-462.
28. Jansen E, Williams KE, Mallan KM, et al. The Feeding Practices and Structure Questionnaire (FPSQ-28): A parsimonious version validated for longitudinal use from 2 to 5 years. *Appetite*. 2016;100:172-180.
29. AEDC. Australian Early Development Census Data Explorer. https://www.aedc.gov.au/data/data-explorer?id=42643. Published 2014. Accessed October 16, 2015.
30. Brinkman SA, Gialamas A, Rahman A, et al. Jurisdictional, socioeconomic and gender inequalities in child health and development: analysis of a national census of 5-year-olds in Australia. *BMJ open.* 2012;2(5):e001075.
31. Kessler RC, Barker PR, Colpe LJ, et al. Screening for serious mental illness in the general population. *Arch Gen Psychiatry*. 2003;60(2):184-189.
32. Australian Bureau of Statistics. Australian Health Survey: Nutrition-State and Territory Results, 2011- 12. http://www.abs.gov.au/websitedbs/censushome.nsf/home/seifa2011?opendocument&navpos=260. Published 2015. Accessed October 16, 2017.
33. Jansen E, Mallan KM, Daniels L. Extending the validity of the Feeding Practices and Structure Questionnaire. *Int J Behav Nutr Phys Act*. 2015;12(90).
34. Jansen E, Harris HA, Mallan K, et al. Measurement invariance of the Feeding Practices and Structure Questionnaire-28 among a community of

socioeconomically disadvantaged mothers and fathers. Appetite. 2018;120:115-122.

35. Schoeppe S, Trost SG. Maternal and paternal support for physical activity and healthy eating in preschool children: a cross-sectional study. *BMC Public Health*. 2015;15(1):971.
36. Galloway AT, Fiorito LM, Francis LA, et al. 'Finish your soup': Counterproductive effects of pressuring children to eat on intake and affect. *Appetite*. 2006;46(3):318-323.
37. Birch LL, Marlin DW, Rotter J. Eating as the "Means" Activity in a Contingency: Effects on Young Children's Food Preference. *Child Dev*. 1984;55(2):431-439.
38. Remington A, An E, Croker H, et al. Increasing food acceptance in the home setting: a randomized controlled trial of parent-administered taste exposure with incentives. *Am J Clin Nutr*. 2012;95(1):72-77.
39. Roberts L, Marx JM, Musher-Eizenman DR. Using food as a reward: An examination of parental reward practices. *Appetite*. 2017;120:318-326.
40. Steinsbekk S, Sveen TH, Fildes A, et al. Screening for pickiness–a validation study. *Int J Behav Nutr Phys Act*. 2017;14(1):2.
41. Australian Burea of Statistics. Education and Work, Australia, May 2016. Canberra 2016. http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/6227.0May%202016?OpenDocument Accessed August 8, 2017.
42. Nolan M, Rikard-Bell G, Mohsin M, et al. Food insecurity in three socially disadvantaged localities in Sydney, Australia. *Health Promot J Austr*. 2006;17(3):247-253.

43. Gorber SC, Tremblay M, Moher D, et al. A comparison of direct vs. self-report measures for assessing height, weight and body mass index: a systematic review. *Obes Rev*. 2007;8(4):307-326.
44. Lundahl A, Kidwell KM, Nelson TD. Parental underestimates of child weight: a meta-analysis. *Pediatrics*. 2014;133(3):e689-703.

Table 1. Socio-demographic characteristics and differences between mothers and fathers (N=416) and their children (N=208)

