Strategies to Increase Vegetable Intake in the Early Years

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The candidate confirms that the work submitted is her own, except where work which has formed part of jointly authored publications has been included. The contribution of the candidate and the other authors to this work has been explicitly indicated below. The candidate confirms that appropriate credit has been given within the thesis where reference has been q2made to the work of others.

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Dedicated to Our Wonderful Parents

Nita Mahesh Shah

Mahesh Natvarlal Shah

&

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Abstract

Vegetables consumed regularly and in variety as part of a balanced diet are known to protect against non-communicable diseases. However, children across Europe fail to meet recommended intakes. Therefore, effective interventions for encouraging vegetable intake are needed for preschool children. The present thesis adopted a mixed methods design to investigate strategies to increase vegetable intake in children aged 2-5 years, who are at the peak of food fussiness. A systematic review synthesised evidence from the existing literature using meta-analyses and found that repeated taste exposure was the most effective strategy for promoting vegetable intake compared to other interventions. Study 1 investigated effects of taste exposure and nutrition education delivered separately or in combination, which showed that taste exposure significantly increased intake of an unfamiliar vegetable. Study 2 tested the effects of reading a storybook about vegetables and sensory play on intake of a novel vegetable, finding that learning and play are essential for recognition and intake, with sensory play also promoting willingness to taste. Study 3 used semi-structured interviews to explore parental perspectives on vegetable strategies. This indicated that parents use a range of strategies with children, yet their success varies. This study raised concerns of ecological validity in methods tested by scientific studies in comparison to how they are implemented in homes. The present thesis provides evidence for implementing strategies which increase familiarity and learned safety with vegetables, in particular taste exposure. Repeated multisensory learning, including tasting should be incorporated into nutrition education programmes to enhance vegetable consumption. Encouraging preschool children to eat more vegetables in balance with other foods provides protective health benefits for a lifetime. By making a commitment to prioritise greater vegetable intakes, parents and caregivers can apply known, successful strategies, suited to their specific child, to increase familiarity and intake of vegetables in the child's diet.

List of Abbreviations

ADJ: Adjusted

ANOVA: Analysis of Variance

ANCOVA: Analysis of Covariance

BMI: Body Mass Index

BMIz: Weight for height (adjusted for age and sex) Body Mass Index z-scores

CDC: Centers for Disease Control and Prevention

CEBQ: Child Eating Behaviour Questionnaire

CENTRAL: Cochrane Central Register of Controlled Trials

CI: Confidence Interval

CINAHL: Cumulative Index of Nursing and Allied Health Literature

CONSORT: Consolidated Standards of Reporting Trials

EPHPP: Effective Public Health Practice Project

EPIC: European Prospective Investigation of Cancer

ERIC: Educational Resource Information Centre Database

FF: Food Fussiness

FFL: Flavour-Flavour Learning

FFQ: Food Frequency Questionnaire

FN: Food Neophobia

FNL: Flavour-Nutrient Learning

FU: Follow-up

G: Hedges g

HSE: Health Survey for England

I2: Inconsistency

ICC: Intra cluster correlation

NCMP: National Child Measurement Programme

PFP: PhunkyFoods Programme

PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-analyses,

RCT: randomised control trial

RE: Repeated Exposure

SEM: Standard Error of Mean

SPSS: Statistical Package for the Social Sciences

SR: Systematic Review

SRQR: Standards for Reporting Qualitative Research

WHO: World Health Organisation

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General Introduction

Chapter 1
Developing healthy food preferences in the early years: a review of literature

The overall aim of this thesis was to enhance our understanding of the best ways to encourage young children to eat vegetables. To achieve this aim, studies were conducted to investigate the efficacy of different strategies for promoting vegetable intake in preschool children. The thesis has adopted a mixed methods approach, as using both quantitative and qualitative methods enhance understanding more than using a single research method (Creswell & Plano-Clark, 2010). This introductory chapter begins by providing background to the importance of increasing vegetable consumption, why this is particularly the case for preschool children, it then highlights some of the strategies used in the target age group (2-5 years) and identifies relevant theoretical frameworks for understanding vegetable consumption in the early years. Finally, the objectives of the overall thesis and how these have been addressed in the subsequent Chapters are outlined.

1.1 Why is eating vegetables important?

Eating a well-balanced diet high in plant-based foods can significantly reduce the risk of various non-communicable diseases such cardiovascular diseases, colorectal cancer, stomach cancer, stroke, diabetes, obesity and, therefore, overall mortality (Aune, Giovannucci, et al., 2017; Boeing, Bechthold, et al., 2012; Hartley, Igbinedion, et al., 2013; Lee, Shin, Oh, & Kim, 2017; Wang, Ouyang, et al., 2014; WHO, 2014). The World Health Organization suggests that adults should consume 400g or more of fruit and vegetables per day to improve overall health. Current recommendations for adults vary between countries from 400g to 800g (Aune, et al., 2017; WHO, 2011). In the UK, recommendations for preschool children include eating a variety and a minimum of five 40g portions (200g: 5-a-day) of fruit and vegetables a day (First Steps Nutrition Trust, 2016; NHS, 2015). This includes fresh, frozen, dried, canned and 100% juices. Although, fruits and vegetables share some antioxidants, bioactive compounds, and phytochemicals and so offer similar health benefits (Liu, 2013; Slavin & Lloyd, 2012), it is argued that vegetables may be more beneficial than fruits. This is because most vegetables are rich in dietary fibre and low in sugar, sodium, fat, cholesterol and energy density (Liu, 2013; Slavin & Lloyd, 2012). For example, eating high fibre foods helps to improve gut health, bowel function and to reduce the risk of cardiovascular disease (Slavin, 2013).

Certain vegetables such as green leafy vegetables are thought to play an important role in reducing risk of type 2 diabetes and cardiovascular disease (Blekkenhorst, Sim, et al., 2018; Carter, Gray, Troughton, Khunti, & Davies, 2010). Large scale, population-based studies indicate that eating vegetables confers a protective effect with each daily portion consumed reducing the probability of death by 16%, compared to 4% for fruits (Oyebode, Gordon-Dseagu, Walker, & Mindell, 2014). Evidence from research with older adults suggests that increased intake of vegetables can slow the rates of cognitive decline and reduce the risk of dementia (Loef & Walach, 2012; Morris, Evans, Tangney, Bienias, & Wilson, 2006).

Despite the known benefits of eating vegetables from epidemiological research, increasing their intake remains more challenging than increasing fruit intake. For example, a systematic research review with meta-analysis by Evans, Christian, Cleghorn, Greenwood, and Cade (2012) reported that school-based interventions improved fruit intake but that the impact on vegetable intake was negligible. Also, vegetables taste very different to fruits and may need more preparation time because they tend to be cooked (Appleton, Hemingway, et al., 2016). This suggests that different strategies may be necessary for promoting the intake of fruits and vegetables. With all these factors in mind, the present thesis focussed on increasing consumption of vegetables only.

1.2 Why is developing food preferences early important?

Early childhood is a period of rapid growth and an important phase for developing eating habits because the dietary behaviours acquired during the early years of life can extend to adulthood (De Cosmi, Scaglioni, & Agostoni, 2017; Harris, 2008; Ventura & Worobey, 2013). Children learn about their food likes and dislikes by direct contact with foods, such as through tasting, feeling, seeing, smelling and by observing their food environment, including the eating behaviours of others (Johnson, 2016; Nicklaus, 2016; Sandell, Mikkelsen, et al., 2016). Therefore, it is crucial that children are exposed to a varied food experience and a positive food environment from early childhood.

The significant rise in children with obesity (BMI ≥ 95th percentile) by the time they start primary school is of public health concern (de Onis, Blossner, & Borghi, 2010). In the Government's National Child Measurement Programme (NCMP) for England, 2017-18, among children in the reception class (aged 4-5 years) prevalence of overweight was 12.8% and prevalence of obesity was 9.5% (NCMP, 2019). Similar figures are also reported in the US, where the 2013-2014 National Health and

Nutrition Examination Survey indicated that among children and adolescents aged 2-19 years overweight is 16% and obesity is 17%, (Fryar, Carroll, & Ogden, 2016). Preventing obesity, and its associated comorbidities, is a clear priority for an individual's health and wellbeing (Pantalone, Hobbs, et al., 2017), hence children need to be encouraged to eat better and keep active. Eating foods low in energy density and high in nutrient content such as vegetables may help to prevent excess weight gain and improve health. Thus, it is important that children learn to make healthy food choices in the early years and learn to eat nutrient-dense foods such as vegetables.

1.2.1 Why vegetable consumption in preschool children?

Only one in five children are reported to meet their 5-a-day intake of fruit and vegetables, hence most children in the US and Europe, including the UK eat less than recommended (CDC, 2015; HSE, 2017; Kim, Moore, et al., 2014; Lynch, Kristjansdottir, et al., 2014). Research among 3 to 4 year old children using the validated Child and Diet Evaluation Tool (CADET) diary reported that only 16% of children in their sample (n = 207) ate the recommended 5-a-day and 14% had eaten no fruits or vegetables on the test day (Cockroft, Durkin, Masding, & Cade, 2005). It is thought that increasing intake of vegetables remains challenging due to their bitter taste, unfamiliar texture and low energy density. For example, according to the Vital Signs report, fruit intake had increased from 2003 to 2010 among 2 to 18 year olds, but vegetable intake did not change during this same period (Kim, et al., 2014). Similar trends have also been reported in the USA-Feeding Infants and Toddlers study (FITS), in which positive changes for fruit intakes have been noted but consumption of vegetables was shown to be inadequate. The study highlighted that among those children who did consume some vegetables there was a clear lack of variety, reducing the opportunity for children to experience different tastes, flavours, textures, colours and sounds (Dietz, Roess, et al., 2018; Dwyer, 2018).

Research suggests that when children are ready to receive their first solid foods (at around six months of age), this is an opportune period for introducing new flavours and textures due to a willingness to eat new foods including vegetables (Birch, McPhee, Shoba, Pirok, & Steinberg, 1987; Mennella, Nicklaus, Jagolino, & Yourshaw, 2008; Mennella & Trabulsi, 2012). However, after this stage, around the age of 2 years children begin to seek autonomy over their food choices and are also likely to go through phases of food neophobia and food fussiness. Thus, they are more selective about what they eat. In particular, children are less likely to eat

vegetables (Cooke, Haworth, & Wardle, 2007; Dovey, Staples, Gibson, & Halford, 2008; Lafraire, Rioux, Giboreau, & Picard, 2016; Walton, Kuczynski, Haycraft, Breen, & Haines, 2017).

1.3 An ecological model for childhood dietary intake

The focus of the present thesis is to investigate strategies that promote vegetable intake. However, it is also important to have some contextual understanding of other influential factors which may help to shape children's dietary intake, including vegetables. Some of these influential factors will be considered briefly in this section before moving onto specific vegetable promoting strategies in preschool children. According to the Ecological Systems Theory, human behaviour is dependent on the interaction between personal characteristics such as genetics and age, and the environment in which the child is situated, such as their family, school and larger social contexts, e.g. community (Bronfenbrenner, 1986). The ecological model proposed predicting child dietary intake by Davison and Birch (2001) is divided into three layers progressing from inherent to external influences on intake: the inner layer of child's characteristics; the middle layer of parenting styles and family characteristics and in the outer layer there are community, demographic and societal factors (Figure 1.1)

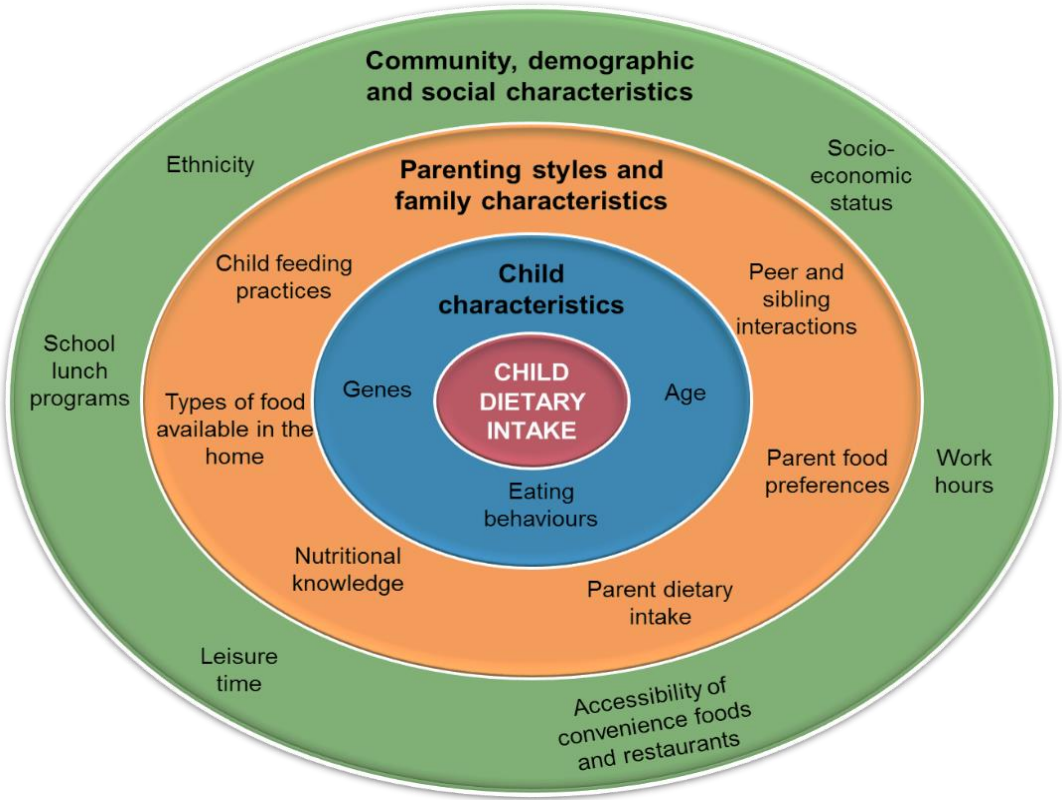

Figure 1.1 Ecological model of predictors of childhood dietary intake, adapted from Davison and Birch (2001)

1.3.1 Genetic influence

As shown in the ecological model, genetic influences are important in shaping children's food preferences and eating behaviours. Research with the Gemini cohort of twins born in 2007 (2402 families) demonstrated that genetic influence accounted for 54% of vegetable preferences (Fildes, van Jaarsveld, et al., 2014). Similar findings have also been reported from a different twin sample which estimated 37% heritability for vegetable preferences (Breen, Plomin, & Wardle, 2006). Twin studies generally compare resemblances of monozygotic twin pairs who share 100% of their genes with dizygotic twin pairs sharing 50% of their genes (Fildes, van Jaarsveld, Llewellyn, et al., 2014) to determine and understand the influence of gene-environment interactions on food preferences. Interestingly both studies also found that influences may vary by types of foods, for example genetic factors dominated more nutrient-dense foods such as fruits, vegetables and protein, whereas stronger shared environmental effects were observed for energy-dense foods such as snacks and desserts. Heritability factors are also known to play an important role in eating behaviour. Thus, although genetics play a significant role in determining food preferences, the environment in which these genes are expressed is also important in determining what preferences emerge and are maintained.

1.3.2 Child eating behaviours, food fussiness and food neophobia

Children's eating behaviours also depend on food type, thus, high levels of food avoidance behaviours such as food fussiness and food neophobia are shown towards vegetables (Dovey, et al., 2008; Howard, Mallan, Byrne, Magarey, & Daniels, 2012). Food fussiness is defined as selective food intake involving rejection of foods which are familiar as well as those which are unfamiliar, whereas food neophobia is specific to avoidance of new foods (Dovey, et al., 2008). Food fussiness is typically measured using the Food Fussiness subscale of the Child Eating Behaviour Questionnaire (Wardle, Guthrie, Sanderson, & Rapoport, 2001) and food neophobia is often assessed using the Child Food Neophobia Scale (Pliner, 1994). These psychometric tools are reported to be reliable and valid however, they tend to overlap in constructs which can be problematic when used together. Both eating behaviours can have an adverse effect on healthy eating, since by selecting only preferred familiar foods, children may limit the quality and variety of their diet, especially eating too few vegetables (Cooke, Carnell, & Wardle, 2006; Dovey, et al., 2008). Food fussiness and food neophobia are highly correlated (with r values around 0.7) and they both share common aetiology in early

childhood, which can be explained by heritability and shared environment factors, such as the home environment (Smith, Herle, et al., 2017).

Food avoidance behaviours have been associated with low intake of fruits and vegetables (Cooke, et al., 2006; Holley, Haycraft, & Farrow, 2017). Fildes, van Jaarsveld, Cooke, Wardle, and Llewellyn (2016) found that genes common to food fussiness also influence the intake of fruits and vegetables. It is understood that rejection of certain foods such as bitter vegetables and development of food avoidance behaviours are a consequence of natural evolutionary processes in which children's instinctive behaviour is to avoid potentially harmful substances (Dazeley & Houston-Price, 2015; Rozin & Vollmecke, 1986). Thus, for children to include bitter, green leafy vegetables in their diet is challenging since bitterness in nature can signal danger, such as toxic content. Food fussiness and food neophobia are known to peak between the ages 2-5 years, however children in this age group are also open to acquiring new food preferences. Therefore, encouraging children to try different vegetables using taste exposure and experiential learning strategies in a positive and supportive environment may promote familiarisation and liking of unfamiliar foods, and over time this may reduce food avoidance behaviours (Park & Cho, 2016a; Ventura & Worobey, 2013).

1.3.3 Flavour exposure *in utero*, during lactation and via complementary foods

Research has demonstrated that exposing children to flavours (including vegetable flavours) through amniotic fluid and later through breast milk can increase children's preference for the exposed flavour in early life (Mennella, 1995; Mennella & Beauchamp, 1991a, 1991b, 1993, 1999; Mennella, Jagnow, & Beauchamp, 2001; Mennella, Johnson, & Beauchamp, 1995). For example. Mennella, et al. (2001) conducted a study with pregnant women who were planning to breastfeed their infants. They were randomly allocated to one of three groups; 1) carrot juice consumed during the last trimester but only water during lactation 2) water consumed during pregnancy but carrot juice during lactation, and 3) water consumed both during pregnancy and lactation (control). Infants were then tested during the weaning stage for their preference for carrot. It was found that infants who were exposed to carrot flavour prenatally or during lactation exhibited fewer negative facial expressions when they were fed carrot-flavour cereal compared to plain cereal. Also, ratings of enjoyment were higher for carrot-flavoured than plain cereal in the infants who had experienced carrot either *in utero* or via breastmilk.

Despite these differences in subjective ratings no significant effect of exposure on intake was observed.

In a longitudinal study, children who were exclusively breastfed for three or more months had higher odds of consuming two or more vegetables at four years of age in comparison to children who were formula fed or partially breastfed (Burnier, Dubois, & Girard, 2010). As demonstrated by Mennella, et al. (2001) early flavour exposure gained through breastmilk encouraged greater acceptance of a wider variety of foods during the weaning period and throughout childhood. Hence infants of mothers who eat a variety of foods, including vegetables during breastfeeding will expose their infant to a diversity of flavours which are absent in formula milk. Also breastfeeding may promote responsive feeding. Hence mothers who breastfeed their child are more likely to adopt feeding strategies which are less controlling and more responsive (Burnier, et al., 2010) and these feeding practices are associated with children adopting healthier food choices (Fisher, Birch, Smiciklas-Wright, & Picciano, 2000).

As well as breastfeeding infants, introducing vegetables as first foods during complementary feeding can also encourage children to eat more vegetables in the short term (Barends, de Vries, Mojet, & de Graaf, 2013; Barends, de Vries, Mojet, & de Graaf, 2014; Chambers, Hetherington, et al., 2016; Hetherington, Schwartz, et al., 2015). For example, a study by Barends, et al. (2014) found that children given vegetables as their first food in comparison to children receiving fruit as their first food had 38% higher daily vegetable intake at 12 months of age. This suggests benefits of a vegetable first approach to complementary feeding. However, by 23 months of age, these differences were not sustained. Therefore, longer term studies are needed to establish the duration of the vegetable first approach and what is needed to sustain these effects in the long term.

1.3.4 Parental feeding strategies

Shaping children's eating environments is also important in establishing eating habits in children. For example, making healthy foods available at home, and parental feeding practices which promote healthy food preferences and eating behaviours (Birch, Savage, & Ventura, 2007). The role of parenting in general has been regarded as highly influential and early work by Baumrind (1978) and further extended by Maccoby and Martin (1983) has been pivotal in this area. General parenting is characterised as encompassing two central features - demandingness and responsiveness. These then vary by intensity and so four types of parenting

styles have been generated: 1) the authoritative style is characterised by high demandingness and monitoring, and high responsiveness 2) the authoritarian style is characterised by high demandingness and monitoring but low responsiveness and warmth, 3) The indulgent/ permissive style is characterised by warmth but lacks monitoring and control and 4) the uninvolved style is characterised by little control, low monitoring and little involvement with the child (Hughes, Power, Orlet Fisher, Mueller, & Nicklas, 2005; Shloim, Edelson, Martin, & Hetherington, 2015). See Figure 1.2 for examples of what parents within each parenting style may do in order to get their child to eat vegetables (adapted from Shloim, et al., 2015).

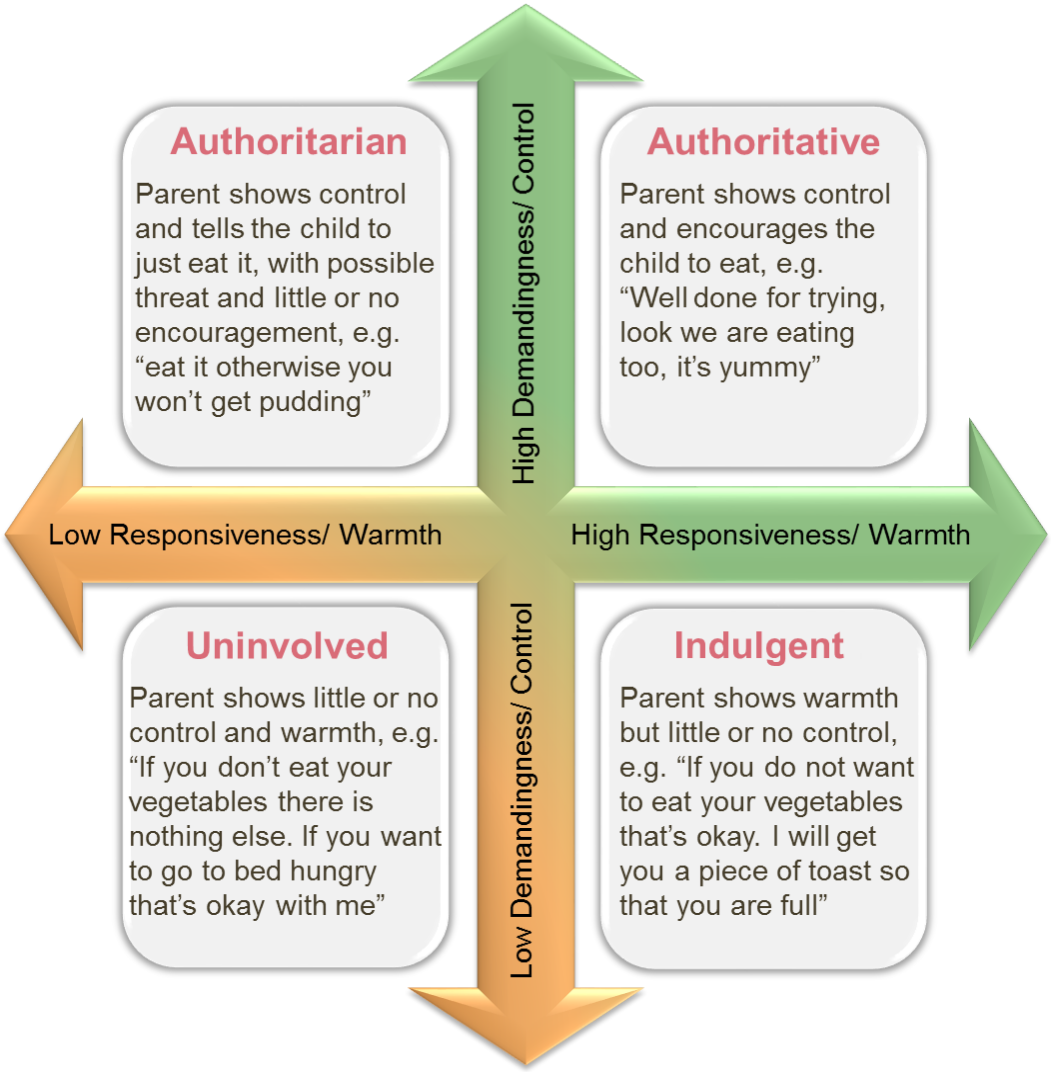

Figure 1.2 Parenting styles with notional examples of how this may lead to feeding practices related to vegetable consumption

The specific role of parenting style, feeding style and feeding practices for increasing children's vegetable consumption has been investigated. For example, instrumental feeding (i.e. rewarding or punishing child using food incentives for

desirable behaviours) is related to an indulgent feeding style and associated with low consumption of vegetables (Inhulsen, Merelle, & Renders, 2017). Similarly, an authoritarian feeding style by being demanding but showing low responsiveness has also been associated with low consumption of vegetables (Scaglioni, De Cosmi, et al., 2018). Whereas parents who employ an authoritative feeding style applying both a level of control as well as encouragement and involving children were more likely to be successful in getting their children to eat vegetables (Shim, Kim, et al., 2016)

The relationship between parental feeding style and children's eating behaviour is bidirectional (Farrow, Galloway, & Fraser, 2009). Therefore, the ways in which parents employ different feeding practices may be in direct response to their child's eating traits. For example, parents of fussy eaters may apply authoritarian practices including pressuring their child to eat or they may use instrumental feeding since they are concerned that their child is eating a rather bland or unhealthy diet. However, there is lack of longitudinal evidence to disentangle the reciprocity between fussy eating and feeding practices (Harris, Fildes, Mallan, & Llewellyn, 2016).

1.3.5 Socio-economic status and home food environment

According to the ecological model (Birch and Davidson, 2001) the wider context of the child's eating environment is an important determinant of dietary choice and intake. A review by Rasmussen, Krolner, et al. (2006) highlighted that both socio-economic status, availability and accessibility of fruits and vegetables at home were important determinants for children's fruit and vegetable consumption. For example, they reported that low socio-economic status was associated with low and less frequent intake of both fruit and vegetables and this may be related to availability of these foods in the household. Their review suggested that when fruits and vegetable were reported to be available at home by children and adolescents aged 6-18 years, their intake of these foods was greater than those who reported did not have access to these food in home.

1.4 Strategies for increasing vegetable intake in preschool children

Given that the intake of vegetables is set within the wider context of maternal diet during breastfeeding, child eating traits, parenting styles, feeding practices and the general home environment, it is clear that efforts to increase vegetable preference

and consumption are likely to be most effective in early life. Several behavioural techniques have been developed and trialled in order to intervene during early development to facilitate exposure, familiarisation and subsequently preferences for and intake of vegetables. Below, these different techniques are reviewed specifically with a focus on the early years of life.

1.4.1 Repeated taste exposure interventions

Beyond the exposure to some flavours *in utero* and through breastfeeding, solid food introduction begins the child's journey to their new taste world and involves more than just taste since children see, smell, and experience texture of foods. For convenience, the field tends to refer to this journey mainly with reference to taste and so below the term "taste exposure" is used throughout but encapsulate all aspects of the food experience.

For direct and overall sensory experience of vegetables it is important that children chew and swallow these nutrient dense foods. A study by Zeinstra, et al. (2007) found that children aged 4-5 years were able to distinguish between likes and dislikes but were not able to differentiate the specific tastes (e.g. salty, sour, bitter) of food. Their study concluded that for children aged 4-5 years the appearance and textures (including feeling in the mouth) of food were most important for determining liking and disliking. Hence, for younger children the 'mouth feel' factors (feeling of textures in the mouth e.g. soggy, crunchy, creamy sensation) are important for food intake and may influence expression of neophobia when feeding children foods with complex or multiple textures (Rose, Laing, Oram & Hutchinson, 2004; Werthmann. Jansen, Havermans, et al., 2005). Children who are food fussy or food neophobic are likely to be hypersensitive to textures (Harris and Coulthard, 2016). It is known that children typically prefer smooth foods compared to foods with 'bits' in them and unless vegetables are pureed they tend to have more complex textures; for example, tomatoes have firm skin, pulp and seeds (Harris and Coulthard, 2016). Thus, exposing children to a variety of tastes and textures may reduce their likelihood of food neophobia.

Studies of complementary feeding identify early flavour exposure to vegetables as an important strategy during the weaning stage (around 6 months) to encourage acceptance (Barends, et al., 2013; Hetherington, et al., 2015; Remy, Issanchou, Chabanet, & Nicklaus, 2013). However, taste perception and evaluation may lead to food refusal in some children including rejection of vegetables (Gibson, Wardle,

& Watts, 1998). Hence, interventions which focus on the taste element of the foods are necessary but risky (since children may reject on the basis of unfamiliarity or disliked tastes). The repeated taste exposure strategy in which children are offered the same foods frequently is reported to be the most effective way of promoting intake of unfamiliar vegetables in children (Ahern, Caton, Blundell, & Hetherington, 2014; Caton, Blundell, et al., 2014; Hausner, Olsen, & Moller, 2012; Holley, Farrow, & Haycraft, 2017b). The mechanism which may facilitate this strategy is through familiarization (Zanjonc, 1968) and learned safety (Kalat & Rozin, 1973). According to the mere exposure theory a single exposure (with no negative consequence) is enough to produce a positive attitude towards a stimulus, thus repeated taste exposure interventions promote positive acceptance over time (Rioux, Lafraire, & Picard, 2018; Zanjonc, 1968).

Studies have demonstrated that children increase their intake of vegetables after five taste exposures, although on average children will generally require between eight to ten taste exposures at a regular interval, e.g. once a week, (Birch, et al., 1987; Caton, Ahern, et al., 2013; de Wild, de Graaf, & Jager, 2017; Hausner, et al., 2012; Remington, Aññez, Croker, Wardle, & Cooke, 2012). The required number of exposures is often not achieved by the caregiver because they may interpret their child's facial expression in response to new foods as dislike or disgust and are unwilling to continue offering the same food (Carruth, Ziegler, Gordon, & Barr, 2004; Cooke, et al., 2007; Cooke, Wardle, et al., 2004).

Several studies have been conducted by combining the repeated exposure strategy with other vegetable promoting strategies (some of these strategies and their findings are further discussed under relevant sections). For example, repeated exposure has been paired with non-food rewards, such as rewarding children with stickers or praise for tasting the target vegetables (Fildes, van Jaarsveld, Wardle, & Cooke, 2014b; Horne, Greenhalgh, et al., 2011; Remington, et al., 2012). A study of reward and taste exposure by Fildes, van Jaarsveld, et al. (2014b) found that daily parental administration of a single small piece of a disliked vegetable, with a sticker after the child had tried the food, was sufficient to increase the intake of a target vegetable in the home setting. Combining exposure with strategies such as rewards and modelling have long-lasting effects, up to six months post intervention (Cooke, Chambers, et al., 2011; Horne, et al., 2011). Additionally, Horne, et al. (2011) found that once liking for the target foods was established during snack time, the effects generalised to lunchtime in complete absence of the previously offered reward (a

small toy). This shows that continuation of offering rewards may not be necessary after the children have learned to like and accept the vegetables. However, it should be noted that the study by Horne, et al. (2011) only included 20 children in their study, and therefore a larger sample size is needed to confirm these results.

Studies have also combined the repeated exposure technique with modelling; where children are encouraged to learn to eat vegetables by observing the eating behaviour of others, e.g. their parents or peers (Horne, et al., 2011; Remington, et al., 2012). Other strategies combined with taste exposure include flavour-flavour learning (FFL) and flavour-nutrient learning (Ahern, Caton, Blundell, & Hetherington, 2013; Ahern, et al., 2014; de Wild, de Graaf, & Jager, 2013). Most studies incorporating these associative learning methods (FFL and FNL) have found that mere exposure to the target vegetable alone is sufficient to increase the intake of the target vegetables, and adding flavours or nutrients generally provided no additional advantage (Ahern, Caton, Blundell, et al., 2013; Bouhlal, Issanchou, Chabanet, & Nicklaus, 2014; Caton, et al., 2013; de Wild, et al., 2013; Hausner, et al., 2012). These findings are discussed further in section 1.4.6.

While taste exposure strategies are robust in promoting vegetable intake in children, this is not the only way to increase the familiarity of the vegetable in children. Using other sensory modalities such as hearing (the name of the food or sound it makes while chewing), sight (seeing the food), touch (feeling the texture in hands/ mouth) and smell of the food (Dazeley & Houston-Price, 2015) are also important components within the learning experience.

1.4.2 Non-taste sensory learning interventions; sound, sight, touch and smell

Contemporary research with preschool children demonstrates the importance of sensory elements to familiarise children with fruits and vegetables (Coulthard & Ahmed, 2017; Coulthard & Sealy, 2017; Dazeley, Houston-Price, & Hill, 2012). Methods such as listening, seeing, touching and smelling may be very useful for young children, especially fussy eaters as selective eating in preschool children has been associated with hypersensitivity to food stimuli (Coulthard & Sealy, 2017; Dazeley & Houston-Price, 2015; Zucker, Copeland, et al., 2015). For example, food neophobic children and fussy eaters often reject vegetables based on their visual appearance or texture (Coulthard & Sealy, 2017; Coulthard & Thakker, 2015; Dovey, et al., 2008; Rioux, et al., 2018; van der Horst, Deming, Lesniauskas, Carr,

& Reidy, 2016). Hence interventions incorporating visual exposure including picture books and tactile-play activities may particularly benefit these children more than taste exposure alone.

1.4.2.1 Visual exposure and storybook (sound and sight)

Listening to stories and looking at pictures are activities which are regularly enjoyed by preschool children. Storybooks are generally engaging and interaction with the parent or caregiver during story time provides an opportunity for children to acquire new knowledge (Horst & Houston-Price, 2015). The illustrations in storybooks help children to better recall stories and being repeatedly exposed to pictures of foods increases children's visual familiarity with the foods (Greenhoot, Beyer, & Curtis, 2014; Heath, Houston-Price, & Kennedy, 2014). Research on visual exposure using picture books has had mixed results in terms of its effectiveness in increasing acceptance of vegetables (de Droog, Buijzen, & Valkenburg, 2014; Heath, Houston-Price, & Kennedy, 2011; Heath, et al., 2014; Houston-Price, Butler, & Shiba, 2009; Osborne & Forestell, 2012). For example Heath, et al. (2014) reported that toddlers aged 19-26 months who were exposed to a storybook every day for two weeks consumed more of the unfamiliar vegetable that had featured in the book compared to an unexposed control vegetable. The picture book exposure not only increased the intake of the unfamiliar vegetable, but it also reduced the level of encouragement needed for the children to taste the target foods. Similarly, de Droog, et al. (2014) reported a positive effect of exposure to an illustrated storybook (which included an embedded health message) on intake of a familiar vegetable. They further added that picture books are particularly effective when the children are actively involved (e.g. when asked questions about the story). Children aged 4-6 years increased their intake of carrots after being exposed to the vegetable in a picture book. The study also found that eating more carrots displaced consumption of cheese (high energy density food) within a snack.

In contrast, a study with 4-8 year old children found that engaging children with real vegetables produced greater effects on tasting vegetables (fresh soya bean) than visual exposure using photographs (Coulthard & Ahmed, 2017). This study shows that direct experience with target vegetables is very important for increasing intake of the vegetables, at least in the older children. However, the study did not include a control group which received no intervention.

Outcomes of visual exposure research with very young children (around age 2 years) have been successful for increasing vegetable intake and in preschool,

visual exposure has been embedded as part of multisensory learning interventions (Coulthard & Ahmed, 2017; Coulthard, Palfreyman, & Morizet, 2016; Coulthard & Sealy, 2017; Coulthard & Thakker, 2015; Coulthard, Williamson, Palfreyman, & Lyttle, 2017; Nederkoorn, Jansen, & Havermans, 2015).

1.4.2.2 Role of olfaction (smell) in food intake

Olfaction plays an important role in sensing of foods; the smell of the food contributes to overall flavour experience, and can influence the desire to consume a particular food (Boesveldt & de Graaf, 2017). However, the influence of odour alone on less palatable/ less pungent foods such as raw vegetables is understudied and warrants further investigation. It should be noted that the outcome of olfactory activities may depend on an individual's awareness, and their ability to smell, both of which can vary by age (Monnery-Patris, Wagner, et al., 2015; Wagner, Issanchou, et al., 2014). Although there are no studies implementing olfactory experience alone for vegetable intake in children, there is emerging evidence for its use in multisensory interventions (Dazeley & Houston-Price, 2015).

1.4.2.3 Multisensory learning interventions (sound, sight, touch and smell)

Investigations of multisensory learning (using sight, sound, touch, smell and excluding taste) as a way of familiarising children to new foods, reveal that this produces an increased willingness to try vegetables. For example, a study in children aged 12-36 months found that familiarising children to unfamiliar fruits and vegetables by looking, listening, feeling and smelling them during playtime for 4 weeks, increased their willingness to touch and taste these foods during lunch time (Dazeley & Houston-Price, 2015). Similarly, Coulthard and Sealy (2017) found that a single session of sensory play with fruit and vegetables was enough to encourage children to try more of the study foods than those who only observed the fruit and vegetable sensory play session or received non-food sensory learning, demonstrating the importance of children actively touching and feeling the foods. However, willingness to try was assessed using binary scores (0/1), depending on whether the children placed the test foods it in their mouth or not, regardless of swallowing the test food. Hence, the effect of this type of intervention on actual intake beyond tasting is unknown. Also, this study only examined familiar vegetables (i.e. carrots, cucumber and tomatoes (see, Ahern, Caton, et al., 2013), thus, these findings may not generalise to unfamiliar vegetables.

Exposure to the sensory properties of food during tactile-play may particularly benefit children who are food neophobic, going through a period of fussy eating or

who are simply unwilling to taste new/ disliked foods (Coulthard & Sealy, 2017; Coulthard & Thakker, 2015; Dazeley, et al., 2012; Nederkoorn, et al., 2015). However, these suggestions are only based on correlations observed between food avoidance behaviours, sensory learning and vegetable intake and so warrants further investigation. In particular, it is important to consider how children who are food fussy or neophobic and more sensitive to touch engage with these types of activities. Sensory activities with food involving listening, seeing, smelling, touching, and tasting can be encouraged from a very young age. See Figure 1.3 for simple techniques which can be used when introducing new foods to young children.

The main advantage of using non-taste sensory learning is that it can be implemented during the usual mealtimes or outside of the meal context; e.g. during cooking, gardening and nutrition education sessions. Incorporating these activities outside of the meal context may alleviate the stress associated with tasting the vegetables for some children (Dazeley & Houston-Price, 2015). Other advantages of visual exposure include ease of administration, since storybooks are more readily applied to the early years' care context than repeated taste exposure. This may save time and also reduce food waste. However, storybooks and taste are only part of a bigger picture involving more comprehensive nutritional education.

1.4.3 Nutrition education interventions

Nutrition education interventions which include parents generally provide them with nutritional information for their children and/or family. For example, Sharma, Chuang, and Hedberg (2011) sent a tip-sheet about modifying home nutrition, whereas Sirikulchayanonta, Ledsee, Shuaytong, and Srisorrachatr (2010) provided a letter with guidance to motivate and encourage children to eat a variety and quantity of fruits and vegetables. Tabak, Tate, Stevens, Siega-Riz, and Ward (2012) gave parents the option to choose one of four newsletters from the following topics: vegetable availability, picky eating, modelling or family meals. Clearly parents play a central role in their child's eating habits, but many young children regularly attend childcare, therefore, preschools are ideal settings to provide nutrition education and to encourage healthy eating (Kobel, Wartha, et al., 2017; Mikkelsen, Husby, Skov, & Perez-Cueto, 2014). Indeed, most preschool settings in the UK are required to integrate some nutrition education within the nursery curriculum (Department for Education, 2017).

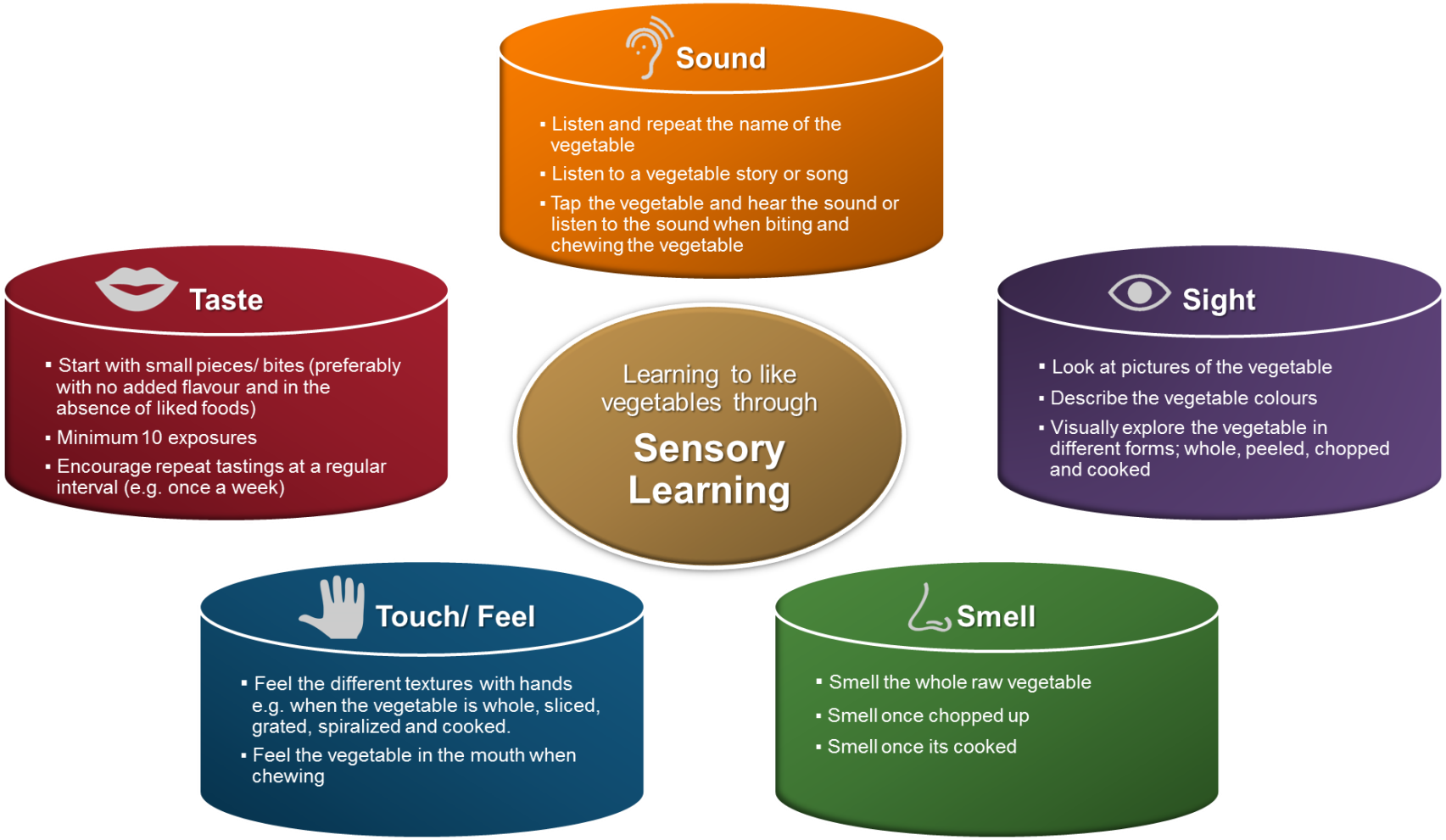

Figure 1.3 Basic sensory learning techniques that parents or preschool staff can use to encourage young children to become familiar with vegetables. Ideas adapted from work by (Dazeley & Houston-Price, 2015)

Nutrition education programmes in the early years' settings teach childcare staff, parents and/or children about the nutritional value of food (Bell, Hendrie, Hartley, & Golley, 2015; Gripshover & Markman, 2013; Williams, Cates, et al., 2014). In education programmes which involve children, the sessions are usually interactive and engaging as they incorporate fun activities such as educational stories, singing, arts, crafts, drawing, games, gardening, cooking and tasting (Sharma, et al., 2011; Vereecken, Huybrechts, et al., 2009; Witt & Dunn, 2012). Components of each nutrition education programme vary, but in preschools they have generally proven to be effective in encouraging children to increase their fruit and vegetable intake. For example, in the study by Witt and Dunn (2012), children aged 2-5 years who received 12 circle time lessons on the 'Color Me Healthy' intervention increased their vegetable snack intake by approximately 21%. However, education programmes implemented in nurseries tend to focus on vegetables which are already familiar to the children such as carrots, tomatoes and broccoli but their effects on unfamiliar vegetables are less studied (Nekitsing, Blundell-Birtill, Cockroft, & Hetherington, 2018).

Furthermore, nutrition education programmes are generally longer in duration and can vary from a few weeks to several months compared to other interventions which tend to be shorter in duration such as reward, pairing or taste exposure. For example, educational interventions by Brouwer & Neelon, 2013, Reinaerts, Nooijer, Candel, & Vries, 2007, Tabak, et al., 2012 and Vereecken, et al., 2009 were all 4 months or longer in duration compared to interventions involving taste exposures by Remington, et al., 2012, Holley, Haycraft, & Farrow, 2015, Fildes, van Jaarsveld, Wardle, & Cooke, 2014a Caton, et al., 2013 which were less than 4 weeks in duration. This may be because it could take some time for small children to process the information taught to them, hence learning from these types of intervention may be beneficial in the longer term. Moreover, the effects of education programmes on actual vegetable intake tend to be smaller than other interventions such as sensory learning, reward or taste exposure (Appleton, et al., 2016; DeCosta, Moller, Frost, & Olsen, 2017; Holley, Farrow, et al., 2017b). One reason for the smaller effect sizes may be the over-reliance on self-report (food frequency questionnaires) or assessing proxy measures of intake, such as liking, knowledge and willingness to taste. More direct measures of intake may provide better evidence of the effectiveness of nutrition education beyond their effects on awareness of and knowledge about vegetables. Nutrition education provides only indirect experience of vegetables within the curriculum and therefore may be less effective than direct

exposure to foods by smelling, feeling and tasting (Nekitsing, Blundell-Birtill, et al., 2018; Nekitsing, Hetherington, & Blundell-Birtill, 2018b). Therefore, incorporating sensory activities including taste to nutrition education programmes may provide an opportunity for children to change knowledge as well as intake of vegetables.

1.4.4 Non-food reward

Parents often use incentives in order to get their children to eat. However, offering children liked foods (e.g. dessert) to encourage intake of target foods such as vegetables can be counterproductive, with children reducing intake of the target food and increasing intake of the liked food (Birch, Marlin, & Rotter, 1984; Mason, 2015). This has been explained by the concept of 'over-justification', where children's preference for the reward is encouraged while liking for the target food is discouraged (Birch, Birch, Marlin, & Kramer, 1982; Birch, et al., 1984; Mikula, 1989). As a result, research suggests that offering children non-foods rewards such as stickers or social rewards such as praise may be more effective than food rewards for increasing children's vegetable intake (Cooke, Chambers, Añez, Croker, et al., 2011; Cooke, Chambers, Añez, & Wardle, 2011; Corsini, Slater, Harrison, Cooke, & Cox, 2013; Fildes, van Jaarsveld, et al., 2014a; Holley, et al., 2015; Horne, et al., 2011; Laureati, Bergamaschi, & Pagliarini, 2014; Presti, Cau, Oppo, & Moderato, 2015; Remington, et al., 2012). For example, a study by Cooke, Chambers, Añez, Croker, et al. (2011) with children aged 4-6 years found that offering children a tangible reward (sticker) or social praise with daily taste exposure increased children's intake of a disliked vegetable. The study reported that the effects were sustained at three months follow-up when rewards were used compared to taste exposure alone.