	Mothers N=208	**Fathers N=208**
Characteristics	**M (SD) or %**	
Age (years)	33.4 (5.3)	35.9 (6.6)***
BMI (kg/m^2) self-reported		
Healthy weight (BMI<25)	43.3	23.1
Overweight (25 ≤ BMI > 30)	22.1	40.9
Obese (BMI ≥ 30)	26.0	23.1***
University educated	33.2	22.6*
Relationship to child		
Biological parent	98.1	95.1
Step-parent/ partner	1.0	3.9
Adoptive parent	0	0.5
Grandparent	1.0	0.5
Born in Australia/NZ	78.8	82.2
English Language spoken at home	87.5	89.9
Identify as Aboriginal or Torres Strait Islander	4.8	3.8
Hours of paid work/ week	18.1 (17.0)	38.8 (16.3)***
Parent Distress[a]	19.7 (7.7)	17.1 (7.1)**
Number of meals eaten per week with child[b]	16.1 (5.0)	12.9 (4.7)***
	Children (N=208)	
Girls	50%	
Age (years)	3.6 (1.0)	
BMIz score	0.67 (1.33)	

*p<0.05; **p<0.01; ***p <0.001; M(SD)= Mean (Standard Deviation); BMI= Body Mass Index; NZ= New Zealand; [a]Summative score from Kessler-10[32] (possible range: 10 to 50); [b]Possible range: 0 to 21; Differences between mothers and fathers were compared using independent samples t-test for continuous variables and chi-square tests for categorical variables.

Table 2. Feeding practices[a] and child 'food fussiness'[b] Pearson correlations for mothers and fathers of children (mean age 3.6 years old)

	Composite child 'food fussiness' score[b]	
	Mothers (N=208)	Fathers (N=208)
Persuasive Feeding[a]	0.34**	0.33**
Reward for Eating[a]	0.33**	0.29**
Reward for behaviour[a]	0.11	0.15*

**p<.01. Subscales are from the [a]Feeding Practices and Structure Questionnaire-28[28]; [b]Composite child 'food fussiness' (average score of mother- and father-report) from the Children's Eating Behaviour Questionnaire[9]

Table 3. Final cluster centers and descriptive data for mother-father pairs' (N=208) feeding practices

	Cluster				M (SD)
Persuasive feeding[a]					
	M_{Lo}/F_{Lo} (*n*=19)	M_{Hi}/F_{Lo} (*n*=75)	M_{Lo}/F_{Hi} (*n*=51)	M_{Hi}/F_{Hi} (*n*=63)	
Mother	1.86	3.25	3.15	4.11	3.36 (0.73)
Father	1.98	2.95	3.78	4.07	3.41 (0.77)
Reward for Eating[a]					
	M_{Lo}/F_{Lo} (*n*=62)	M_{Hi}/F_{Lo} (*n*=72)	M_{Lo}/F_{Hi} (*n*=20)	M_{Hi}/F_{Hi} (*n*=54)	
Mother	1.54	2.92	2.16	3.80	2.66 (0.98)
Father	1.67	2.63	3.65	3.84	2.76 (0.99)
Reward for Behaviour[a]					
	M_{Lo}/F_{Lo} (*n*=61)	M_{Hi}/F_{Lo} (*n*=45)	M_{Lo}/F_{Hi} (*n*=78)	M_{Hi}/F_{Hi} (*n*=24)	
Mother	1.39	2.62	2.64	3.80	2.40 (0.86)*
Father	1.58	2.06	3.16	3.80	2.53 (0.94)*

*p <0.05 difference between mother-father (paired-samples t-test); M(SD)= Mean (Standard Deviation); Subscales from the Feeding Practices and Structure Questionnaire-28[28]; Clusters derived from *k-means* cluster analysis where M_{Lo}/F_{Lo}=mother and father lower than sample mean; M_{Hi}/F_{Lo}=mother higher than and father lower than sample mean; M_{Lo}/F_{Hi}= mother lower than and father higher than sample mean; M_{Hi}/F_{Hi}=mother and father higher than sample mean

Figure 1. Composite 'food fussiness' M(SE) scores reported by mother-father feeding clusters (N=208, children mean age 3.6 years old)