The learning process observed when rewards are offered can be explained by operant conditioning. Here individuals make the association between a particular, voluntary behaviour and subsequent consequences (Tolman, 1932). According to the 'law of effect' or positive reinforcement theory if a behaviour is followed by a positive consequence then it is more likely to be repeated (Skinner, 1938; Thorndike, 1911). However, use of reward means reliance on extrinsic motivation and according to the self-determination theory use of this approach undermines intrinsic motivation (Deci, Koestner, & Ryan, 1999). Also, the withdrawal of reward at a later stage may result in extinction. It may be more appropriate to use rewards in combination with other effective strategies such as modelling and taste exposure. It is unclear to what extent non-food rewards are additive to increasing children's

vegetable intake, since rewards are typically offered alongside taste exposure and modelling (Cooke, Chambers, Añez, Croker, et al., 2011; Fildes, van Jaarsveld, et al., 2014a; Horne, et al., 2011; Remington, et al., 2012).

1.4.5 Modelling

Another important form of learning, is social learning theory acquired through modelling (Bandura, 1977). Children learn new behaviours by observing their parents, family and peers. Observational learning and modelling play a significant role in children's eating habits. Pioneering research by Birch and colleagues has demonstrated the importance of peer modelling. For example, in one study a target preschool child was seated next to another 3 or 4 peers with preferences for a different vegetable, for four consecutive days. At the end of the study target children displayed a shift in preference for the non-preferred vegetable (Birch, 1980). Therefore, childcare settings may be ideal for targeting children's vegetable intake. Parents are also very important role models for their children's diets and eating behaviours (Brown & Ogden, 2004; Wardle, 1995). For example, a study with 8-12 year old children found that children were more likely to meet the recommendations for fruit and vegetable consumption if children reported parental role modelling of vegetable consumption at snack time and green salad at dinner (Draxten, Fulkerson, Friend, Flattum, & Schow, 2014). Of course, while positive role modelling by parents and peers can have a positive outcome, if children observe food refusal and low intakes of healthy foods then this too will be modelled. Therefore, parents are key role models in this endeavour (Scaglioni, et al., 2018).

Another strand used in modelling research is the use of animated characters. For example, in a study by Horne, et al. (2011) children were shown videos of cartoon characters Jess and Jarvis who named the target fruit or vegetable and then enthusiastically modelled eating the target food. Modelling was used alongside taste exposure and reward strategies. The study reported a significant increase in intake of multiple fruits and vegetables from baseline to post-intervention and intake was maintained at the six-month follow-up in children aged 24-52 months. Whilst animated footage is appealing and within the "Food Dudes" programme shown to be effective (Horne, et al., 2011), animation interventions may take time to produce an effect. For example, in a study by Zeinstra, Kooijman, and Kremer (2017) children aged 4-6 years watched eight sessions of a video clip featuring two popular Dutch TV idols role modelling carrot eating and some children also ate carrot at the same time. The study reported no increase in carrot intake post-intervention,

however at 9-month follow-up it was reported that carrot intake increased by 20-30g. This may be because all children were 9 months older by the follow-up and research suggests that children tend to become less fussy with time (Cooke, Chambers, Añez, Croker, et al., 2011). Although, the study by Zeinstra, et al. (2017) used a vegetable (carrot) which is generally consumed by children, the authors reported that approximately 40% of the children were consistent non-eaters. Character modelling using videos may be an effective strategy for encouraging some young children to eat vegetables, however developing these types of interactive videos require animator skills, are time consuming and can be costly. Whereas parent, teacher and peer modelling are convenient and ecologically valid approaches and are likely to be feasible and sustainable over time.

1.4.6 Stealth and pairing

Hiding vegetables or masking their flavour is a popular method used by parents to encourage intake by stealth (Caton, Ahern, & Hetherington, 2011; Holley, Farrow, & Haycraft, 2017a; Pescud & Pettigrew, 2014). Parents disguise vegetables by blending them with other foods or including a puree version within a sauce which the child likes to eat. Spill, Birch, Roe, and Rolls (2011a) demonstrated that hiding vegetables among other foods to reduce energy density is an effective strategy for increasing vegetable intake and decreasing overall energy intake at mealtimes. This method may increase children's vegetable intake, however Pescud and Pettigrew (2014) argue that children are unaware of hidden vegetables and therefore are missing the opportunity to learn actively about the vegetable.

Pairing strategies includes flavour-flavour learning (e.g. pairing with salt) and flavour-nutrient learning (e.g. pairing with oil) to increase children's vegetable consumption. (Ahern, Caton, Blundell, et al., 2013; Ahern, et al., 2014; Bouhlal, et al., 2014; Capaldi-Phillips & Wadhera, 2014; Caton, et al., 2013; de Wild, et al., 2013; Hausner, et al., 2012; Remy, et al., 2013; Savage, Peterson, Marini, Bordi Jr, & Birch, 2013). The method generally involves pairing the target vegetable with a food or flavour which is already liked. This can be explained by associative learning which predicts that linking a liked food or flavour with a disliked stimulus increases acceptance of the disliked stimulus (Wadhera, Capaldi Phillips, & Wilkie, 2015). The learning process involves the participant forming associations between the new flavour and the positive aspects of the unconditioned stimulus such as nutrients or liked flavour, which would result in participant eventually developing preference for the original new flavour (Capaldi, 1996). Since vegetables are usually disliked due

to their bitter taste and low energy density (Gibson & Wardle, 2003) this type of conditioning may be expected to enhance the taste and energy density and thus increase children's liking and vegetable intake.

The pairing strategy has mostly been combined with taste exposure techniques, however the evidence for use of this strategy is mixed in the literature (Appleton, Hemingway, Rajska, & Hartwell, 2018; Holley, Farrow, et al., 2017b; Wadhera, et al., 2015). For example, a study by Capaldi-Phillips and Wadhera (2014) with preschool children found that pairing sweetened or unsweetened cream cheese was more effective than repeated exposure alone for a novel bitter tasting vegetable (brussels sprouts) but pairing was not effective for a familiar non-bitter vegetable (cauliflower) and taste exposure alone was effective. In comparison studies by Caton, et al. (2013) and de Wild, de Graaf, and Jager (2015) have demonstrated that repeated exposure was effective while flavour-flavour learning (FFL), or flavour-nutrient learning (FNL) had no additive effect on children's intake of vegetables.

These findings for FFL and FNL may be attributed to the type of vegetables used in these studies (i.e. novel, unfamiliar vegetables) or due to the unfamiliar pairing with the flavours used (e.g. nutmeg). Also, young children may rely on their internal biological signals for initiation and termination of feeding and are likely to reduce intake of energy dense foods due to satiation processes (Hughes & Frazier-Wood, 2016). Therefore, adding extra energy (e.g. sunflower oil and maltodextrin) may alter the sensory profile of foods, thus the texture and flavour experienced and this may evoke conditioned satiety (Caton, et al., 2013; de Wild, et al., 2013; Remy, et al., 2013). As a result, children may be deterred from eating the vegetables paired with additional energy. Moreover, there may be an issue of generalization decrement of using FFL and FNL, i.e., child's acceptance of a vegetable paired with a particular added flavour may vary and not generalise to the same vegetable in its pure form or with an alternative flavour (Wheeler, Amundson, & Miller, 2006). The use of FFL and FNL may need to be evaluated when promoting vegetable intake in young children.

1.4.7 National initiatives to improve vegetable intake

Governmental efforts have been devised to improve children's vegetable consumption, mainly through repeated offering and therefore exposure. For example, in the UK to encourage fruit and vegetable intake in young children 'the School Fruit and Vegetable Scheme' (SFVS) has been introduced, where children

aged 4-6 years in primary schools are offered one free fruit or vegetable daily (NHS, 2018). However, it is unknown how frequently children receive vegetables as part of this scheme. In a longitudinal study which offered free fruit to children there was no overall benefits after 14 years on intake of fruits and vegetables (Stea, Hovdenak, et al., 2018). Another example is the wide reach (UK, EU and US) of the Food Dudes nutritional education programmes. The programme is based on evidence-based ways to encourage children to eat healthily, including increasing their vegetable intake (Centre for Activity and Eating Research; Bangor University, 2000-2019).

Recently there have been advances in the development of technology and entertainment education for increasing young children's knowledge and intake of vegetables. Based on evidence, mobile phone apps are available to support parents and children. For example, 'Flavor Baby' app (Rockne Production, 2018) for introducing a range of vegetables during complementary feeding and 'Vegetable Maths Masters' app for supporting preschool and primary school children to learn about eating different vegetables as well as enhancing their maths skills (Aston University, 2018). Farrow, Belcher, et al. (2019) reported that 'Vegetable Maths Masters' which uses repeated visual exposure, rewards and modelling technique is successful for increasing children's liking and intake of familiar vegetables. Since these are novel tools, it is not yet known whether their implementation will influence intake of unfamiliar vegetables in the long-term.

1.5 Overall summary and gaps in the existing literature

The present chapter has provided evidence of low intake of vegetables among children and that lack of vegetable consumption may impact an individual's health in the short and the long term. Therefore, insufficient intake of vegetables in children remains an area of concern for parents and for public health agencies. As illustrated by the ecological model there are multiple factors influencing a child's dietary intake behaviour, including child factors, parental factors and wider social factors. Hence multiple factors may need to be considered when developing strategies to promote vegetable intake in children.

Despite various efforts from parents, carers, professionals and public health agencies it remains a challenge to encourage children to eat more vegetables. Hence more research is needed to understand which strategies are effective in young children and whether some strategies are more effective than others. More research is needed to investigate which strategies are effective for children going

through a period of food fussiness. Also, there is a need to assess if strategies are specific to the type of vegetable i.e. whether they are familiar or unfamiliar to the child. This knowledge will help to tailor interventions in home and childcare settings.

Evidence from research highlighted in this Chapter shows that most published interventions that aim to improve vegetable intake are successful to some extent. However, they all have limitations which should be considered when developing future interventions (Appleton, et al., 2016). For example, the taste exposure strategy which is based on mere exposure theory is effective for increasing intake of target vegetables but there is no evidence that the effect will transfer to other vegetables beyond those targeted (Hendrie, Lease, Bowen, Baird, & Cox, 2016). Similarly, nutrition education is crucial for building knowledge about eating a variety of vegetables; however, simply learning about why and what we should eat does not bridge the gap between awareness and actual consumption (Nekitsing, Hetherington, & Blundell-Birtill, 2018). Non-taste sensory learning and visual exposures are a novel approach for promoting vegetable intake in children, however the methodology of measurement needs to be improved to accurately assess how effective these strategies are beyond increasing children's willingness to taste.

A single strategy is unlikely to work for every child; therefore, combining strategies discussed earlier rather than using a single component intervention may benefit greater numbers of children, including those who are going through a period of fussy eating. Finally, many strategies highlighted in the present chapter seems to be effective for promoting vegetable intake in preschool children, including taste exposure, non-taste sensory learning, visual exposure, nutrition education, non-food reward, modelling, stealth and pairing. However, more qualitative research is needed to understand if these strategies are used by parents in home settings. As parents are key role players in children's diet and behaviour from the early years, having some contextual knowledge about strategies parents employ at home would help health professions to better develop interventions for young children in the future.

1.6 Aims and objectives

Specific research aims for individual studies and methods implemented are highlighted within each Chapter. See Figure 1.4 for an overview of the present thesis. The overarching aim of this thesis was to investigate strategies to promote vegetable intake in children aged 2 to 5 years using a mixed method approach. The aim was achieved in three phases:

First, a systematic review was conducted and meta-analysis was employed to synthesise existing evidence of vegetable promoting strategies for children aged 2-5 years. In particular, the systematic review assessed which strategies are most effective for encouraging vegetable intake and if there any specific strategies developed for the food fussy children (Chapter 2).

Second, two intervention studies were developed based on findings from the existing literature and scientific evidence. Studies were conducted and evaluated using robust experimental design (e.g. randomised controlled trials) and process evaluations were also completed to assess implementation, feasibility and suitability (Chapters 3 and 4).

Third, a qualitative study was designed for an in-depth understanding and insight into parental perspectives on strategies used during the preschool years to increase children's vegetable consumption. Thematic analysis was used to explore if strategies used by parents of high food fussy children were different to those used by parents of low food fussy children (Chapter 5). Findings from Chapters 1 to 5 were synthesised and discussed in the general discussion Chapter and recommendations were made for future research and practice (Chapter 6)

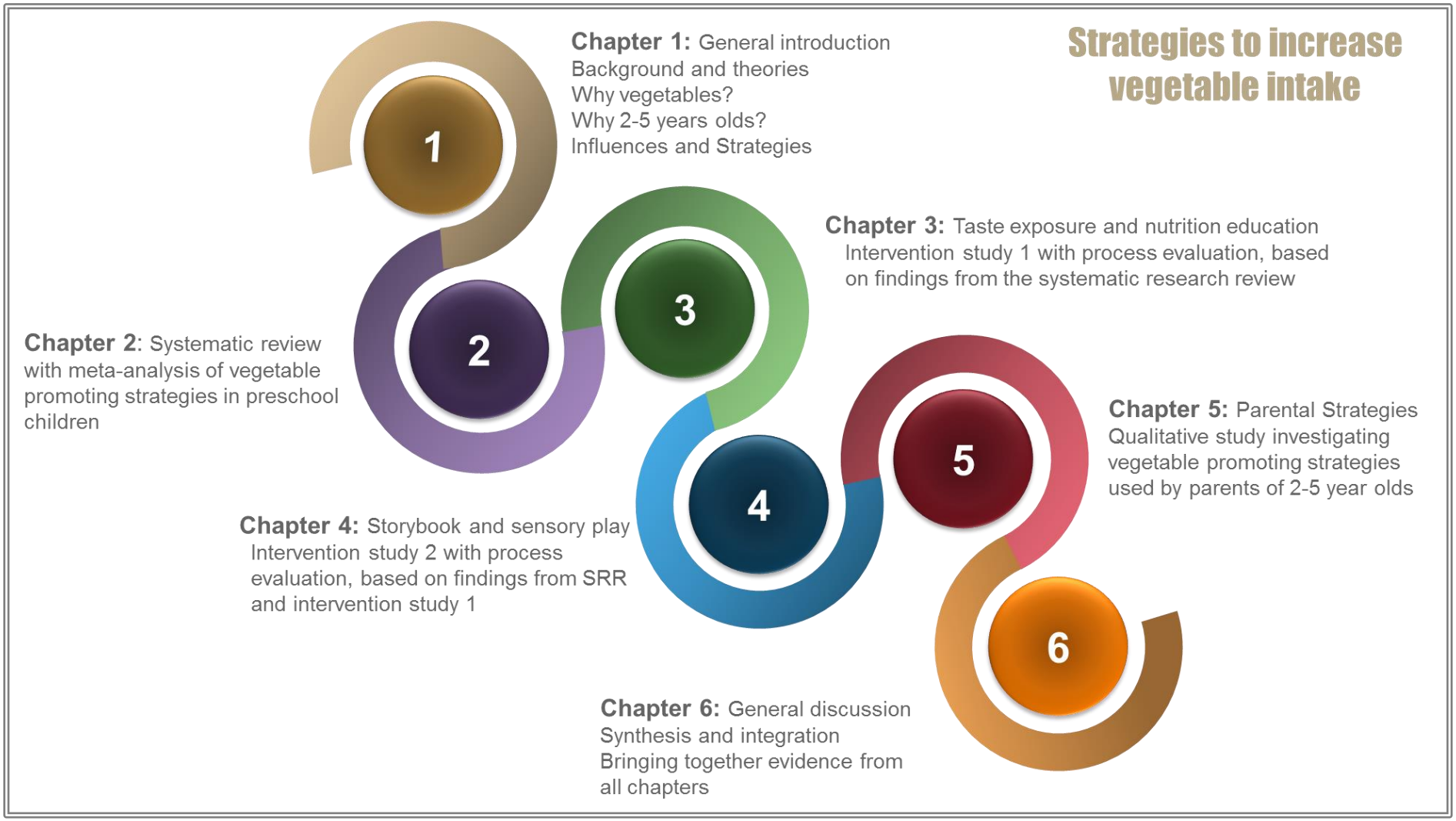

Figure 1.4 Overview of the thesis Chapters

Chapter 2

Systematic Review with Meta-Analysis

Chapter 2
Systematic review and meta-analysis of strategies to increase vegetable consumption in preschool children aged 2-5 years

In Chapter 1 various strategies, and their theoretical bases, used to increase vegetable intake in preschool children were discussed. There is a need to objectively assess which strategies are most effective for increasing vegetable intake in children at the peak of food fussiness (aged 2-5 years). Therefore, the present chapter aims to collate and evaluate evidence concerning vegetable promoting strategies from contemporary studies using a systematic approach and synthesise results using meta-analyses.

2.1 Steps taken

1. Planned a systematic research review to compile evidence of existing intervention studies looking at promoting vegetable intake in preschool children aged 2-5 years
2. Registered the systematic research review on PROSPERO international prospective register of systematic reviews to show transparency in the research
3. Conducted the systematic research review using scientific databases, including the grey literature databases
4. Collated evidence from contemporary studies, from 2005 - 2016
5. Compiled evidence using quantitative synthesis (meta-analyses)
6. Reported findings in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines

2.2 Introduction

As discussed in Chapter 1 eating the recommended amount of fruits and vegetables has many health benefits, yet most consumers across different countries do not meet dietary recommendations for daily fruits and vegetable intake (Aune, et al., 2017; Hall, Moore, Harper, & Lynch, 2009; WHO, 2011). Evidence from large cohort studies strongly suggests that preschoolers' intake of vegetables is insufficient (Angelopoulos, Kourlaba, Kondaki, Fragiadakis, & Manios, 2009; Huybrechts, Matthys, et al., 2008; Manios, Kourlaba, et al., 2009). Increasing vegetable intake is more important than increasing fruit intake because fruits are high in natural occurring sugars and according to Oyebode, et al. (2014) vegetables have a greater protective effect than fruit (reducing death by 16% per each daily portion compared to 4% for fruit).

Low consumption of vegetables has been attributed to their strong or bitter taste, unfamiliar texture, low energy density and lack of availability/ accessibility as well as eating behaviour traits such as food fussiness and food neophobia (Bell & Tepper, 2006; Blanchette & Brug, 2005; Cooke, et al., 2007; Cooke, et al., 2004; Di Noia & Byrd-Bredbenner, 2014; Dovey, et al., 2008; Holley, Haycraft, et al., 2017; Johnson, McPhee, & Birch, 1991; Rasmussen, et al., 2006). Food fussiness peaks in children aged 2-5 years, yet this is also a time when children acquire novel food preferences since eating habits are still developing (Addessi, Galloway, Visalberghi, & Birch, 2005; Cooke, et al., 2007; Cooke & Wardle, 2005). Vegetable intake may be doubly disadvantaged by disliking and child fussiness, however, strategies such as repeated taste exposure, modelling, flavour enhancement, stealth, tangible rewards (non-food) or social praise have been shown to promote vegetable intake (Anzman-Frasca, Savage, Marini, Fisher, & Birch, 2012; Caton, et al., 2013; Cooke, Chambers, Añez, & Wardle, 2011).

It is important to understand which strategies are most successful in early years to promote liking and intake of vegetables, as eating habits developed during childhood track into adulthood (Harris, 2008; Ventura & Worobey, 2013). Evidence from previous reviews suggests that interventions to encourage fruit and vegetable intake are selectively beneficial for fruits but not vegetables (Evans, et al., 2012; French & Stables, 2003). Changing vegetable intake might require different strategies to promote intake. Most reviews of fruit and vegetable intake tend to focus on children aged five and over, reporting intakes of both food groups (e.g. Blanchette & Brug, 2005; Delgado-Noguera, Tort, Martinez-Zapata, & Bonfill, 2011;

Diep, Chen, Davies, Baranowski, & Baranowski, 2014; Evans, et al., 2012; French & Stables, 2003; Krolner, Rasmussen, et al., 2011; Rasmussen, et al., 2006). A systematic research review by Appleton, et al. (2016) described vegetable promoting interventions across the lifespan. From their search, 77 studies detailing 140 interventions were found, most (81%) of these were conducted in children. This may be attributable to a greater opportunity to intervene in school settings or to a greater adaptability of children to interventions compared to adults. However, it may also be more important to intervene early to change eating habits since health benefits can be accrued over time.

To date two Cochrane reviews with meta-analysis have been published concerning vegetable intake in children aged 5 and under (Hodder, Stacey, et al., 2018; Wolfenden, Wyse, et al., 2012). The review by Wolfenden, et al. (2012) revealed that pairing repeated exposure with a tangible non-food or social reward was effective in increasing intake of targeted vegetables. However, only randomised controlled trials were included in their review and only two studies were included in their meta-analysis. Similarly, the recent meta-analysis by Hodder, et al. (2018) included 11 studies, hence, there may be other effective strategies missed by these reviews. Moreover, they also included studies with children younger than two who may be more willing to eat vegetables compared to the children who are experiencing the peak of food fussy period (2-5 years) (Cashdan, 1994; Caton, et al., 2014). Finally, a systematic review by Holley, Farrow, et al. (2017b) qualitatively summarised various strategies used for encouraging vegetable intake in 2-5 year olds, however their search returned a limited number of studies looking at educational strategies.

2.2.1 Aims and objectives

The present review aimed to investigate the effectiveness of interventions to increase vegetable intake in children aged between 2-5 years by performing a comprehensive search and including a variety of study designs and settings. In particular the study aimed to objectively identify strategies which are most successful for increasing vegetable intake.

2.3 Methods

The protocol for the present review was registered on PROSPERO; International Prospective Register for Systematic Reviews (registration number: CRD42016033984). The review is reported in accordance with Preferred Reporting

Items for Systematic Reviews and Meta-analyses (PRISMA) guidelines (Liberati, Altman, et al., 2009). See Appendix A1 for the completed PRISMA checklist.

2.3.1 Search strategy

The databases searched to identify published articles were OVID (Medline, Embase, PsycINFO, Global Health and CAB Abstracts), EBSCO (Cumulative Index of Nursing and Allied Health Literature; CINAHL and Educational Resource Information Center Database; ERIC), Cochrane Central Register of Controlled Trials (CENTRAL), ProQuest, PubMed, Scopus, and Web of Science. Moreover, grey literature databases e.g. SIGLE, Open Grey, Copac, World Cat and the reference lists of relevant previous reviews and retrieved articles were also hand searched.

As the food environment and food habits have changed over time and the International Health Regulation (IHR) framework was introduced in 2005 (WHO, 2007), contemporary evidence of studies published since the year 2005 (to January 2016) were sought. The language was limited to English. The key terms highlighted in Table 2.1 were used and adapted according to the requirements of individual databases for subject field (for example, for some search engines only a few keywords were used to retrieve maximum papers whereas for others most keyword groups were combined using “or” and “and” to maximise retrieval of mainly relevant papers). See Appendix A2 for an example of the search strategy using the Medline database.

Table 2.1 Search terms used to identify relevant articles for the present systematic research review

Subject	Related keywords
Topic	Vegetable OR vegetables OR veg OR F&V OR FV
Intervention / Outcome	Intervention OR strategy Or strategies OR facilitators OR campaign OR promote OR programme OR initiative OR factor OR trial OR liking OR preference OR intake OR consumption OR uptake OR attitude OR behavior OR behaviour
Participant	Child OR Children OR infant OR toddler OR pre-schooler OR preschooler OR girl OR girls OR boy OR boys OR mother OR maternal OR father OR parent OR caregiver OR 2 year Or 3 year Or 4 year Or 5 year OR age 2 OR age 3 OR age 4 OR age 5
Setting	School OR nursery OR Nurseries OR daycare OR day-care OR early year OR early years OR preschool OR playschool OR playgroup OR kindergarten OR classroom OR home

2.3.2 Selection of studies

The screening process was done by a single reviewer (CN). Studies which aimed to increase children's vegetable intake were considered for inclusion. Articles were included if vegetables were the only target food group or were part of a health intervention (e.g. promoting healthy eating or/and physical activity). Studies in which vegetable intake data could not be extracted were excluded; for example, studies measuring fruit and vegetables combined or measuring secondary outcomes such as liking, willingness to try or using proxy measures of intake such as vegetables observed in lunch boxes. Likewise, to focus on findings from the age group which was most likely to experience food fussiness, studies were also excluded where data on children of the desired age range (2-5 years) could not be extracted. Only full articles were included. No restrictions were applied for study designs (e.g. randomised controlled trial; RCT, experiment or pre-post format), type of interventions, settings or comparison groups. A total of 30 studies were identified for inclusion, see Figure 2.1 for PRISMA flow diagram of the study selection process.

2.3.3 Data extraction

The details of each study were extracted by the author CN and were verified by a second reviewer (MH or PB). An extended summary table of each study including: the type of intervention, aim, design, participant age, study setting, details of intervention, comparison and main outcomes for vegetable intake is presented in Table 2.2.

The vegetable intake data extracted was based on direct measurements, observations or from parent self-reported questionnaires. For the meta-analysis vegetable outcome data immediately post-intervention were used (not the follow-ups). If necessary the study authors were contacted for further details.

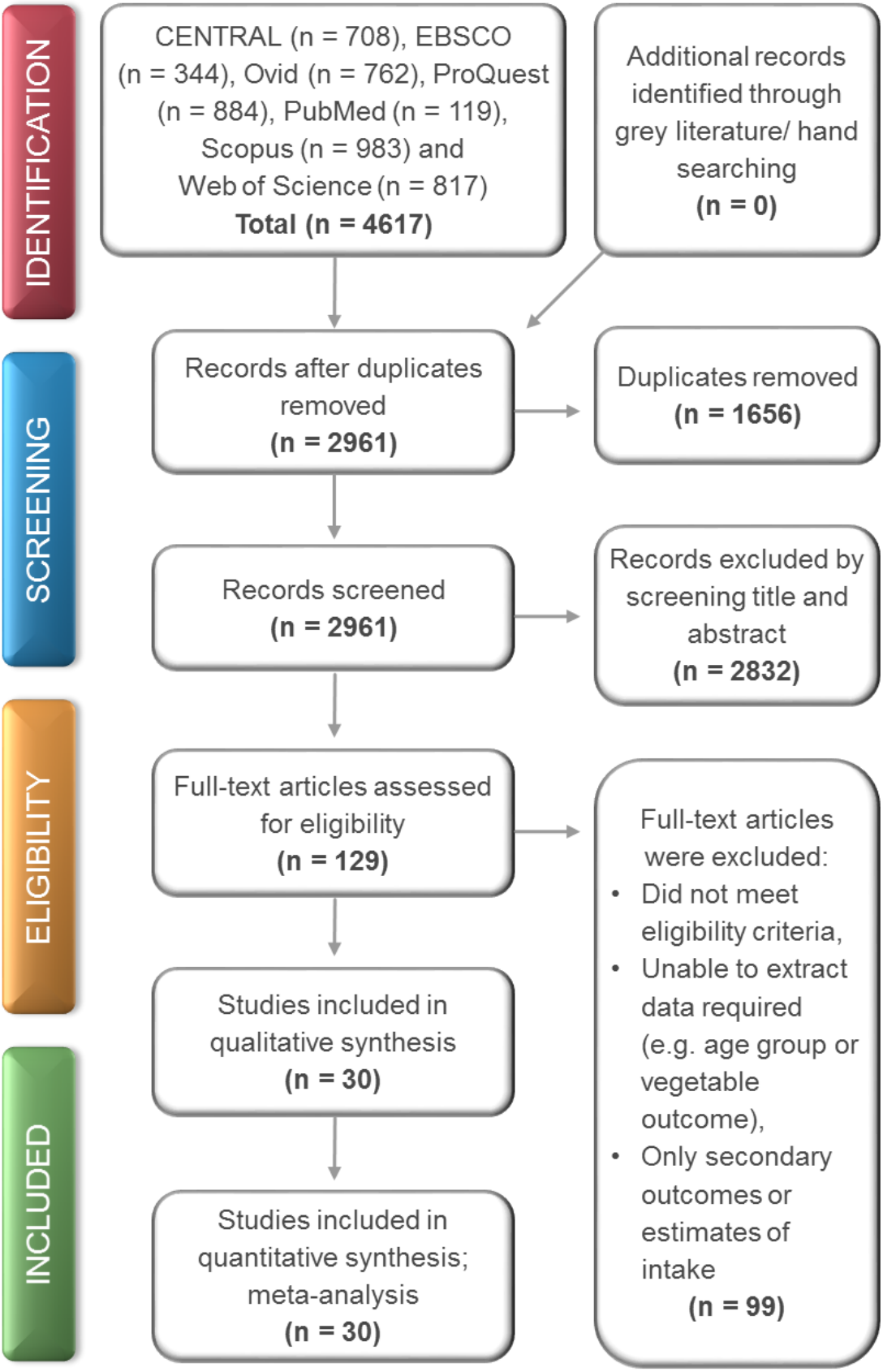

Figure 2.1 PRISMA diagram of the study screening process and article selection.

Table 2.2 Summary of studies included in the review that assesses strategies to increase vegetable intake in preschool children, aged 2-5 years.

Study/ intervention	Aim	Design	Sample[a], setting, location	Intervention	Control/ comparison	Vegetable related conclusions for primary and secondary outcome
Bell, et al. (2015) - **Educational** - **Food service**	Assess the impact of "Start Right – Eat Right" nutrition award scheme (SRER) on food and nutrient intakes.	Pre-post	2-4 years n = 216-221 Day-care centres (Adelaide, South Australia)	Centre directors and cooks received 9 hours of nutrition training (including improving provision of fruit and vegetable). SRER dietitians supported the staff and reviewed the progress of the programme.	Pre-intervention measures.	Post intervention (2-6 months later) intakes of all core food groups increased except for vegetable intake (estimated using observed plate wastage method). Future research to investigate nutrition strategy to reduce food wastage, i.e. change intake, in particular vegetables to maximise cost effectiveness of food-service interventions.
Bouhlal, et al. (2014) - **Taste exposure** - **Pairing**	Compare effect of repeated-exposure and flavour-flavour learning on acceptance of a non-familiar vegetable (salsify puree).	Between-subjects	24-36 (27.13 ± 7.37) months n = 151 Nurseries (Dijon, France)	8 exposures to salsify (weeks 2-5) 1) repeated exposure (RE) - salsify in standard form 2) flavour-flavour learning (FFL salt - salsify with added salt 3) FFL spice - salsify with added nutmeg spice.	Pre-intervention measures (week 1) Control vegetable: carrot intake measured at pre and post intervention, no exposure.	Increase in the amount consumed (g) of the unfamiliar vegetable at post-intervention (week 6) and at follow-up week 10, 19 and 32. No group effects on liking or intake however, greater change in RE compared to both FFL groups. RE is an effective and simplest method to increase vegetable intake in the short and long term.
Brouwer and Neelon (2013) - **Educational**	Assess the feasibility of "Watch Me Grow"; a gardening intervention to promote fruit and vegetable intake.	Cluster RCT	3-5 years n = 12 Childcare centres (North Carolina, USA)	The 4-month intervention included a fruit and vegetable garden, monthly "crop-a-month" curriculum, gardening support, and technical assistance from health educator.	Pre-intervention measures (not same individuals observed at baseline and post intervention). Control centres	Vegetable intake (servings) was greater for intervention children compared to control children. Four centres were involved, but intake of only 3 children was randomly observed from each centre.

Study/ intervention	Aim	Design	Sample[a], setting, location	Intervention	Control/ comparison	Vegetable related conclusions for primary and secondary outcome
Caton, et al. (2013) - **Taste exposure** - **Pairing**	Compare effectiveness of FFL and FNL with RE on increasing intake of a novel vegetable (artichoke puree).	Randomly assigned between-subjects	24-38 (31.05 ± 3.50) months (full study sample 9-38; 23.6 ± 5.09 months) n = 32 (data extracted from n = 72) Nurseries (West and South Yorkshire, England, UK)	10 exposures to artichoke puree (over 3 weeks) 1) RE: basic form 2) FFL: paired with sucrose 3) FNL: paired with sunflower oil	Pre-intervention measures Control vegetable: carrot intake measured at pre and post intervention, no exposure	Intake (g) of both vegetables increased over time however, changes in artichoke intake was greater than carrots. Artichoke intake increased to the same extent in all conditions and effect was persistent up to 5 weeks post-intervention. Therefore, regardless of the familiar taste or energy density, repetition is imperative for increasing intake. Five exposures were sufficient to increase vegetable intake.
Correia, O'Connell, Irwin, and Henderson (2014) - **Pairing** - **Visual exposure**	Investigate pairing of a vegetable (broccoli) with a familiar, well-liked food and enhancing the visual appearance of a vegetable (cucumber) on increasing vegetable intake.	Cluster randomised crossover	4-5 (4.4 ± 0.6) years n = 43 (Lunch) n = 42 (Snack) Child-care centre (New Haven Connecticut, USA)	Lunch (paired with a familiar food): steamed broccoli served on top of cheese pizza. Snack (visually appealing): raw cucumber served with chive and olive arranged in a shape of a caterpillar.	Comparison lunch: steamed broccoli was served on the side of cheese pizza. Comparison snack: raw cucumber was served as semicircles with chive and olive garnish.	No increases in vegetable (g) consumption. Pairing increased willingness to try (consumption of 3g or more) the vegetable. Greater consumption at snack time indicated that snack times in nurseries are opportune moments for increasing vegetable intake.

Study/ intervention	Aim	Design	Sample[a], setting, location	Intervention	Control/ comparison	Vegetable related conclusions for primary and secondary outcome
Cravener, Schlechter, et al. (2015) - **Reward**	Effects of pairing positive stimuli (stickers and cartoon packaging) with vegetables and presenting them as a default snack in "low-vegetable consumers" at risk of obesity.	RCT	3-5 (3.9 ± 0.8) years n = 24 Home-based (State College, Pennsylvania, USA)	4 weeks parent-led intervention. Week 1 (baseline) and week 4 (follow-up): generic packaged raw vegetables (celery, broccoli, carrots, red peppers, cauliflower, and sweet snap peas) offered as a free choice with an alternative snack (granola bar). Weeks 2 and 3: vegetables packaged in containers with favourite cartoon characters and stickers inside, presented as the default choice (children were allowed to opt out and request the granola bar after a 5-minute wait).	Pre-intervention measures Week 1-4: control group received generic packaged vegetables, presented as a free choice with an alternative snack (granola bar).	Treatment group increased vegetable intake (g per day) from baseline to week 2, however the effects were not sustained by week 4 when the treatment was removed. Parents were able to administer the intervention in home settings therefore future studies to test long-term sustainability of these practices.
de Wild, et al. (2013) - **Taste exposure** - **Pairing**	Investigate FNL as a strategy to increase acceptance of novel vegetable (endive).	Crossover	24-48 (35.0 ± 8.3) months n = 28 Day-care centres (Wageningen, Netherlands)	7 weeks crossover intervention. Vegetable soups (endive and spinach) were offered twice per week (7 exposures to each vegetable). FNL: vegetable soup paired with high energy (endive or spinach) 1) High energy variant of one soup (endive) and low energy variant of the other (spinach) 2) Low energy variant (RE) of one soup (endive) and high energy variant of the other (spinach)	Pre-intervention measures RE: no flavour-nutrient paring: low energy version of each vegetable soups (maltodextrin and sunflower oil was not added)	There was an increase in intake (g) for both variant of vegetable soups irrespective of the energy content, this indicated effect of mere exposure on intake, but not FNL. Results showed a significant liking for the vegetable soup paired with high energy and this supports FNL. Effects were significant at 2 and 6 months follow-up.

Study/ intervention	Aim	Design	Sample[a], setting, location	Intervention	Control/ comparison	Vegetable related conclusions for primary and secondary outcome
de Wild, de Graaf, Boshuizen, and Jager (2015) - **Taste exposure** - **Choice**	Investigate if choice-offering is an effective strategy to increase children's vegetable intake in home situation.	Randomly assigned between-subjects	2-5 (3.7 ± 1.0) years n = 70 Home-based (Wageningen, Netherlands)	Exposed 12 times (12 days) to six familiar target vegetables (broccoli, carrots, peas, cauliflower, French beans, and string beans) at home during dinner. Choice group were offered two selected vegetables each time (4 exposures to each vegetable over the 12 days).	Comparison: no-choice group only received one of six target vegetables on each day (2 exposures to each vegetable over the 12 days)	Results suggested that choice-offering has some, but not robust effect on increasing vegetable intake (g) in children. Age and liking of the vegetables mediated the effect of offering a choice.
Fildes, van Jaarsveld, et al. (2014b) - **Taste exposure** - **Reward**	Test the efficacy and acceptability of mailed materials giving parents instructions on taste exposure as a means of increasing vegetables (disliked) acceptance.	RCT	3-4 (3.9 ± 0.3) years n = 442 Home-based (Gemini cohort, 2011-2012, England and Wales, UK)	Parent-administered intervention. Parents were mailed instructions to provide taste exposures. The intervention involved offering each child 14 daily tastes of a disliked (target) vegetable with a small reward (a sticker) if the child complied.	Pre-intervention measures Control group: no treatment	Increased intake (number of pieces eaten) of an initially disliked vegetable. Study highlighted value of parent-administered exposure and how such strategy can be implemented without direct contact with a health professional.
Fisher, Mennella, et al. (2012) - **Taste exposure** - **Pairing**	Determine if repeated exposure to a moderately-liked raw vegetable with a familiar dip influenced liking and intake among bitter-sensitive and bitter-insensitive children.	Between – subjects	3-5 (4.0 ± 1.0) years n = 147 Head Start centres (Houston, Texas, USA)	Intake of six vegetables including the moderately liked target vegetable (broccoli) was measured at baseline and post intervention. Broccoli was offered in four conditions twice a week for 7 weeks (13 exposure trials). 1) with regular salad dressing as a dip, 2) with a light (reduced energy/fat) version of the dressing as a dip, 3) mixed with the regular dressing as a sauce	Pre-intervention measures Control group: broccoli without dressing	Providing a dip in any form (regular, light, or as a sauce) increased intake of raw broccoli (g) among bitter-sensitive preschoolers (70% in current study but not those who were not bitter-sensitive). Light-dip decreased intake in children who were not sensitive to bitter taste. Liking increased following exposure but did not vary by bitter sensitivity or dip-condition.

Study/ intervention	Aim	Design	Sample[a], setting, location	Intervention	Control/ comparison	Vegetable related conclusions for primary and secondary outcome
Gripshover and Markman (2013) - **Educational**	Assess the impact of teaching young children a new theory; 'food as a source of nutrition'.	Cluster RCT	4-5 (experiment 1: 4.9 ± 0.35, experiment 2: 4.7 ± 0.28) years n = 59 (experiment 1) n = 103 (experiment 2) Preschool (Stanford University) (Stanford, California USA)	10-12 week intervention: conceptual framework for understanding nutrition included food-body relationship, food as a source of nutrition and diverse nutrients were presented in five child-friendly storybooks (included language, colour photographs of food and people and interactive questions). The intervention group read 0-2 books each week.	Pre-intervention measures Experiment 1: control group: no treatment, children's un-tutored nutrition knowledge was recorded for comparison. Experiment 2: alternative condition, 5 child-friendly story books (e.g. enjoyment of healthy eating, exercise etc.)	Learning led children to eat more pieces of vegetables at snack time in both experiments, although the children were not instructed to eat more vegetables as part of the intervention. Young children can benefit from an intervention that teaches theories about nutrition.
(Harnack, Oakes, et al., 2012) - **Food service**	Evaluate the effects of two meal service strategies on intake of fruits and vegetables (serving fruits and vegetable first and serving meals portioned by providers).	Randomised crossover	2-5 years n = 53 Head Start centre (Minneapolis, Minnesota, USA)	Crossover trial over 6-week period during usual lunch time. 1) Provider portioned condition (week 1 & 6) - portioning a specific quantity of all menu items on plate rather than allowing the child to self-serve food items. 2) Fruits and vegetables first condition (week 3 & 5) - minor adjustment to traditional family style meal where fruits and vegetables served first before other meal items.	Control condition: (week 2 & 4) usual traditional family style meal service	The observed intake of fruit but not vegetable servings increased during serving fruits and vegetables first condition. Intake of both fruits and vegetables was lower for provider portioned condition. Results supports the current recommendations for traditional family style meal service.

Study/ intervention	Aim	Design	Sample[a], setting, location	Intervention	Control/ comparison	Vegetable related conclusions for primary and secondary outcome
Hausner, et al. (2012) - **Taste exposure** - **Pairing**	Investigate mere exposure, FFL and FNL strategies to increase a novel vegetable (artichoke).	Between-subjects	22-38 (28.7 ± 3.71) n = 104 Nurseries (Copenhagen, Denmark)	10 exposure to respective artichoke puree (over 4 weeks) 1) RE: mere exposure 2) FFL: sweetened puree 3) FNL: energy dense puree with added oil.	Pre-intervention measures Control vegetable; carrot intake measured at pre and post intervention	The mere exposure and FFL strategies increased acceptance of vegetable intake (g). Five to six exposures were sufficient to increase intake of the novel vegetable. Repeated exposure is a simple and effective technique that can be used in home and day care settings.
(Holley, et al., 2015) - **Taste exposure** - **Reward** - **Modelling**	Evaluate effectiveness of home-based intervention of rewards, modelling and repeated exposure to increase children's liking and consumption of a previously disliked vegetable.	Between-subjects	25-55 (38.0 ± 7.75) months n = 115 Home-based (East Midlands, England, UK)	Parents were instructed to offer small piece of the target disliked vegetable (selection from baby corn, celery, red pepper, cherry tomato, cucumber, and sugar snap peas) for 14 consecutive days. Four experimental conditions: 1) Repeated exposure 2) Modelling (parent) and repeated exposure 3) Rewards (sticker and praise) and repeated exposure or 4) Modelling, rewards and repeated exposure.	Pre-intervention measures Control centres: no treatment	In comparison to the control group increases in liking and consumption (g) were seen in the rewards and repeated exposure and the modelling, rewards and repeated exposure condition. Parent-led, home-based intervention incorporating rewards and modelling are cost efficient strategies to increase children's vegetable intake.

Study/ intervention	Aim	Design	Sample[a], setting, location	Intervention	Control/ comparison	Vegetable related conclusions for primary and secondary outcome
Horne, et al. (2011) - **Taste exposure** - **Reward** - **Modelling**	Determine whether modelling (animated character) and rewards intervention produce large and lasting increases in fruit and vegetable consumption.	Within-subjects	24-52 (34.0) months n = 20 Nursery (Bangor University) (Bangor, Wales, UK)	Children were exposed to 8 fruit and 8 vegetables (presented as 4 different food sets, each comprising 2 fruit and 2 vegetables). Taste exposure: during baselines 1-4, children received different food set daily (snack time and again at lunch time). Intake was not rewarded during 4 baselines and during lunch. At least 24 exposures of the target vegetables offered. Reward: 3 types of rewards were offered during the target fruit/vegetable intervention phases based on how many pieces consumed (sticker; lead to group prize, badge or brick from construction toy). Modelling: animated TV characters modelled eating the target foods and urged children to eat 'to be big & strong'.	Baseline measures at different points (for four different food sets)	The interventions produced significant increases in percentage of fruits and target vegetables (baby sweetcorn, courgette, yam and mangetout) pieces eaten. Effects were maintained 6 months after removal of rewards. Intake at lunchtime, in absence of rewards indicated that once liking is established in one context, the behaviour extended to other mealtimes.

Study/ intervention	Aim	Design	Sample[a], setting, location	Intervention	Control/ comparison	Vegetable related conclusions for primary and secondary outcome
Martinez-Andrade, Cespedes, et al. (2014) - **Educational**	Evaluate feasibility and impact of "Creciendo Sanos" - a clinic-based pilot intervention to prevent obesity.	Cluster RCT	24-60 (40.6 ± 10.0) months n = 201 Primary care clinics Home-based Mexico City, Mexico)	6 weekly educational sessions promoted healthy nutrition and physical activity (included counselling, motivational enhancement, obesity awareness and prevention). Parents and children engaged in activities (e.g. playing active games, cooking healthy snacks and creating shopping list). Counselling involved improving self-efficacy and enhancing motivation for change.	Pre-intervention measures Control: usual care – no intervention	Intervention effects were found for vegetable servings (FFQ) at 3 months but no other behaviours. At 6 months, no effect of intervention was detected. Parents reported high satisfaction but barriers for participation and retention included transportation cost and time. Future interventions need to investigate how to improve participation and adherence.
Reinaerts, et al. (2007) - **Educational** - **Food service**	Measure the effects of two school-based interventions on children's intake of fruits and vegetables.	Cluster matched and randomised	4-5 years (4-12 years full study sample) n = 122 - 183 (data extracted from n = 939) Primary schools, Home-based (Limburg, Netherlands)	Interventions components matched for age group (over 8 months). 1) Distribution condition - free fruit & vegetable supply at school and a daily routine integrating a periodic moment for children to eat the distributed fruit & vegetable together (peer modelling). 2) multicomponent condition - classroom curriculum and parental involvement (children provided with lunchbox, to bring fruit and vegetables to school, homework, newsletters and poster reminders at local supermarkets)	Pre-intervention measures Control group received programme after the study period (no intervention during the study).	Interventions were effective in increasing fruit and vegetable intake (FFQ) for the overall study population (4-12 years). However, for the age group I (4-5 years) both interventions did not indicate a significant positive result. The study did not comment on the result of different age groups. However, the differences in findings for different age group indicated the importance of age appropriate intervention.

Study/ intervention	Aim	Design	Sample[a], setting, location	Intervention	Control/ comparison	Vegetable related conclusions for primary and secondary outcome
Remington, et al. (2012) - **Taste exposure** - **Reward**	Evaluate whether parental delivery of an established intervention consisting of exposure to "tiny tastes of an initially disliked vegetable, combined with reward, would be effective in the home setting.	RCT	3-4 (3.95 ± 0.5) years n = 140 Home-based (North London, UK)	12 days Intervention: parents asked to offer target disliked vegetable (selection from carrot, cucumber, white cabbage, red pepper, celery, or sugar snap peas) every day for 12 weekdays. 1) Parent-administered taste exposure sessions with tangible rewards (stickers) 2) Parent-administered taste exposure sessions with social rewards (praise)	Pre-intervention measures Control group: no treatment	Parental use of tangible rewards with repeated taste exposures improved children's liking and intake (g) of initially disliked vegetables. Differences were maintained at 1 and 3 month follow-up. Findings for social reward condition was not significantly different from the control condition.
Roe, Meengs, Birch, and Rolls (2013) - **Variety**	Determine whether providing a variety of familiar vegetables or fruit as a snack would lead to increased selection and intake.	Crossover	3-5 (4.4 ± 0.1) years n = 58 - 60 Family centre (The Pennsylvania State University) (State College, Pennsylvania, USA)	8 afternoon snack times (4 for fruits; apple peach and pineapple and 4 for vegetables; cucumber, sweet pepper and tomato). Children were offered variety of all 3 vegetables together. Similar offerings were also made for fruits.	Comparison: children were offered 3 different vegetables as a single type (one at a time).	Providing a variety increased intake of fruits and vegetables (pieces eaten).

Study/ intervention	Aim	Design	Sample[a], setting, location	Intervention	Control/ comparison	Vegetable related conclusions for primary and secondary outcome
Savage, Fisher, Marini, and Birch (2012) - **Food service**	Assess the effect of serving a range of entree portions on children's ad libitum intake and energy density consumed at the meal.	Within-subjects	3-5 (4.3 ± 0.5) years n = 17 Childcare centre (The Pennsylvania State University) (State College, Pennsylvania, USA)	Participants received different size entrée portion (i.e. 100g, 160g, 220g, 340g and 400g) to measure the effect of varying size portion entrée on ad libitum energy intake of macaroni and cheese, and fixed portions of unsweetened applesauce, green beans, and whole-wheat roll.	No pre-intervention measures or control comparison	Increasing portion size of the entrée, reduced the energy intake (kcal) of foods served with the entrée, including fruit (unsweetened applesauce) and vegetable (green beans). Serving smaller age-appropriate entree portions may help to improve children's nutritional intake including the intake of fruit and vegetables served with the entrée while decreasing plate waste.
Savage, et al. (2013) - **Pairing**	Compare the effects of offering dips (with and without familiar herb and spice) with vegetables and vegetable alone (without dip) on children's willingness to taste, liking, and intake of vegetables.	Within-subjects	3-5 years n = 34 (experiment 1) n = 26 - 27 (experiment 2) Childcare centre (Central Pennsylvania, USA)	Experiment 1 was conducted to determine which vegetable was familiar, disliked or refused and which flavour dip the children preferred. Experiment 2: children rated liking of celery and yellow squash with and without their favourite reduced-fat dip and intake was also measured.	Comparison: intake of vegetable without dip	Herb dip was preferred (pizza or ranch) compared to plain dip. Children were more likely to reject vegetable alone than when served with herb dips. Offering vegetables with reduced-fat dips (familiar herb and spice flavours) can increase tasting and thereby promote liking and intake of vegetables (g), including those which were previously rejected or disliked (celery and yellow squash).