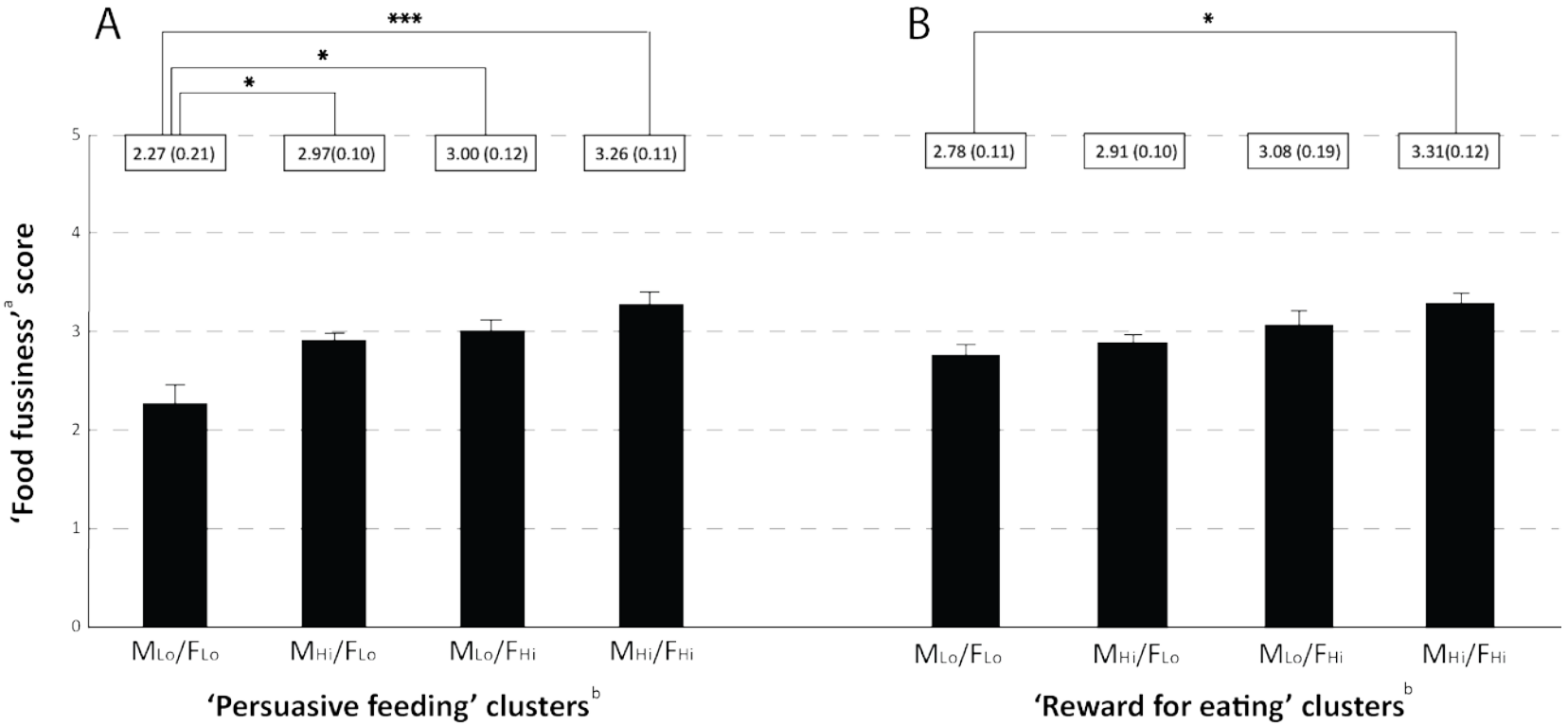

Figure legend: **p*<.05; ***p*<.01; ****p*<.001 for ANCOVA models, both A and B models control for parent distress and child age; M(SE)= Mean (Standard Error); [a]Composite child 'food fussiness' (average score of mother- and father-report); subscale from the Children's Eating

Behaviour Questionnaire[9]; [b]'Persuasive feeding' and 'Reward for eating' is derived from the Feeding Practices and Structure Questionnaire-28[28]; Clusters derived from *k-means* cluster analysis where M_{Lo}/F_{Lo}=mother and father lower than sample mean; M_{Hi}/F_{Lo}=mother higher than and father lower than sample mean; M_{Lo}/F_{Hi}= mother lower than and father higher than sample mean; M_{Hi}/F_{Hi}=mother and father higher than sample mean.