Study/ intervention	Aim	Design	Sample[a], setting, location	Intervention	Control/ comparison	Vegetable related conclusions for primary and secondary outcome
Sharma, et al. (2011) - **Educational**	Pilot test CATCH (Coordinated Approach to Child Health) Early Childhood programme at promoting healthy nutrition and increasing physical activity.	Pre-post	3-5 years n = 61 Head Start centres (Harris County Texas, USA)	The intervention programme was delivered by trained teachers over a 6-week period. The programme included nutrition education, physical activity and a family component. Nutrition-based lessons in classrooms aimed at promoting healthy eating habits such as increasing fruits and vegetables intake. Parent were sent education tip-sheets which were designed to modify the home nutrition.	Pre-intervention measures	Children's observed vegetable servings did not increase significantly. Results indicated good feasibility and acceptability of the programme.
Sirikulchayanonta, et al. (2010) - **Educational**	Evaluate the use of food experience, multimedia and role models for promoting fruit and vegetable consumption.	Pre-post	4-5 years n = 26 Kindergarten (Bangkok, Thailand)	The 8-week intervention consisted of eleven 30-40 minutes interactive activities (e.g. games, cartoon, gardening and cooking). Classroom curriculum: introduced health benefits of fruit and vegetables to improve familiarity and acceptance. Letter were sent to parents to guide them to motivate and encourage their children to eat variety and quantity of fruit and vegetables. While eating together teachers, peers, and parents were used as role models.	Pre-intervention measures	The intervention was effective in increasing fruit and vegetable consumption (g). Study recommend nutrition education in the course curriculum in combination with social support from the teachers and the family can improve and sustain fruit and vegetable intake.

Study/ intervention	Aim	Design	Sample[a], setting, location	Intervention	Control/ comparison	Vegetable related conclusions for primary and secondary outcome
Spill, Birch, Roe, and Rolls (2010) - **Food service**	Investigate whether increasing the portion size of vegetables served at the start of a meal leads to increased vegetable consumption and decreased meal energy intake.	Crossover	3-5 (4.4 ± 0.71) years n = 51 Day-care centre (The Pennsylvania State University) (State College, Pennsylvania, USA)	Test lunch served once a week for 4 weeks. In 3 experimental meals, a first course of raw carrots was served varying in portion sizes (30g, 60g and 90g).	Control comparison: no first course served in control meal	Increasing the portion size of a vegetable (carrot) served as a first course was found to be an effective strategy for increasing vegetable intake (g).
Spill, et al. (2011a) - **Food service** - **Stealth**	Investigate whether incorporating pureed vegetables (hiding) into entrees to reduce the energy density affected vegetable and energy intake.	Crossover	3-5 (4.7 ± 0.62) years n = 39 Day-care centre (The Pennsylvania State University) (State College, Pennsylvania, USA)	1 day a week for 3 weeks Breakfast, lunch and dinner entrée energy density was manipulated by increasing the proportion of pureed vegetables. Entrees were served with un-manipulated side dishes and snacks. 1) 85% ED (tripled vegetable content), 2) 75% ED (quadrupled vegetable content).	Control comparison: standard 100% energy density entrée.	The incorporation of considerable amounts of pureed vegetables to reduce the energy density of meal (breakfast; zucchini, lunch; broccoli, cauliflower and tomato and dinner; cauliflower and squash) was effective to increase the daily vegetable intake (g) and decrease the overall energy intake. The consumption of more vegetables in entrees did not affect the intake of the vegetable side dishes i.e. at lunch (broccoli) or at dinner (green beans).

Study/ intervention	Aim	Design	Sample[a], setting, location	Intervention	Control/ comparison	Vegetable related conclusions for primary and secondary outcome
Spill, Birch, Roe, and Rolls (2011b) - **Food service**	Determine the effects of serving varying portion sizes of a low energy dense, vegetable soup on children's energy and vegetable intake within a meal and over the next eating episode.	Crossover	3-5 (4.7 ± 0.85) years n = 72 Day-care centres (The Pennsylvania State University) (State College, Pennsylvania, USA)	Intervention took place 1 day a week for 4 weeks. 3 varying the portion size of tomato soup served as a lunch first course (150g, 225g and 300g) Standard breakfast, lunch, and afternoon snacks were provided during the test days.	Control comparison: no first course was provided.	Serving a low energy dense, vegetable soup (tomato) as a first course is an effective strategy to reduce children's intake of an energy dense main entree and increase vegetable consumption (g) at the meal. Total vegetable consumption across lunch (broccoli) and afternoon snack (cucumber, cherry tomatoes and carrot) increased as size of the soup portion increased.
Tabak, et al. (2012) - **Educational**	Evaluate a home-based intervention targeted to parents to improve vegetable intake in preschool-aged children.	RCT	2-5 (3.6 ± 0.8) years n = 43 Home-based (Chapel Hill, North Carolina, USA)	4-month feasibility study of home-based intervention of: 2 motivational phone calls (parents were asked to choose 1 of the 4 topics for improvement. Options were vegetable availability, picky eating, modelling and, family meals 4 tailored newsletters were sent which covered all 4 topics.	Pre-intervention measures Control group: were sent 4 children's books (not health/ nutrition related)	Intervention did not increase intake of vegetables (FFQ). However, increases were reported for availability, vegetable types and number of fruits and vegetables offered for snacks. Home-based intervention altering parents' behaviour such as feeding practices and improving the home environment may aid to increase vegetable intake in children.
Vereecken, et al. (2009) - **Educational**	Evaluate the impact of the "Beastly Healthy at School" intervention in children's food consumption.	Cluster RCT	3-5 years n = 476 Schools (East Flanders, Belgium)	6-month intervention (2 days training for staff). An educational package, including an educational map for the teachers, an educative story and educational material for the children and newsletters for the parents.	Pre-intervention measures Control group	No significant effect of intervention was evident for parental reported vegetable intake (g; FFQ).

Study/ intervention	Aim	Design	Sample[a], setting, location	Intervention	Control/ comparison	Vegetable related conclusions for primary and secondary outcome
Williams, et al. (2014) - **Educational**	Evaluate the effects of nutrition-education programme in child-care centres on children's at-home daily consumption of fruit and vegetable and other at-home dietary behaviours.	Matched settings, Cluster RCT	2-5 (4.4 ± 0.3) years n =1143 - 902 Childcare centres/ Home-based (New York City, New York, USA)	Registered dietician provided nutrition education to the parents and children separately over a 6-10 week period. Children received nutritional education e.g. eating variety of fruits and vegetables ("Vary your Veggies"). Staff were educated on nutrition and physical activity policy. Parents were sent weekly newsletters (activities and recipes)	Pre-intervention measures Control centres	The programme improved children's at-home daily consumption of vegetables (reported by parents using pictures of filled cup measurement), no effect on fruit intake. The study also found a significant increase in the frequency of child-initiated vegetable snacking (which contributed to the significant increase in daily vegetable intake). Future research needs to understand the process by which nutrition-education in childcare setting can translate into changes at home consumption.
Witt and Dunn (2012) - **Educational**	Determine whether an interactive nutrition and physical activity programme "Color me Healthy" increases fruit and vegetable consumption.	Cluster RCT	4-5 years n = 122 Childcare centres (Boise, Idaho, USA)	"Color Me Healthy" programme was delivered for 6 weeks. The programme used colour, music, and exploration of the senses to teach children about healthy eating and physical activity. The intervention was teacher-led and included 12 circle-time lessons (2 each week, focused on fruit and vegetables of different colours) and 6 imaginary trip (1 each week, fun imaginary classroom activity).	Control centres did not receive the curriculum	Significant increase in the percentage of fruit and vegetable snack consumed (g) among the intervention group. Results were also significant at the 3-month follow-up.
[a]Age range and mean age (SD) reported where appropriate, sample size at baseline and immediately post intervention (if different to baseline) **G: grams, RE: repeated exposure, FFL: flavour-flavour learning, FNL: flavour-nutrient learning, g: grams, FFQ: Food Frequency Questionnaire**						

2.3.4 Quality assessment

The quality of each study was assessed by at least two researchers independently (CN and MH, PB or JC), using the Effective Public Health Practice Project (EPHPP) quality assessment tool for quantitative studies (EPHPP, 1998; Thomas, Ciliska, Dobbins, & Micucci, 2004). Any disagreements in scores were resolved by discussion between two researchers (CN and MH). Five components were scored (selection bias, study design, confounders, blinding, data collection methods and withdraw and drop-out); from which the overall global quality ratings were calculated. As the effect size did not vary by the quality of the studies (see Table 2.4), no studies were excluded from the analysis based on these ratings. See Figure 2.2 for summary of the quality ratings.

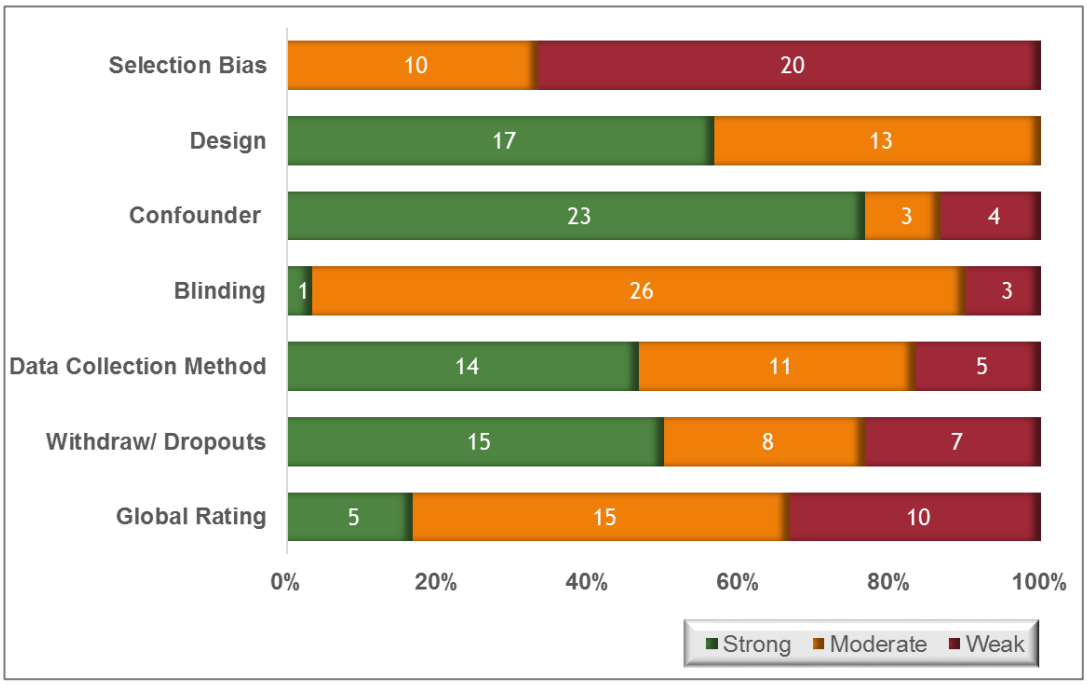

Figure 2.2 Summary of study quality assessment using the EPHPP quality assessment tool

Only five of the 30 studies were rated as strong, 15 were rated as moderate and 10 were rated as weak. Every study had some methodological weakness as no study scored strong for every item. There were substantial issue of selection bias as the majority of the studies recruited convenient samples, hence none were rated as strong on this criterion. Study design and allocation was not always appropriate but as the authors generally described the design, the ratings were mostly satisfactory. Most studies (n = 23) were rated as strong for the confounding variable criterion because for within-subject design participant's characteristics did not vary prior to the intervention and other studies performed covariate analysis to counteract this

problem. Weaknesses identified were not measuring baseline and post-intervention outcome data from the same individuals (e.g. Bell, et al., 2015; Brouwer & Neelon, 2013), and reporting whether precautions were taken to blind the researcher or the participant. The researchers were mostly aware of the group allocation however, blinding the participant to research purpose was not thought to be a problem in the present studies because children young as 2-5 are unlikely to recognise the study objectives. However, blinding was an issue if either the parents were the participant or were responsible for delivering the intervention and reporting the intake measures, as this may generate some reporting bias.

The data collection methods varied in studies; some studies measured vegetable intake objectively i.e. in grams using a precise weighing scale, some observed the number of pieces or servings eaten and others were self-reported using questionnaires such as FFQ. The methods used in studies were generally valid. However, the reliability of these tools was sometimes challenged e.g. modifying tools such as FFQ and not providing further details or intake observed by only one researcher (possibility of reporting bias). Withdrawal and drop-outs were assessed for the period immediately following the intervention and not for any follow-up periods to ensure that each study was appraised equally. Many studies scored weak on this criterion because they did not provide withdrawal information or medium to large (n >100) size studies were more likely to experience higher drop-out/ withdrawal rate.

2.3.5 Statistical analysis

Comprehensive Meta-Analysis (CMA, Biostat, Englewood, NJ, USA) software was used to conduct the meta-analyses. Means, standard deviation (sometimes calculated from the reported standard error) and the sample size (adjusted to the lower value if pre and post n varied) were generally extracted from appropriate time-points (pre and post intervention). If raw data were not reported then significance t-test values, F-ratio and statistically significant p values were sought. If the significant value was statistically significant but not precisely reported then these were rounded to the significant value (e.g. < 0.05 entered as 0.05 and < 0.01 entered as 0.01). To calculate effect size for paired group studies, pre-post correlation is required. However, none of the studies have reported these values in their results. Therefore, based on the authors' knowledge and using existing data from a previous early years health intervention project; HabEat (Caton, et al., 2013; Hausner, et al., 2012), a pre-post correlations thought to be reasonable, r = 0.6 (for

unfamiliar or disliked) and r = 0.7 (for familiar vegetables, moderately liked and usual vegetable intake) were identified and entered. Studies with more than one intervention group were entered separately as intervention arms.

For each meta-analysis/ subgroup analysis (e.g. grouping by type of design) the heterogeneity was assessed using I^2 (inconsistency) statistics. Higgins et al. (2003) described I^2 "as the percentage of total variation across the studies that is due to heterogeneity rather than chance"; values < 0.25 were considered low, < 0.50 were considered moderate and > 0.75 were considered high (Higgins, Thompson, Deeks, & Altman, 2003). As studies did not use identical or even similar procedures a random-effects model was used for all meta-analyses to pool estimated differences in vegetable intake between intervention and comparison groups. This model is more appropriate as there are various small size studies and the model will give a relative weight based on the study population. The random-effects model accounts for within study variance (included in the fixed effect model) and between study variance. Effect sizes are reported using Hedges g (adjusted standardised mean differences), as this measure accounts for differences in measurements of the intake data (e.g. weight in grams, observations, FFQ score). The effect size from each study with confidence intervals and cumulative effect sizes are presented using forest plots (see Figures 2.3 - 2.5). Study was used as the unit for analysis, except for analysis of intervention strategies for which the intervention arm (condition) was used as the unit of analysis (for studies with more than one intervention group).

Sensitivity analysis was performed by excluding three studies, one which reported median data (Bell, et al., 2015), another with various experimental conditions but none were defined as a standard or control condition (Spill, et al., 2010) and a third study by Harnack, et al. (2012) which found non-significant effects for one of their intervention arms but did not report the precise p value (p value of > 0.05 was entered as 0.06). Subgroup analysis was conducted based on study methodology (study design, location, study setting and quality assessment ratings) and intervention factors (intervention strategies, type of vegetable, outcome measurements, delivered by and the intervention recipient).

A meta-regression using the random effect model (methods of moments) was performed on the number of taste exposures used in the intervention. Finally, a funnel plot and Egger's regression test were conducted to check for publication bias.

2.4 Results

2.4.1 Participants and design

There were 4017 participants included in the review. The sample size varied in each study from 12 - 1154 (902 post-intervention) and all studies included boys and girls. The mean age was 3.8 years (based on studies which reported the mean age, n =19). The children were generally from mid-high socioeconomic status, except for Savage, et al. (2013) and Williams, et al. (2014) studies which assessed vegetable intake in children of low income parents. The design of the studies included 4 RCT, 8 cluster RCT, 6 crossover, 6 between-subjects, 3 within-subjects, and 3 pre-post formats (see Table 2.2 for individual study design).

2.4.2 Interventions

The duration of the interventions varied from two single sessions of pairing a vegetable with or without liked food (e.g. broccoli on top of pizza vs broccoli on side of pizza) to an eight-month educational programme. The interventions targeted increasing vegetable intake only (n = 13), increasing intake of both fruit and vegetables (n = 6), increasing vegetable intake as part of more general healthy nutrition (n = 6), general healthy lifestyle (n = 4) or, to prevent obesity (n = 1). To promote vegetable intake in preschool children, nine dominant strategies emerged from the included studies. These were educational interventions, repeated taste exposure, pairing, changed food-services, explicit reward, modelling, choice, variety, and visual presentation. Most of the studies included more than one of these approaches; see Table 2.2 for the strategies included in each study and see Table 2.3 for a description of each strategy and the number of studies using them. There were no specific strategies identified for children going through the fussy eating phase or food neophobia. The comparison groups were reported to receive no treatment (or baseline consumption), usual care or received treatment after the intervention phase.

2.4.3 Types of vegetables used: familiar/ usual and unfamiliar/ disliked

The type of vegetables included in the studies were classified as either: familiar/ usual or unfamiliar/ disliked. The familiar vegetables were usual everyday vegetables, those which were commonly consumed and generally accepted by the study children, for example red pepper, cauliflower, celery, snap peas (mangetout), broccoli, carrots, tomatoes, cucumbers, green beans and swede.

Table 2.3 Description of each intervention strategy and number of studies using them

Intervention	Brief description	n
Educational	• Teaching about the nutritional value to children, parents or/and staff (e.g. Williams, et al., 2014) • Children engage in fun activities such as gardening, games play, cooking classes and tasting (e.g. Sharma, et al., 2011; Witt & Dunn, 2012)	10
Taste exposure	• Opportunity to repeatedly taste the same vegetable/s (e.g. Fildes, van Jaarsveld, et al., 2014b; Hausner, et al., 2012); in present studies the number of exposures varied from 2 – 24.	10
Pairing or stealth	• Presenting vegetables with a liked food or flavour for example herb dip (e.g. Fisher, et al., 2012) • Providing additional nutrients for example sunflower oil or maltodextrin (e.g. Caton, et al., 2013; de Wild, et al., 2013) • Vegetables by stealth, such as incorporating pureed vegetable into an entrée (e.g. Spill, et al., 2011a)	8
Food services	• Provision of target foods e.g. increasing availability and accessibility (e.g. Bell, et al., 2015) • Changed the way food was provided (e.g. served vegetables first e.g. Spill, et al. (2010)) • Modification to the portion size (e.g. Savage, et al., 2012)	7
Explicit reward	• Social; praise (e.g. Remington, et al., 2012) • Tangible non-food rewards e.g. sticker or toy (e.g. Horne, et al., 2011)	5
Modelling	• Learning through observation; for example. Holley, et al. (2015) required the parents to model vegetable intake to encourage their children to eat the vegetables whereas Horne et al. (2014) used animated video characters to model eating of the target foods.	2
Choice	• Provided vegetables singly or offered children a choice of two vegetables (de Wild, de Graaf, Boshuizen, et al., 2015)	1
Variety	• Offered vegetables individually or together (Roe, et al., 2013).	1
Visual presentation	• Provided vegetables in a visually appealing manner – for example presenting slices of cucumber decorated with olives and chives in the shape of a caterpillar (Correia, et al., 2014).	1

Unfamiliar/ disliked vegetables were those which were novel (e.g. salsify, artichoke, endive) or disliked by the study children. That is, they were not favoured or frequently tasted within that sample in the period leading up to the study. The disliked vegetables were typical everyday vegetables; but were targeted selectively as they were not preferred or consumed by the specific child (e.g. white cabbage, snap peas, baby corn, tomatoes, celery and yellow squash). The reasons why a particular vegetable was disliked varied between children (for example a child may

simply refuse to eat a particular vegetable due to its colour or texture (without prior taste experience) or it could be that the child has tasted or eaten the vegetable before but they no longer like this vegetable. Studies which categorised a vegetable as disliked generally asked parents to identify a target vegetable for their child from a selection of the study vegetables (Fildes, van Jaarsveld, et al., 2014a; Holley, et al., 2015; Remington, et al., 2012). The categorisation of the vegetable as familiar/ usual or unfamiliar/ disliked was mainly based on the study's description or imputed by the authors if missing (for example vegetables which feature within the FFQ measures were considered as familiar vegetables since scores reflected reported intakes).

2.4.4 Synthesis of results: meta-analysis

With all 30 studies included, overall a small-moderate effect (g = 0.40) of intervention was observed (Figure 2.3). When 44 intervention arms within 30 studies were used as the unit of analysis, a slightly larger effect size was observed g = 0.42, CI: 0.33-0.51, Z = 8.79, $p < 0.001$. The sensitivity analyses performed by excluding three studies (Bell, et al., 2015; Harnack, et al., 2012; Spill, et al., 2010) indicated effect size of g = 0.43, CI: 0.33-0.53, Z = 8.27, $p < 0.001$ and $Tau^2 = 0.04$, $Chi^2 = 85.13$, df = 26, $p < 0.001$, $I^2 = 69.54\%$. However, considerable heterogeneity was observed when combining individual studies ($I^2 = 73\%$), therefore additional subgroup analyses were performed by grouping them to investigate inconsistency between studies.

2.4.5 Subgroup analyses

Table 2.4 shows results of the subgroup analyses in which studies were grouped according to sharing similar characteristics e.g. the study design or the intervention strategy were similar in studies combined. As can be seen from the I^2 statistics, these analyses reduced dispersion when they were grouped compared to when they were combined individually. However, generally the heterogeneity remained high. The effect sizes significantly varied by the study design, outcome measures, intervention recipient, intervention strategy and the type of vegetable used. Studies which used RCT, within-subjects, between-subjects or crossover design had greater effect sizes than studies which used cluster RCT or pre-post designs. This may be because some of the studies within these design categories did not always include the same participants at baseline and post-intervention.

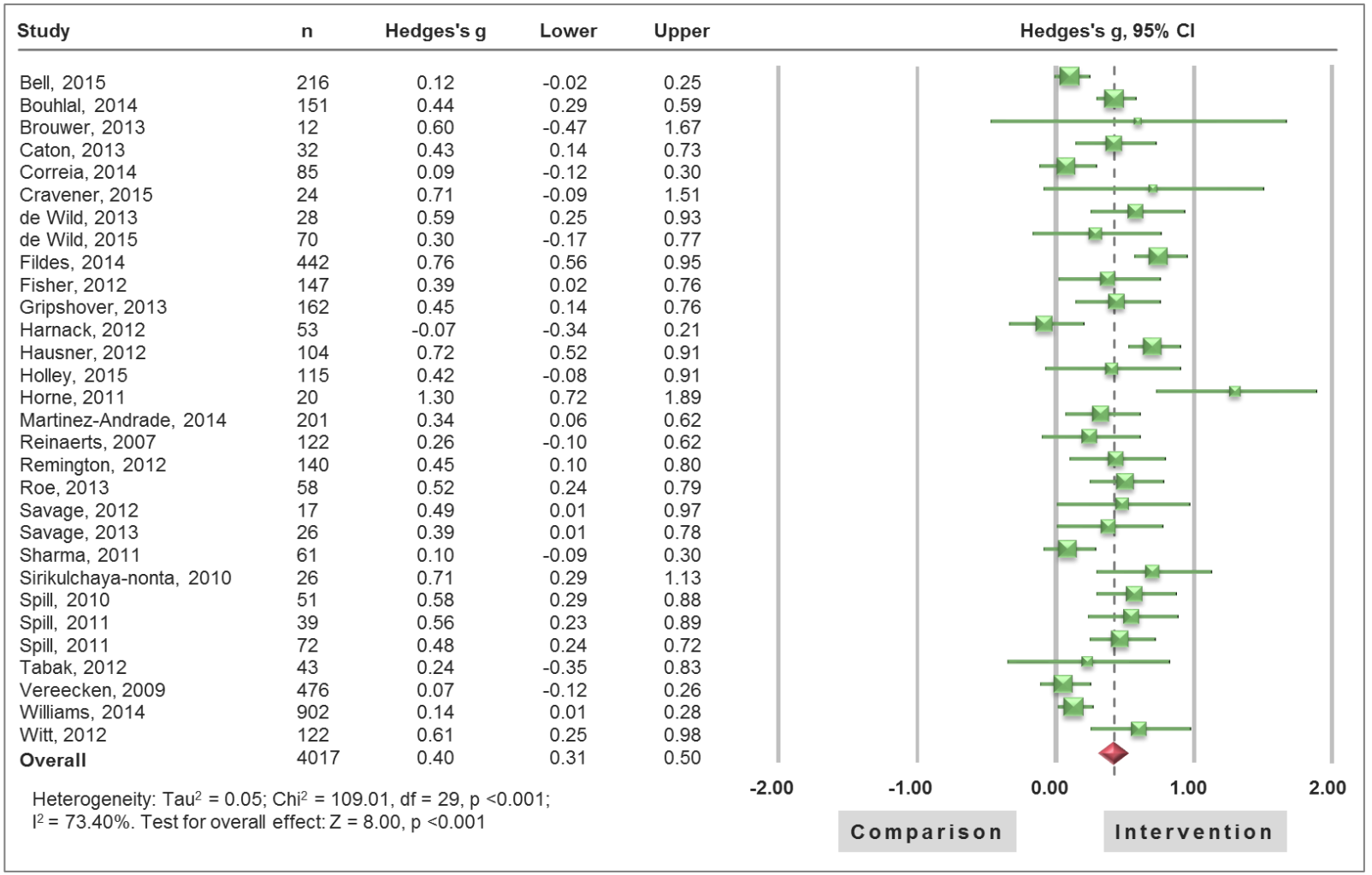

Figure 2.3 Forest plot of overall intervention effect versus comparison on vegetable intake by study (n = 30)

Table 2.4 Subgroup analysis to highlight effect size and heterogeneity by methodology and intervention factors (study as unit of analysis).

Variables	No. of studies	Effect size (95% CI)		I^2 %	Heterogeneity within (Q/p values)	Heterogeneity between (Q/p values)
Main strategy						**10.52***
Educational	10	0.26	(0.13 - 0.39)	54	19.39*	
Taste Exposure	10	0.57	(0.43 - 0.70)	52	18.69*	
Other	10	0.36	(0.22 - 0.50)	61	22.53*	
Design						**11.84***
Between-subjects	6	0.48	(0.31 - 0.66)	26	6.77	
Cluster RCT	8	0.25	(0.10 - 0.40)	44	12.61*	
Crossover	6	0.43	(0.26 - 0.61)	68	15.55*	
Pre-post intervention[1]	3	0.22	(0.01 - 0.44)	72	7.26	
RCT	4	0.59	(0.34 - 0.84)	30	4.30	
Within-subjects	3	0.64	(0.32 - 0.97)	71	6.88*	
Measurement						**18.83***
Cup serving (image)	1	0.14	(-0.18 - 0.47)	0	0.00	
FFQ	4	0.38	(0.14 - 0.62)	0	2.32	
Weight (Grams)	15	0.43	(0.32 - 0.54)	62	36.97*	
Weight (Grams/day)	1	0.71	(-0.14 - 1.56)	0	0.00	
Energy (Kcal)	1	0.49	(-0.08 - 1.06)	0	0.00	
Observed	4	0.08	(-0.12 - 0.28)	0	2.29	
Pieces (count)	4	0.67	(-0.46 - 0.89)	65	8.48*	
Settings						1.01
Early years	22	0.39	(0.28 - 0.50)	76	88.18*	
Home	6	0.51	(0.26 - 0.75)	27	6.92	
Multi	2	0.30	(-0.07 - 0.67)	0	0.12	
Location						13.97
Australia	1	0.12	(-0.25 - 0.48)	0	0.00	
Belgium	1	0.07	(-0.32 - 0.46)	0	0.00	
Denmark	1	0.72	(0.32 - 1.12)	0	0.00	
France	1	0.44	(0.07 - 0.81)	0	0.00	
Mexico	1	0.34	(-0.10 - 0.78)	0	0.00	
Netherlands	3	0.39	(0.10 - 0.69)	0	1.98	
Thailand	1	0.71	(0.17 - 1.25)	0	0.00	
UK	5	0.63	(0.41 - 0.85)	61	10.22*	
USA	16	0.34	(0.22 - 0.46)	59	36.25*	
Quality						0.31
Strong	5	0.42	(0.20 - 0.65)	84	24.76*	
Moderate	15	0.43	(0.28 - 0.57)	16	16.61	
Weak	10	0.36	(0.18 - 0.54)	85	60.48*	
Delivered by						3.84
Parent	6	0.51	(0.26 - 0.75)	28	6.92	
Research Team	6	0.24	(0.05 - 0.43)	67	15.02*	
Teacher	8	0.43	(0.23 - 0.64)	70	23.67*	
Teacher, Researcher	10	0.45	(0.29 - 0.60)	78	41.55*	
Recipient						**9.95***
Child	22	0.48	(0.38 - 0.58)	61	53.22*	
Child, Parent	3	0.29	(0.00 - 0.58)	0	0.17	
Child, Parent, Teacher	4	0.19	(-0.01 - 0.39)	61	7.71	
Staff	1	0.12	(-0.23 - 0.47)	0	0.00	

* $p < 0.005$; bold font indicates the group differences to be statistically significant;
[1]pre-post format studies did not always include the same children.

The effect sizes also varied by how vegetable intake was measured, for example the pooled effect was higher when the pieces eaten were counted than when intake was measured in grams or by FFQ. Also, when children were the only recipient of the intervention, the effect size was higher than when parents or teachers were involved. However, it should be noted that the number of studies in each category was uneven, and this may make comparison imbalanced. There were no other significant overall group differences identified.

Some interesting findings were observed when pairwise comparisons were performed for the category of "who delivered" the intervention and the location of the studies. For example, vegetable intake was higher when the intervention was delivered by the parents compared to the research team alone (excluding teachers); Q = 5.46, df = 1, p = 0.019; and a significantly higher effect size was observed for UK based studies (n = 5) than for US based studies (n = 16), Q = 4.87 with df =1, p = 0.027.

2.4.6 Vegetable familiarity

The pooled effect size varied by the type of vegetable used in the studies, see Figure 2.4. The analysis indicated that intake of unfamiliar or disliked vegetables increased more than that of familiar or usual vegetables. Of the 9 studies investigating unfamiliar or disliked vegetables 8 used a taste exposure strategy (high multi-collinearity) therefore, it was not possible to assess whether intervention strategy or the type of vegetable was a stronger predictor for the intake. However, 8 of the 10 taste exposures studies using unfamiliar or disliked vegetables had a better combined effect (g = 0.60, CI: 0.46-0.74) compared to the 2 studies which used familiar or usual vegetables (g = 0.35, CI: 0.00-0.70). Here the pairwise comparison was not statistically significant, possibly due to lack of power.

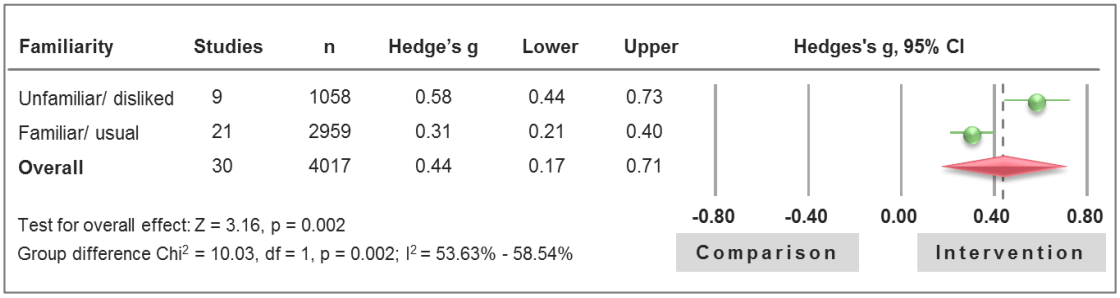

Figure 2.4 Forest plot of subgroup analysis by vegetable familiarity/ liking on vegetable intake (study as unit of analysis, n = 30)

2.4.7 Intervention strategies

Many studies used more than one strategy to promote vegetable intake, for the primary analysis 30 studies were grouped by the main intervention strategy; education, taste exposure or others. The analysis indicated that studies using taste exposure had a significantly higher impact on intake than education or other strategies (Table 2.4). To examine this further and to understand which combination of intervention strategies were most effective, the intervention arms (n = 44) were clustered by the combinations of strategies used (see Figure 2.5). This resulted in 14 different subgroups. Analysis with these subgroups showed that the effect size was highest for taste exposure strategy when coupled with reward and modelling. However, this subgroup only consisted of two studies, which had very different effect sizes. For example, the study by Horne, et al. (2011), had much larger effect size of hedges g = 1.30, CI 0.72-1.80, p < 0.001, compared to an intervention arm within the study by Holley, et al. (2015); hedges g = 0.50, CI: -0.54 - 1.54, p = 0.35).

Further consideration of these subgroup suggests that the effects of taste exposure intervention appears to be the most important, as repeated taste exposure interventions alone have a higher effect than taste exposure and reward combined, reward alone or taste exposure and modelling combined (Figure 2.5). Moreover, taste exposure to the vegetable on its own (plain form) produced a bigger impact on intake than pairing with other flavours, dips or energy. Some interventions such as offering choice, pairing with dips or making vegetables visually appealing did not improve vegetable intake; this may due to lack of power as only one or two studies were from these categories.

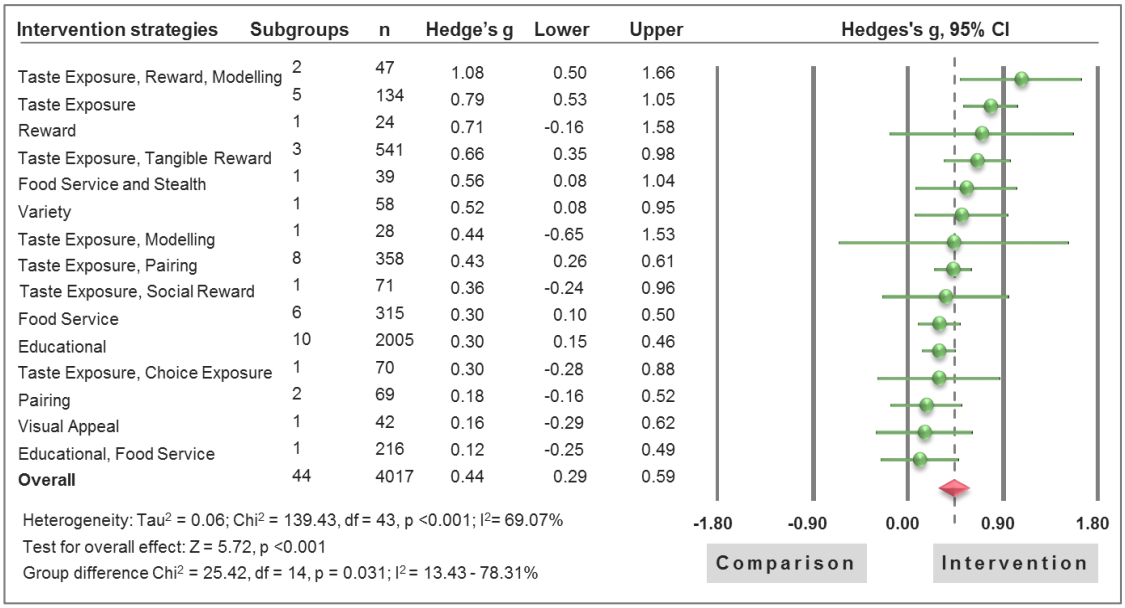

Figure 2.5 Effect by intervention strategies on vegetable intake by intervention arms (n = 44 arranged by the effect size).

2.4.8 Number of taste exposures

A meta-regression analysis was performed to examine if the number of exposures offered in the ten repeated taste exposure studies had an effect on vegetable intake (Figure 2.6). The analysis indicated that the number of taste exposures was positively associated with effect size (B = 0.035 (SEM 0.01, CI 0.00 - 0.06, p = 0.01). The model was statistically significant (Q = 6.21, df = 1, p = 0.013) and the goodness of fit indicated that the effect size did not vary significantly between these studies when the number of taste exposures were controlled for (R^2 = 74%, Tau^2 = 0.02, Q = 10.21, df = 8, p = 0.250, I^2 = 21.67%). For a meaningful improvement in intake (a moderate effect of g = 0. 5) children would require 8-10 taste exposures.

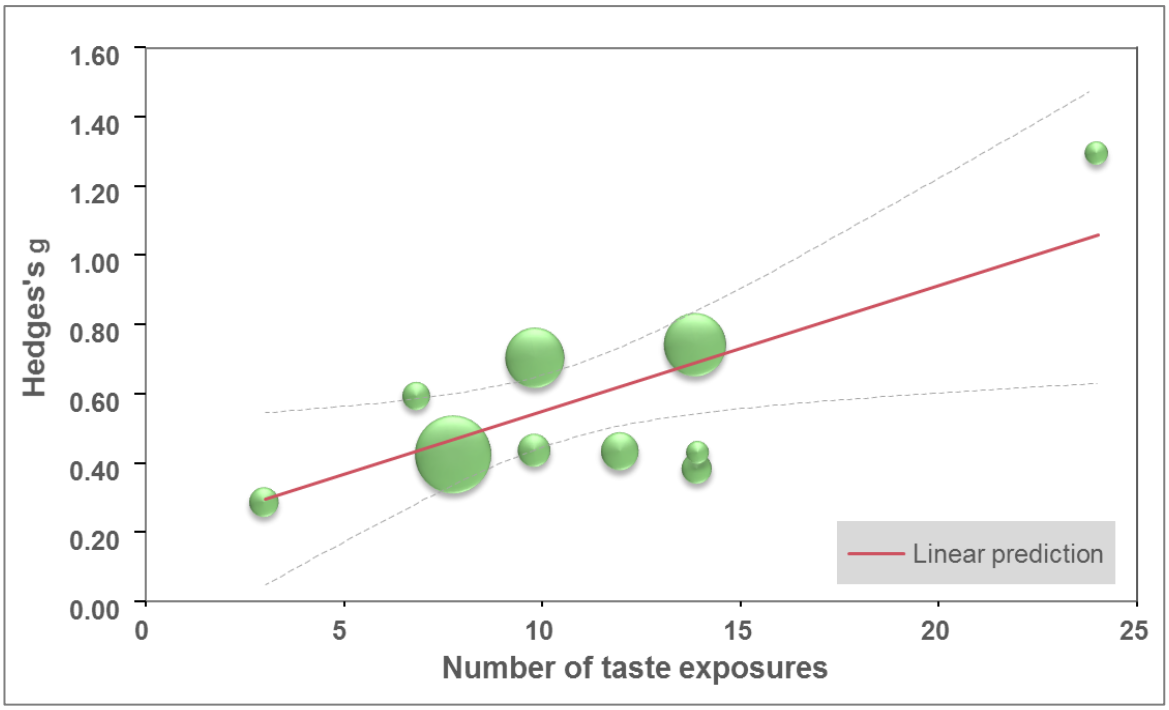

Figure 2.6 Meta-regression of effect size (hedges g) according to the number of taste exposures in repeated taste exposure studies (with line of best fit, 95% confidence interval and each study's weight in the meta-analysis, n = 10).

2.4.9 Publication bias

In order to investigate if there was publication bias a funnel plot and Egger's regression test were performed. The funnel plot indicated significant asymmetry (see Figure 2.7), which suggests the presence of publication bias in the present selection of the studies. This is supported by Egger's regression test, indicating that the unpublished studies were likely to have an effect on the overall change in vegetable intake (intercept (B0) is 1.74, 95% CI: 0.17 - 3.31, df = 28, t = 2.27, p = 0.015). Duval and Tweedie's trim and fill method indicated that under the random effects model, eight studies are missing and if these studies are added to the analysis then the

imputed combined effect is adjusted to g = 0.31 (95% CI, 0.208 - 0.41) from g = 0.40. The overall effect is slightly reduced, however the effect of the interventions on vegetable intake remained favourable compared to the comparison.

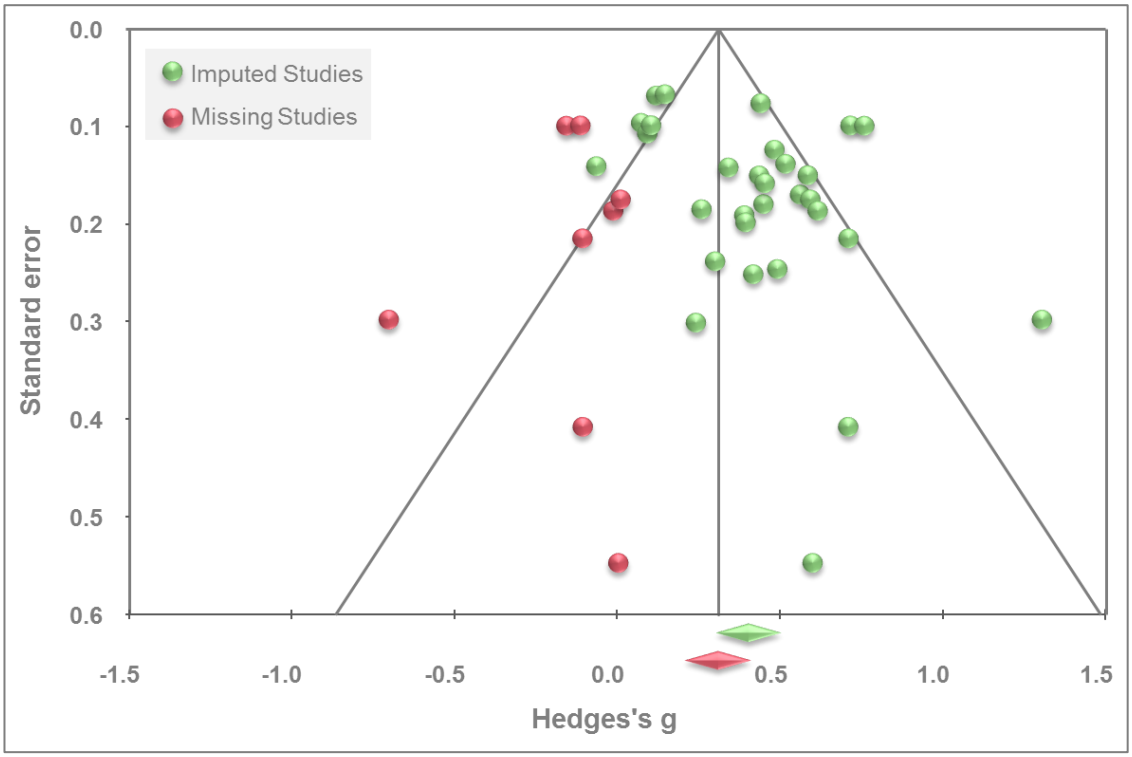

Figure 2.7 An asymmetry Funnel plot of standard error by Hedges g of included (n = 30) and missing studies (n = 8).

2.5 Discussion

2.5.1 Main findings

The present review identified interventions designed to promote vegetable intake in young children and determined whether some strategies were more effective than others. This was the first systematic review which attempted to investigate intake of familiar or usual and unfamiliar or disliked vegetables separately in order to assess whether the type of vegetable offered to the children influenced outcomes. Evidence showed that the intake of unfamiliar or disliked vegetables was more increased than familiar or usual vegetables. This may be a 'ceiling effect' such that the independent variable will have little or no effect on the outcome measurement. Thus, intervention effectiveness may also depend on vegetable familiarity and liking. Overall, evidence from the studies pooled in the meta-analysis indicated that a range of interventions were moderately successful in increasing vegetable intake.

The present meta-analysis revealed that interventions implementing repeated taste exposure had better pooled effects than those which did not. A previous review by Wolfenden, et al. (2012) concluded that the taste exposure strategy was not beneficial in the short-term (at 3 months follow-up), but that using reward with taste exposure was an effective strategy for increasing vegetable consumption. These conclusions should be interpreted with caution as their meta-analysis only included two studies and the findings were mainly driven by one study (Cooke, Chambers, Añez, & Wardle, 2011). Cooke, Chambers, Añez, and Wardle (2011) found that the repeated taste exposure strategy was successful immediately after the intervention and at 1-month follow-up, but exposure alone had no sustained effects at 3 months, although liking increased as expected. The authors further added that due to a compliance problem (e.g. in home), the children in the exposure alone condition may have received fewer exposures than the children in the tangible reward condition. Although the number of exposures were controlled in their analysis, the present review has identified that the number of taste exposures children received was an important factor for increased intake. Interventions with repeated taste exposures were most effective, therefore, in contrast to Wolfenden, et al. (2012), this review stresses the importance of repeated taste exposures, independent of reward. This is further supported by Horne, et al. (2011) who found that once the liking was established during snack time, intake generalised to lunch time in the absence of rewards.

A pairwise comparison indicated that the children had increased intake when vegetables were offered by a parent compared to when offered by the researcher alone. This may be because parents participating in studies may be highly motivated and closeness to the children is likely to yield stronger effects than interventions delivered by unfamiliar others. This is confirmed by finding no differences in effect size when teachers delivered the intervention compared to parents. This review complements and extends the previous review by Holley, et al., (2017a) as the present review is based on quantitative synthesis and provided evidence from educational strategies which were missing in the previous review. The present meta-analysis included nineteen of the twenty-two studies from the previous review (Holley, et al., 2017a). Present findings supported previous suggestions of successful strategies in 2-5 year olds (taste exposure, modelling and non-food reward), however it has further demonstrated the success of these strategies based on effect sizes and more importantly it highlights small effects of educational interventions on vegetable intake.

A previous review by Diep, et al. (2014) found that the quality of the study determined the success of the intervention. This was not apparent in the present review. Most of the studies were scored as weak or moderate and this raises concerns about quality of research in this area. Typically there are problems around lack of representativeness of the sample, the researcher or participants not being blind to the intervention and issues of accuracy when recording intake. However, these are common methodological constraints in this field. Therefore, as suggested by Hodder, et al. (2018) future research should adopt more rigorous methods to minimise risk of bias and advance the field of research concerning promotion of fruit and vegetable intake.

Significant heterogeneity was observed in pooling 30 studies, however, additional subgroup analyses indicated that the moderators were possible sources of inconsistency (e.g. the type of vegetable used and intervention strategies). Furthermore, due to the problem of multi-collinearity, it was difficult to determine whether taste exposure strategy or the use of an unfamiliar vegetable was more important in predicting intake. This needs to be explored in future research. Meta-analysis is a powerful tool to summarise data from many studies, however there is also the potential to over interpret results. For example, small studies tend to report larger treatment benefits than larger studies (Sterne, Gavaghan, & Egger, 2000), affecting the overall effect size. Thus, findings should be interpreted with some caution. A major limitation of using standardised effect size (Hedges g) is the clinical interpretation of the findings. However, in four taste exposure only studies, in which children were provided with at least a full portion of the vegetables, on average children increased their intake by 67g of the target vegetable (Bouhlal, et al., 2014; Caton, et al., 2013; de Wild, et al., 2013; Hausner, et al., 2012). Given that a child portion of vegetables is 40g, this increase of 67g is at least one and a half portions and is therefore clinically important.

Repeated exposure in early years is perceived to be important in the formation of taste preference (Ventura & Worobey, 2013). According to the meta-regression the more exposure a child receives to a particular vegetable the more they will increase their intake of that vegetable. To achieve an increase in intake at least 8-10 exposures are recommended, especially for disliked or unfamiliar vegetables. Moreover, the evidence suggests that offering vegetables alone is better than pairing with flavours or energy as this can result in a negative contrast effect when subsequently presented alone (Dwyer, 2012).

2.5.2 Strength and limitations

Some novel findings have emerged from this review including the effect of vegetable familiarity or liking on intake of vegetables and the most effective intervention strategies in children aged 2-5 years. The findings in relation to vegetable familiarity on intake is novel and interesting, but there are some limitations. While the authors categorised the type of vegetables based on vegetables used in the primary research and author's descriptions there are potential overlaps between the vegetable categories. For example, a vegetable which is familiar can be disliked and unfamiliar foods are not necessarily disliked. Therefore, the outcome from this subgroup analysis should be interpreted with caution.

Moreover, meta-analysis is a statistical procedure that combines results of several independent studies (Egger, Smith and Phillips, 1997). The pooled effects calculated in a meta-analysis are based on the weighted average (means accounting for variance) of results from individual studies which are considered to be similar. Hence, combining study designs is generally discouraged as this would further increase the risk of heterogeneity due to the differing variance in different study designs (Haidich, 2010). For example, variance in between-groups designs studies is likely to be greater than within-groups design studies, similarly confounding factors are likely to vary between RCT and non-RCT studies (Valentinea and Thompson, 2012). Consequently, in the present meta-analysis a random-effects model was used to account for additional sources of variance (within study variance, in addition to between study variance considered by the fixed-effects model; Egger, Smith and Phillips, 1997). Though, this model provides some mathematical corrections (wider confidence interval than fixed-effects model) to account for heterogeneity for calculating a summary estimate, it gives greater weight to smaller studies (e.g. see effect size for the study by Horne et al, 2011). This makes interpretation of the results more difficult and may also lead to biased conclusions (Borenstein, Hedges, Higgins and Rothstein, 2009). For example, results in studies with a small number of participants may be due to chance rather than an actual effect from an intervention. In the present thesis, to address the research aim of identifying the most effective intervention strategies it was necessary to combine different study designs (e.g. limited number of studies with the same study designs only 12 of 30 studies identified for the meta-analysis were RCT/ CRT). However, as shown in table 2.4, the effect size did vary by the study design therefore, findings should be interpreted with further caution.

A comprehensive search for the present review did not retrieve any papers which specifically addressed fussy eaters, but the age range for the search included the peak period for fussy eating. Future studies might investigate what specific strategies are effective in children who score high for food neophobia or fussy eating. Also, longer term studies are needed to investigate if taste exposure strategies are sustainable over time (12+ months) and whether they are feasible and cost effective at a large scale. Moreover, some strategies may need to be tailored to the needs of particular children, for example those with genetic taste sensitivity to bitter tastes (see Keller 2014 for a review).

A previous systematic review by Mikkelsen, et al. (2014) reported that including an education component to children's vegetable intervention was important. In the present meta-analysis, all educational interventions were successful at increasing vegetable intake, but the effect sizes were smaller than the taste exposure strategies. These educational interventions are usually targeted to increase vegetables which are already familiar to the children, therefore more research is needed to assess their effects on unfamiliar vegetables. A more recent systematic review by Hendrie, et al. (2016) investigating children's 'usual intake' rather than a specific target vegetable (e.g. disliked) in 2-15 year olds stated that the taste exposure studies were promising for the target vegetables but no evidence was reported beyond this on their habitual vegetable intake. Therefore, the authors suggested that future interventions should combine taste exposure strategies with those which influence the usual intake. To our knowledge repeated taste exposure (usually for target vegetables) in combination with education (generally for improving the usual intake) has not been investigated on the (habitual) intake of vegetables in children aged 2-5 years. Therefore, these strategies should be combined to assess if intake of both the target vegetable and child's usual vegetable intake can be improved simultaneously.

2.5.3 Conclusions and implications

In conclusion, repeated taste exposure is a simple technique that could be considered suitable for broader translation to childcare settings and the home. Health policy could specifically target the use of novel and disliked vegetables in addition to the usual vegetables consumed in childcare settings with emphasis on offering a minimum of 8-10 exposures. Further research is needed to understand which strategies work best for the food fussy children. Improving liking and encouraging intake of vegetables will lead to long term health benefits only if the intake is sustained. Therefore, lasting strategies which encourage vegetable intake in the early years is essential and can influence later health outcomes.

Locations of studies included in the systematic review

Chapter 3

Taste Exposure and Nutrition Education

Chapter 3

Taste exposure is more effective than nutrition education to increase intake of a novel vegetable in preschool children: a cluster randomised trial

In Chapter 2, meta-analysis indicated that taste exposure was the most effective single strategy for increasing intake of unfamiliar or disliked vegetables in preschool children. However, the effects of nutrition education on intake of unfamiliar vegetables are less well known than effects on familiar vegetables. Since nutrition education is commonly used in preschool settings, the study presented in Chapter 3 will examine whether nutrition education is effective for increasing intake of a novel vegetable in comparison with taste exposure as well as a combination of both nutrition education and taste exposure. This study set out to determine the relative effectiveness of each strategy and whether the combined condition might produce an additive effect on vegetable intake. In addition, the time course of any effect on intake was tracked over time (at weeks 24 and 36) and whether any of the strategies were effective for food fussy children. Feedback from a process evaluation was conducted to assess whether these strategies are considered suitable for use in preschool settings.

3.1 Steps taken

1. Designed and conducted a novel intervention study by combining both taste exposure and nutrition education
2. Implemented robust study design and research methods to collect data
3. Pre-registered the trial at clinical trials.gov
4. Evaluated the effects of nutrition education, taste exposure and their combined effects on intake of a novel vegetable
5. Evaluated short-midterm effectiveness of these interventions
6. Assessed the impact of these strategies for food fussy children
7. Completed process evaluation for both types of interventions
8. Reported findings according to the Consolidated Standards of Reporting Trials (CONSORT) statement for cluster randomised trials

3.2 Introduction

Chapters 1 and 2 have highlighted the importance of eating more vegetables as well as barriers which impede intake, especially for preschoolers. Children who are fussy eaters appear to be especially resistant to eating vegetables, and it has been proposed that systematic exposure in early life is needed to encourage vegetable intake in these children (Dovey, et al., 2008) . Parents of fussy eaters use a variety of vegetable specific strategies including hiding vegetables in meals as well as food and non-food rewards to encourage intake (Holley, Haycraft, & Farrow, 2018). Food fussiness peaks between the ages of 2 and 5 years yet there are few studies which investigate which strategies benefit children with food fussiness (Caton, et al., 2014; Owen, Kennedy, Hill, & Houston-Price, 2018).

Preschool provides an ideal opportunity for children to learn about healthy eating and to try new foods for the first time (Kobel, et al., 2017; Mikkelsen, et al., 2014; Williams, et al., 2014). Nurseries encourage healthy eating through nutrition education programmes. These programmes are tailored to the child's age with learning activities that are designed to be fun and interactive as well as educational. However, education programmes implemented in nursery tend to focus on vegetables which are already familiar to the children and their effects on unfamiliar vegetables are understudied (Nekitsing, Blundell-Birtill, et al., 2018). Furthermore, the effects of these programmes on actual food intake tend to be small, perhaps due to the indirect nature of the exposure (Nekitsing, Blundell-Birtill, et al., 2018; Nekitsing, Hetherington, et al., 2018b). Therefore, it has been proposed that learning about vegetables through direct experience of the taste, smell and texture through exposure and engaging children in hands-on activities to increase familiarisation will increase intake of vegetables (DeCosta, et al., 2017).

Repeated taste exposure is known to enhance intake of vegetables (Ahern, et al., 2014; Caton, et al., 2013; Holley, Haycraft, et al., 2017), via familiarisation (Zanjonc, 1968) and learned safety (Kalat & Rozin, 1973). Eight to ten taste exposures to a novel or previously disliked vegetable are sufficient to increase consumption at the group level (Birch, et al., 1987; Caton, et al., 2011). However, this may not be effective at the individual level since caregivers may not achieve this number of exposures as they interpret initial refusal as genuine dislike (Carruth, et al., 2004; Cooke, et al., 2007; Cooke, et al., 2004). Similarly, in nurseries, to avoid waste, children may not be offered vegetables which are thought to be disliked.

Providing children with incentives such as tangible non-food rewards (like stickers) with repeated taste exposure can increase vegetable acceptance, both in the home

and in nursery (Fildes, van Jaarsveld, et al., 2014b; Holley, et al., 2015; Remington, et al., 2012). Indeed, combining nutrition education, specifically designed to increase knowledge about vegetables, with taste exposure might produce a synergistic effect in increasing vegetable intake. Synergy in this context may be achieved by both encouraging children to try the taste of an unfamiliar vegetable therefore giving them direct experience of the target vegetable (smell, taste, and texture) as well as by increasing their awareness of different vegetables and their benefits to health and wellbeing. For young children it may be important to understand why vegetables are good for them in order to also taste and eat them when offered.

3.2.1 Aims and hypothesis

The aim of this cluster randomised trial was to test the relative efficacy of repeated taste exposure, nutrition education, and a combined taste exposure plus nutrition intervention compared to a no intervention control on intake of an unfamiliar vegetable in preschool children. In particular, the study assessed whether these strategies were effective in encouraging intake of an unfamiliar vegetable in children who are relatively food fussy. The primary hypothesis to be tested was that children would increase intake of an unfamiliar vegetable following intervention relative to control; and that a combined taste exposure plus nutrition education would enhance intake of the vegetable more than either intervention alone and relative to a control. The second hypothesis tested was that food fussy children would increase vegetable intake more after repeated taste exposure compared to nutrition education.

3.3 Methods

This chapter is reported according to the CONSORT guidelines for cluster randomised trials (see Appendix B1 for the completed checklist).

3.3.1 Study design and setting

A 2x2 factorial parallel design (with a no intervention control) was used in the present cluster randomised controlled trial (see Figure 3.1). For ease of intervention delivery and feasibility in a nursery setting, it was decided that a cluster randomisation trial was the most appropriate design. The 11 nurseries agreeing to participate in the study varied in size, therefore stratified randomisation was used. The nurseries were divided into three strata, with the four largest in one stratum, then the four smallest in another stratum. One nursery in each stratum was assigned to each intervention condition using an online list generator (https://www.random.org/lists); (1) taste exposure only, (2) nutrition education only, (3) taste exposure plus nutrition education, or (4) no

intervention (waitlist control). Researcher CN generated the random allocation sequence for each nursery and nursery managers chose the day and time which was most convenient for them, and thus which children would be included in the study. Nursery managers were not informed of their condition allocation until all nurseries were recruited (post consent) and randomised. It was possible to conceal condition allocation between clusters but not within cluster. Parents were given a list of potential study vegetables used during the study phase.

Nurseries were offered the PhunkyFoods programme (PFP) as an incentive to take part (normally valued at £395 per annum); they either received this during the intervention or on completion of the study. All procedures were conducted in accordance with the ethical guidelines set by the British Psychological Society and approved by the University of Leeds, School of Psychology Research Ethics Committee (16-0198). The trial was preregistered (ClinicalTrials.gov; identifier NCT03003923). The study lasted for 12 weeks (September 2016 - December 2017) including a 10-week intervention phase (plus baseline and post-intervention assessment) with follow-up (FU) intake of the unfamiliar vegetable measured at weeks 24 (March 2017) and 36 (June 2017).

3.3.2 Sample size and participants

A previous cluster randomised trial in this field reported that clustering did not influence the outcome, therefore specific power calculations were not performed to account for clusters (De Bock, Breitenstein, & Fischer, 2012). The target sample size to include at least 40 children in each group was based on a previous randomised controlled trial by Remington, et al. (2012). It was estimated that a minimum of two to three settings per group would be needed to meet this target. Fifty-five nurseries from Leeds, Brighouse and Halifax (West Yorkshire, UK) were sent a recruitment email (see Appendix B2) in July 2016, followed by a telephone call.

In all, 219 children (from 11 nurseries) were enrolled in the study, however the anticipated sample size was not fully met for the final analysis (see Figure 3.2). The low number of children in the control condition was attributed to low attendance on different test days. Consent to participate was sought from the nursery manager at the cluster level and individually by parents using an opt-out approach (see Appendix B3 for the nursery opt-in consent form; Appendix B4 for the poster displayed outside nursery rooms to make parents further aware of the ongoing research study; and Appendix B5 for the parent information letter and opt-out consent form).

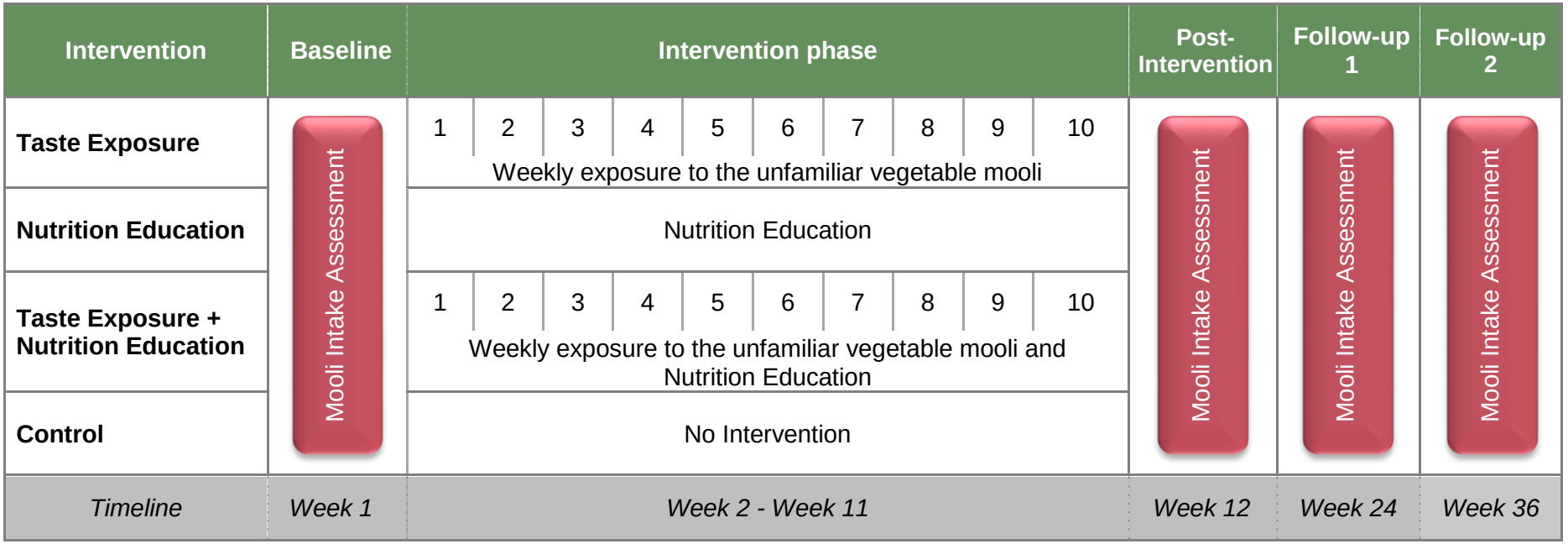

Figure 3.1 Design of a study testing the effectiveness of taste exposure and nutrition education on intake of an unfamiliar vegetable (mooli).

The intervention lasted 10 weeks and intake of mooli was measured for all children at baseline (week 1), post-intervention (week 12), follow-up 1 (week 24) and follow-up 2 (week 36). Children in the taste exposure intervention were offered mooli once a week and children in the nutrition education intervention were offered ‘Strive for Five’ and ‘Eat Well’ nutrition lessons from an existing PhunkyFoods education programme

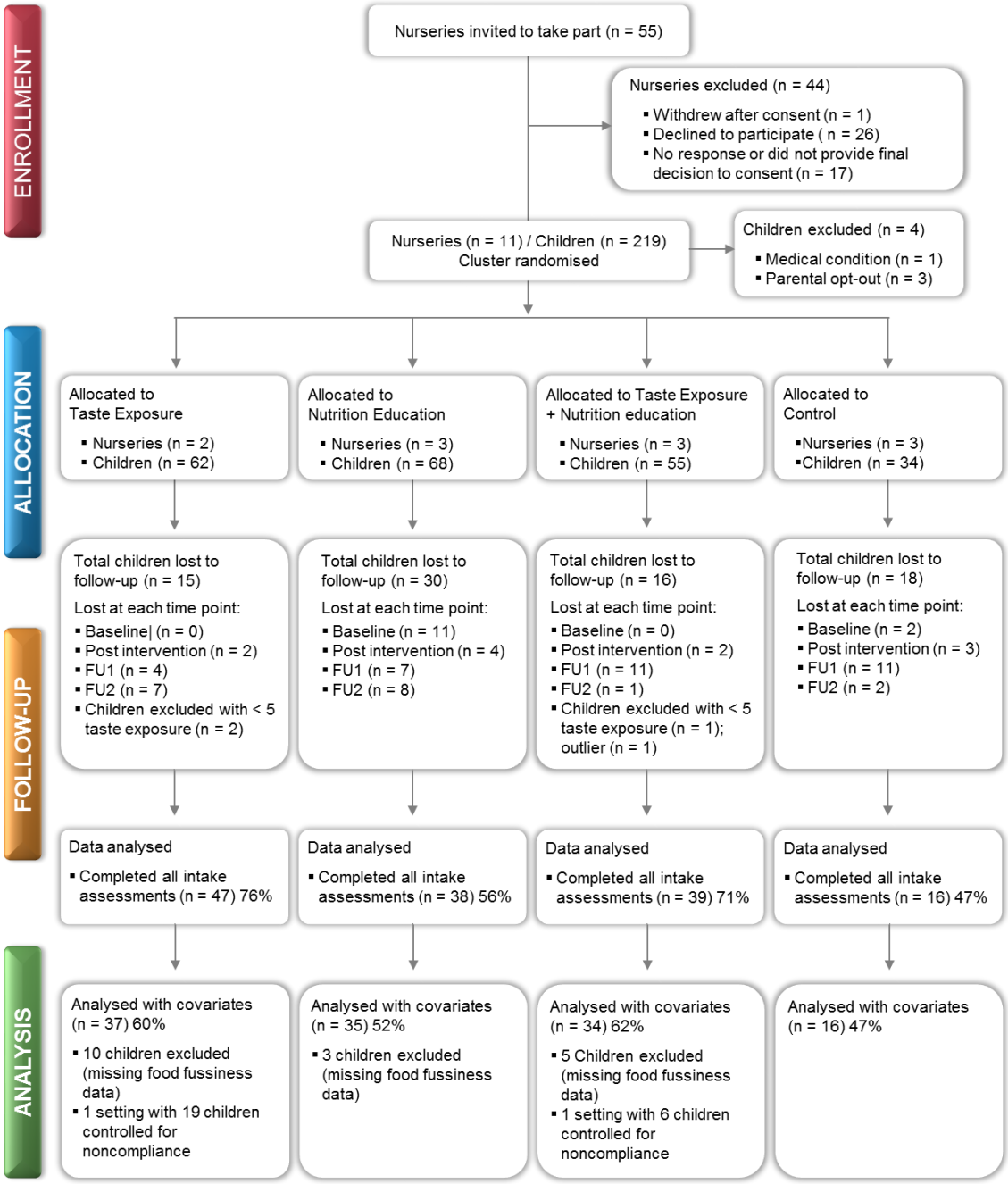

Figure 3.2 Flow of clusters (nurseries) and children through phases of the trial. Clusters were controlled for in the analysis. Children were classified as lost to follow-up and excluded from the analysis if they were away at any of the intake assessment days. For further analysis data were excluded for missing individual food fussiness score or nurseries for noncompliance.

Nursery managers signed the informed consent form and children could say no and decline to participate in research activities. All children aged 2-5 years attending their nursery class on the agreed test day were included. Children were excluded from the study if they had any relevant food allergies, a medical condition which would prevent them from eating the test vegetable or if their parents opted out of the study (Figure 3.2). Nurseries were eligible to take part if they were not participating in other nutrition

health programmes and were able to commit to the time frame of the study (9 months).

3.3.3 Material - target unfamiliar vegetable

During development of the intervention, all nursery managers were asked about vegetables offered to children in their settings. Based on this information a selection of seven unfamiliar vegetables, available through all seasons in the UK, were selected for a taste test (coccinia cluster beans, steamed beetroot, raw beetroot, marrow, cherry belle radish and mooli white radish). These vegetables were tasted and independently rated by a panel of ten researchers. The purpose of the tasting session was to identify a novel vegetable (unfamiliar), that could be eaten raw (e.g. not too bitter or hard) and was suitable for nursery children (i.e. not too strong or sour). For each vegetable the panel was asked to respond to 17 statements, for example, “I eat this vegetable often”, “this vegetable is bitter” and “I would not eat these vegetables”. This was mostly rated using a Likert scale (1 = strongly disagree, 2 = agree, 3 = neutral, 4 = disagree, 5 = strongly disagree). See Appendix B6, for the full list of statements and ratings. Based on the ratings and suggestions of most panel members, mooli (a variety of daikon, long white radish) was selected to be used as the unfamiliar vegetable for the present study.

3.3.4 Procedure

The nursery staff were provided with all the necessary resources and basic instructions to deliver the intervention to children in their nurseries. During week 1 baseline intake of mooli was measured at the pre-arranged snack time and children’s height and weight was also measured. Over the next 10 weeks children in the intervention conditions were offered either the taste exposure, nutrition education or the combined intervention and children in the control condition were offered no intervention. After the intervention, at week 12 post-intervention, mooli intake was measured. Mooli intake was also recorded at two follow-up periods (week 24 and week 36) at the usual snack time. The intervention was delivered at the level of the nursery and outcomes were measured at the individual level.

3.3.5 Baseline, post-intervention and FU intake assessment procedure

Intake of mooli was assessed at weeks 1, 12, 24 and 36. The vegetable was offered to children at their usual snack time (mornings or afternoons) and so it was assumed that children would be moderately hungry. A snack time was initiated for two nurseries which did not normally have a snack session as they only offered 3 main meals

(breakfast, lunch and dinner) in their setting. Each vegetable portion was weighed (to the nearest 0.01g) before and after each snack time using a digital scale (Mettler PJ4000) by the research team. Fresh mooli was peeled and cut into bite size pieces (thin ~0.4mm slices, in circles, semicircle or quadrants depending on the size of the mooli). Snack bags were labelled with child's name and weighed for each child with ~40g portion (see Figure 3.3 for preparation of mooli). Spare bags were also prepared in case children requested more of the vegetable.

Study snacks were delivered to the nurseries at least 30 minutes prior to their snack session to allow staff time to prepare for this. Children were allowed to eat *ad libitum* during each snack time. Staff were asked to ensure that children did not share their snack with others and that any leftovers were returned to the individual snack bags. Staff were advised to store the vegetable in the fridge, or the cool bag provided before and to return the bags to the cooler after consumption; this was done to reduce any moisture loss. Snack bags were collected after the snack session and were re-weighed immediately to calculate intake.

Figure 3.3 Preparation of mooli (target vegetable) for the taste test and intake assessments

3.3.6 Intervention – taste exposure and nutrition education

For the taste exposure and taste exposure plus nutrition education conditions, the researcher prepared mooli as snacks, delivered this to each nursery and then the snacks were provided to children by the nursery staff. The procedure for mooli preparation and intake were same as those on the intake assessment days (see section 3.3.5). Taste exposure involved offering mooli during usual snack time once per week, every week for 10 weeks (weeks 2-11). The vegetable snack was offered in pre-weighed 40g portions using individual snack bags labelled for each child. See Figure 3.4 for children eating mooli during the snack time.

Figure 3.4 Children eating mooli during taste exposure intervention

For the nutrition education clusters, nursery staff were trained by the PhunkyFoods team to deliver the existing nutrition education programme (www.phunkyfoods.com). Staff were instructed to teach two specific components of the PFP as often as possible over the 10-week period, namely: “Strive for 5” and “Eat Well” and, then to record these activities on a checklist (see Appendix B7 for the “Strive for 5” lesson plan; Appendix B8 for the “Eat Well lesson plan and Appendix B9 for the lessons checklist for both components). For the “Eat Well” component children learned about eating a well-balanced diet, adapted from the UK EatWell guide and in “Strive for 5!” children were taught about eating five portions of fruits and vegetables each day as well as the importance of eating a variety of these foods. It should be noted that the PFP does not contain any activities directly relating to mooli.

The PFP is designed for nursery children and follows the English Early Years Foundation Stage Framework, promoting learning through planned purposeful play, and a mix of adult-led and child-initiated activities. PFP provides nurseries with ideas and inspiration for classroom carousel play activities (e.g. stories, role play, and games), practical food handling/ preparation activities, educational displays for the

classroom and parental involvement opportunities. Resources are available in both online and offline formats and cover a range of nutrition education topics. Staff were given materials to support their teaching within the curriculum covering communication and language, physical development, literacy, expressive arts and design, food preparation and display themes. These included photo cards, posters, a floor mat, game ideas, interactive video stories, music, food preparation, tasting ideas, drawing and colouring activities. Figure 3.5 shows children engaging in activity during a PhunkyFoods education session.

Figure 3.5 Children learning about eating a variety of fruit and vegetables during nutrition education lesson

Staff were requested to complete a checklist of activities they had delivered during the main intervention period (see Appendix B9). The checklist consisted of 12 activities for each of the two modules (24 possible). In this checklist, staff identified which of the 12 activities they used in lessons from the module and this was converted to a percentage to indicated coverage of the materials. In total, six nurseries using the PFP delivered at least 35% or more of the required contents (delivery of the intervention was as follows; 100% (n = 2), 50% (n = 2), 40% (n = 1) and 35% (n = 1). Nurseries in the nutrition education clusters were able to continue accessing and delivering the PFP during the post-intervention period, reflecting pragmatic and real-world delivery access.

For the taste exposure plus nutrition education intervention children were offered both weekly taste exposures and the nutrition education programme (as described above). The control condition did not receive any intervention during the study period but were offered the education programme on completion of the study (after week 36).

3.3.7 Data collection and measures

3.3.7.1 Primary trial outcomes

The primary pre-specified outcome was weighed intake of mooli. All children across conditions were offered the mooli at four time points: Baseline (week 1), Post-intervention (week 12), FU1 (week 24), and FU2 (week 36). The outcomes were measured at an individual level because factors such as body mass index (BMI), age and eating traits may affect vegetable intake and vary between children.

3.3.7.2 Secondary trial outcomes

A secondary outcome originally planned during the study registration was usual vegetable intake, assessed using the European Prospective Investigation of Cancer (EPIC) Norfolk Food Frequency Questionnaire (FFQ; Mulligan, Luben, et al., 2014). Parents were asked to complete the FFQ at baseline, week 12 and week 24. Those parents who completed the questionnaires at all 3 time-points were entered into a prize draw with a chance to win £100 in shopping vouchers. The overall response rate from 3 time-points was very low (13%) and as a result the secondary outcome data are not reported in the present chapter.

3.3.7.3 Other measures: Demographic and anthropometric

The investigator measured height using a stadiometer (Seca 217) and weight using a portable weighing scale (Seca 878). Body mass index (BMI) z-scores (adjusted height and weight for age) were calculated using the WHO anthropometric calculator (http://www.who.int/childgrowth/software/en). Child age and sex were recorded by nursery staff.

3.3.7.4 Other measures: Child eating behaviours

Food fussiness was measured using the 6-items of the Food Fussiness subscale (α = 0.91) from the Child Eating Behaviour Questionnaire (Wardle, et al., 2001). Food neophobia was assessed using the 6-items (α = 0.90) of the Food Neophobia Scale (Pliner, 1994). Parental response rates were low during the first attempt (22%). Given the importance of identifying food fussiness and neophobia in the cohort a second attempt was made with the help of the nursery staff to encourage responses on these two constructs (see Appendix B10 for the questionnaire). Generally parents provided this information (n = 135), however in some cases due to time constraints, some parents agreed that the nursery key worker could complete the questionnaire on their behalf (n = 24). There were no differences in ratings by parents or the key worker (independent group comparison).

3.3.7.5 Intervention evaluation measures

As part of the process evaluation nursery staff were asked to complete feedback surveys regarding the intervention. Members of staff from nine nurseries (excluding controls) were asked to rate the materials on the following items: acceptability, user engagement, implementation and effectiveness of the taste exposure and/or PFP, depending on condition. See Appendix B11 for the taste exposure evaluation questionnaire and Appendix B12 for the PhunkyFoods nutrition education evaluation questionnaire[1]. The questionnaire consisted of open-ended questions, for example, for the taste exposure evaluation, "what would help or what barriers would there be to include repeated taste exposures in your usual practice"?, as well as items requiring response on a Likert scale. For example, for the nutrition education evaluation "the PhunkyFoods resources are engaging for children" (response was rated on a scale of 1 to 5, where 1 was 'strongly disagree' and 5 was 'strongly agree').

3.3.8 Statistical analysis

3.3.8.1 Primary analysis

Descriptive statistics (means + SEM) were generated for demographic variables and to plot the pattern of intake and change in intake by condition over time. Correlations were conducted to show the contribution of participant characteristics to baseline and changes in intake. Chi-square and ANOVA were conducted to check for differences in sex, age, BMIz, food fussiness, food neophobia and baseline mooli intake across condition, as well as between those children whose data was included and those who were originally recruited. Intake data were excluded from analyses where children in the taste exposure conditions had fewer than five taste exposures (n = 3). Also, for this condition since intake was measured weekly, if the data were missing for the baseline (n = 6) or post-intervention intake (n = 17) then the child's very first or the last intake was used for the analysis. Children in the nutrition education and control condition with missing intake data at baseline or post-intervention and any children's data missing for FU1 or FU2 were excluded from the main analysis (n = 75). One child who ate 121g of the test vegetable at post-intervention (in the combined condition) was an outlier (identified by an extreme value on the box plot), therefore was excluded from the analysis.

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[1] The PhunkyFoods nutrition education evaluation questionnaire used for the present study was an existing questionnaire used by the company for their annual programme evaluation. Only the format of the questionnaire was edited for the present study.

As children were recruited using a cluster design it was important to account for the impact of cluster assignment. Therefore, design effect adjustments were applied to the analysis as suggested by Campbell et al. (2000) and Murray (1998). Variance was calculated using the Restricted Maximum Likelihood Model (IBM SPSS) based on the baseline intake data; nurseries were added as the random factors and food fussiness as a covariate. There was a small clustering effect observed using this method. The intra-cluster correlation (ICC) of $\rho = 0.035$ with average cluster size of 11.7 children per nursery indicated a design effect of 1.41. The ICC was similar to a previous study in this field (De Bock, Breitenstein and Fischer 2012). De Bock, Breitenstein and Fischer (2012) and Lai and Kwok (2015) have stated that the clustering can be ignored if the design effect is < 2.0. However, to report more precisely the primary analysis in the results section are reported after the corrections (indicated by $_{adj}$ in the results section).

Intake data, in particular for baseline was positively skewed as many children ate 0g of mooli. Therefore, analyses were mostly performed on the change in intake data, as this was more normally distributed. The change in intake was calculated as the difference in score between the baseline intake and intake at each time point (post-intervention, FU1 and FU2). Bivariate and partial (independent of the intervention) correlations were performed to investigate the contribution of participant's characteristics to baseline and change in intakes.

A non-parametric Wilcoxon Signed Ranks test was performed to investigate if intake of the test vegetable increased from baseline to post-intervention. A 3x2x2 mixed measures ANOVA was carried out to examine the main effects of time (post, FU1 and FU2), taste exposure (taste or no taste exposure), and nutrition education intervention (education or no education) on change in mooli intake from baseline. To further investigate the effects of the interventions an ANCOVA was performed using the above procedure with food fussiness and noncompliance as the covariates.

3.3.8.2 Subgroup analysis

For the subgroup analysis further children with missing food fussiness data (n = 18) were excluded. Moreover, two nurseries (n = 25 children) in the taste exposure condition (one from taste exposure only and one from combined intervention condition) were considered as non-compliant to the intervention because they continued to offer their usual nursery snacks to the children immediately after the target study snacks (mooli). This may have affected the intake of the unfamiliar vegetable, especially for the children receiving the weekly taste exposures as they

might have learned that their usual snack will follow if they chose not to consume the study vegetable. Therefore, to control for children in these settings a categorical dummy variable ‘non-compliance’ was created and added as a covariate.

A subgroup analysis with only the high food fussy children were performed using the above ANCOVA procedure with noncompliance as a covariate to explore the effectiveness of the intervention for the food fussy children. In addition, an exploratory subgroup analysis using the Mann Whitney U test was performed to examine the issue of noncompliance within the two settings. A non-parametric test was more appropriate here because there were unequal number of children between the compliance vs noncompliance group and the change in intake data was skewed for the noncompliance group. Data are reported as means with their standard errors, unless otherwise stated. Where the assumptions of sphericity were violated the Greenhouse-Geisser correction was applied. All analyses were performed using IBM SPSS Statistics, version 24 (SPSS, 2018). The α-value was set at $p < 0.05$.

3.4 Results

3.4.1 Participant characteristics

Included in the final analysis were 140 children (70 boys/ 70 girls) with complete intake assessments at all four time points with a mean age of 40.6 ± 0.4 months (see Figure 3.2). Table 3.1 provides the baseline characteristics of the children who took part in the intervention. There were no differences across intervention conditions in sex distribution or mean BMI z-score. However, there were small group differences in terms of age, food fussiness and food neophobia and these are indicated in the table. No differences were found in baseline characteristics or intake of the children who were lost to follow-up compared to those who completed the study (see Appendix B13).

3.4.2 Association of participant characteristics with vegetable intake

The correlations summarised in Table 3.2 show the contribution of participant characteristics to baseline and changes in intake. Children’s age and BMIz did not correlate with intake or change in intake at any point in the present study, therefore it was not controlled for within the analysis. Food fussiness and food neophobia showed a strong positive association, as expected. Both of these food avoidance behaviours were associated with changes in intake at post-intervention and FU2, but not with baseline intake nor change in intake at FU1.

Table 3.1 Characteristics of nursery children and baseline intake (g) of the unfamiliar vegetable by intervention condition.

	Taste exposure	Nutrition education	Taste exposure + Nutrition education	Control	p value
N total (min/max)	37 / 47	35 / 38	39/ 34	16	
N per cluster (C) (min/max)	37 / 47 C1 = 19 C 2 = 18 / 28	35 / 38 C1 = 15 C2 = 4 / 6 C3 = 16 / 17	39 / 34 C1 = 6 C2 = 19 / 24 C3 = 9	16 C1 = 6 C2 = 4 C3 = 6	
Sex (girl/ boy)	24/ 23	15/ 23	25/ 14	6/ 10	0.12 (χ^2)
	← *Mean ± SEM* →				
Age, months	38.11 ± 0.83[a,b]	43.42 ± 0.54[a,c]	40.54 ± 0.65[c]	41.75 ± 0.87[b]	<0.001 (F)
BMIz	0.74 ± 0.14	1.15 ± 0.15	0.85 ± 0.14	0.63 ± 0.20	0.13 (F)
Food Fussiness	2.82 ± 0.12 [d]	2.62 ± 0.13	2.30 ± 0.12[d,e]	3.15 ± 0.21[e]	0.002 (F)
Food Neophobia	2.43 ± 0.10 [d]	2.19 ± 0.09	1.93 ± 0.10[d,e]	2.57 ± 0.12[e]	<0.001 (F)
Baseline Intake (g	3.23 ± 1.00	4.51 ± 1.54	7.06 ± 2.02	2.63 ± 2.07	0.25 (F)

Mean ± SEM are reported unless stated otherwise.
Significant differences between groups are indicated by ANOVA (F) and Chi-square (χ2) tests.
N (min/ max); the total number of children included in the analysis with intake data from all four time-points (n = 140) and food fussiness/ food neophobia data (n = 122).
Differences between groups are as follow: [a] taste exposure and education; [b] taste exposure and control; [c] nutrition education and combined group; [d] taste exposure and combined group; and [e] combined group and control

Children who scored higher on food fussiness and food neophobia were less likely to increase their intake of the unfamiliar vegetable over time. As both eating behaviours were highly correlated with each other, and association of food fussiness was stronger with the change intake, only food fussiness was controlled for in the subsequent analysis. Children's baseline intake was associated with change in intake at all points. Children who ate less at the beginning of the study had greater change in intake at post-intervention, FU1 and FU2. Therefore, those children who had greater improved intake at post-intervention, continued to eat more of the test vegetable at follow-ups.

Table 3.2 Patterns of correlations between participant characteristics and their baseline intake and change intake of the target vegetable.

	Age	BMIz	Food fussiness	Food neophobia	Baseline intake	Change post	Change FU1
BMIz[a]	0.21*						
Food fussiness[a]	0.09	-0.06					
Food neophobia[a]	-0.03	-0.16	.85**				
Baseline intake[b]	0.05	0.14	-0.11	-0.15			
Change post[c]	-0.02	0.06	-0.26**	-0.22*	-0.35**		
Change FU1[c]	-0.06	-0.07	-0.17	-0.10	-0.20*	0.68**	
Change FU2	-0.02	0.13	-0.27**	-0.19*	-0.28**	0.50**	0.48**

Change; change in intake were calculated from the baseline intake: post; post intervention (week 12), FU1; follow-up 1 (week 24), FU2; follow-up 2 (week 36).
Correlation tests performed were based on the dataset, [a] Pearson's correlations [b] Spearman correlations and [c] Partial correlations independent of the intervention type.
Significance indicated as follows: *p < 0.01; **p < 0.001

3.4.3 Primary analysis

3.4.3.1 Change in mooli intake over the intervention and beyond

Mean intakes of mooli at each time-point by condition is shown in Figure 3.6 and changes in intake from baseline to post-intervention and follow-ups by 2x2 factorial design are displayed in Figure 3.7.

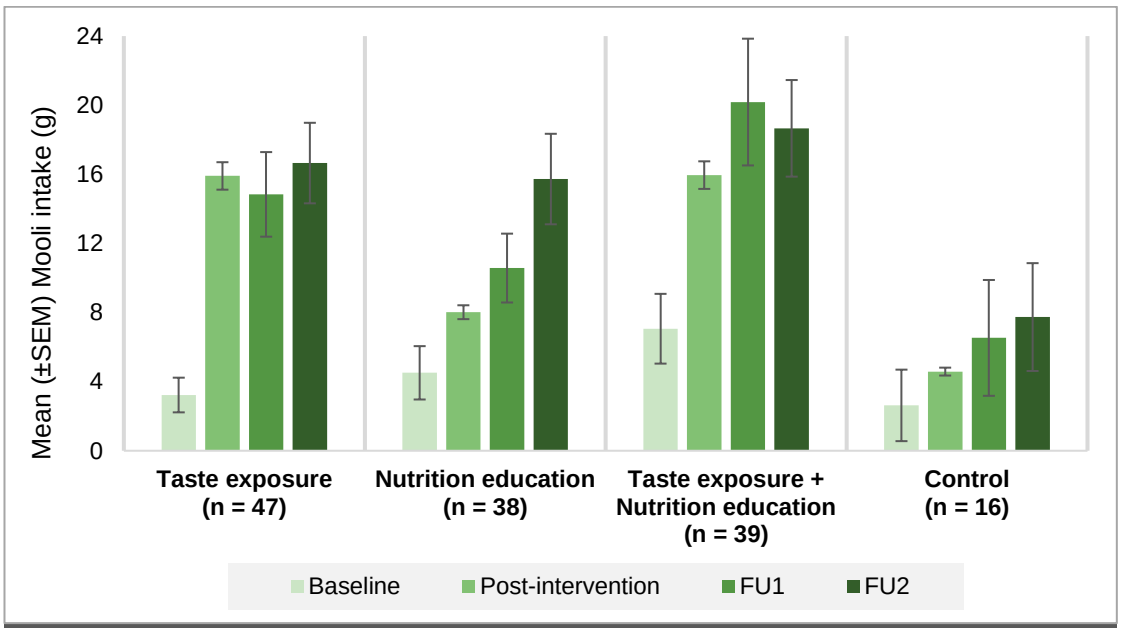


Figure 3.6 Mean (±SEM) intake (grams) of mooli by condition at baseline (week 1), post-intervention (week 12), Follow-up 1 (week 24) and Follow-up 2 (week 36).

The average intake of mooli at baseline was 4.6 ± 0.8g and this did not vary by group. The mean intake at post-intervention was 12.5 ± 1.3g. A Wilcoxon Signed-Ranks Test indicated that the post-intervention intake was significantly higher than the baseline intake $_{adj}Z = -4.88$, $p < 0.001$. This suggests that all children regardless of the condition increased their intake of mooli.

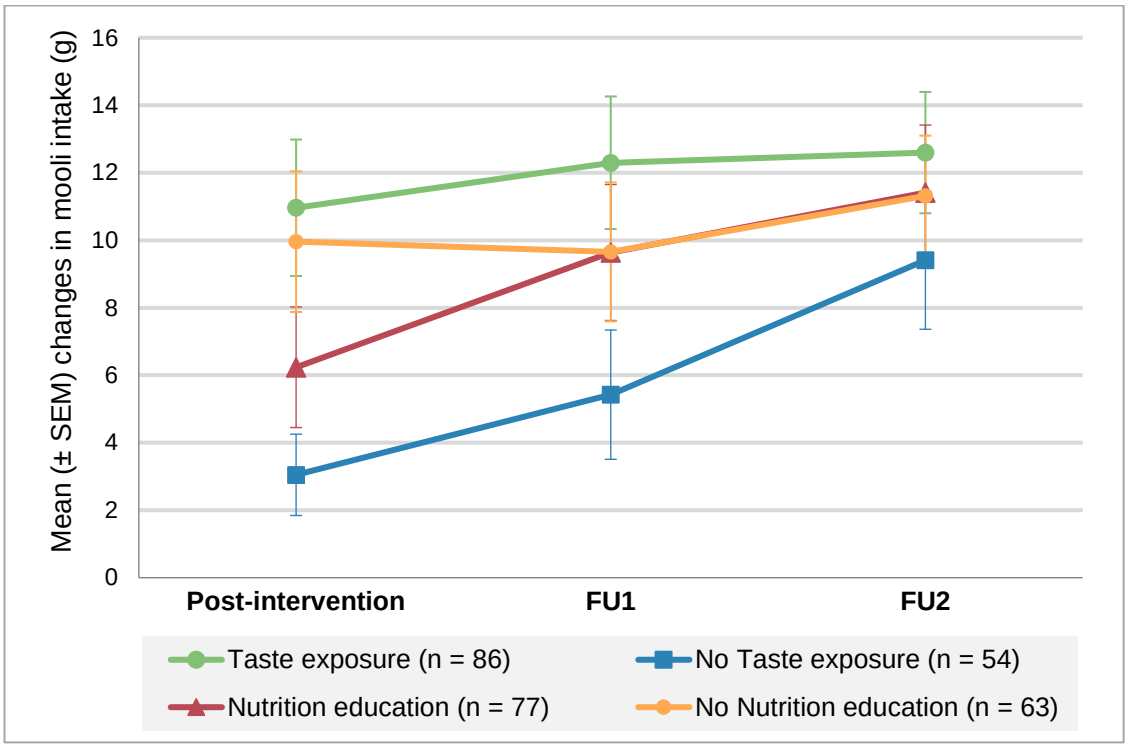


Figure 3.7 Changes in intake (mean ± SEM) of mooli (g) from baseline to post-intervention, FU1 and FU2 by 2x2 factorial design.

ANOVA showed that the pooled change in intake did not vary by time (post-intervention, FU1, FU2), indicating that the change in intake from post-intervention was maintained at follow-ups ($_{adj}F$ (1.9, 255.2) = 2.44, p = 0.120). Overall there was a significant main effect of the taste exposure intervention ($_{adj}F$ (1,136) = 4.78, p = 0.030, $\eta p^2 = 0.05$). Over the 3 time-points, children who received the taste exposure intervention increased their intake on average by 11.9 ± 1.5g compared to 5.3 ± 2.1g for children who did not receive the repeated taste exposures. In comparison, children receiving the education intervention increased their intake by 9.1 ± 1.6g compared to 8.0 ± 2.0g for children who did not receive the nutrition education programme. There was no main effect of nutrition education nor any interaction effects were observed (maximum $_{adj}F$ (1, 136) = 0.59), demonstrating that nutrition education had no additional effects over taste exposure on improving intake of the novel vegetable.

3.4.3.2 Change in mooli intake: controlling for food fussiness and noncompliance.

ANCOVA indicated that when controlling for food fussiness and noncompliance (see exploratory analysis below) there was no significant effect of time ($_{adj}$ F (1.87), 216.9 = 0.11, p = 0.736). The effect of taste exposure intervention remained statistically significant ($_{adj}$ F (1,116) = 5.34, p = 0.023, ηp^2 = 0.06). There was no main effect of education intervention, nor any interaction effects (maximum $_{adj}$ F (1, 116) = 1.65). This suggests that when controlling for covariates which are likely to affect the outcome, the effect of the repeated taste exposure strategy is greater than education in promoting vegetable intake in children.

3.4.4 Subgroup analysis

3.5.4.1 Exploratory analysis; non-compliance to taste exposure intervention

It was not pre-planned to investigate the effects of non-compliance. However, as two nurseries in the two taste exposure groups did not follow the protocol correctly and offered children their own snack immediately after the study snacks, it was important to investigate the effects of non-compliance on the outcome. Hence, non-parametric Mann Whitney U tests were performed to explore the issue of non-compliance. Twenty-five children who were offered the usual nursery snacks immediately after the study snack showed a lower increase in mooli intake compared to 61 children who were not offered their usual snacks. Median changes in intake with the inter quartile range (IQR) and statistical significance are indicated in Table 3.3. The results showed that offering usual snack did influence consumption of the test food. The effects were observed at post-intervention and FU1. However, by FU2 the differences were smaller.

Table 3.3 Median (IQR) change in mooli intake for taste exposure groups who were offered their usual snack (non-compliance) and not offered their usual snack.

Time-point	Offered their usual snack[1]	Offered only study snack	U	p
	Median (IQR)			
Post-intervention	0.2g (-0.5 - 3.1)	7.1g (0.1 - 34.6)	509.00	0.016
FU1	0.1g (-1.2 - 1.9)	11.1g (0.2 - 36.4)	401.50	0.001
FU2	2.3g (-0.5 - 13.0)	9.90 (0.3 - 31.8)	557.50	0.051

[1]Nurseries were considered non-compliant as they offered children their own snack immediately after the study snacks

3.5.4.2 Intervention effectiveness for the food fussy children

A previous study by Steinsbekk, Sveen, Fildes, Llewellyn, and Wichstrøm (2017) proposed that a score ≥ 3 on the CEBQ fussiness subscale was an indication of medium to high levels of food fussiness. To investigate if children who scored high on food fussiness benefited from the interventions, food fussiness scores were dichotomised as high (≥ 3) or low (< 3). The number of children based on this categorisation varied in each group (taste exposure only; 16 high and 21 low, education only; 12 high and 23 low, combined group; 5 high and 29 low; and control; 9 high and 7 low). ANCOVA indicated that when controlling for the two non-compliant settings, high food fussy children significantly increased their intake if they received the taste exposure intervention than those who did not ($F(1, 37)$ 5.15, $p = 0.029$, $\eta p^2 = 0.12$). Average change in intake over the 3 time-points was +11.2 ± 3.3g for taste exposure groups (n = 21) compared to +0.5 ± 3.0g for those who did not receive the taste exposure intervention (n = 21). No effects of nutrition education, nor interaction effects were observed (maximum $F(1, 37) = 0.22$).

3.4.5 Categorisation of children based on their eating status

Table 3.4 Proportion of children in each intake category, at each time point by intervention condition.

Time-point	Eating category	Taste Exposure	Nutrition Education	Taste Exposure + Nutrition education	Control
			n (%)		
Baseline[a]	Non-eaters	15 (32%)	7 (18%)	14 (36%)	4 (25%)
	Eaters	32 (68%)	31 (82%)	25 (64%)	12 (75%)
Post-intervention[b]	Non-eaters	3 (6%)	0 (0%)	4 (10%)	4 (25%)
	Eaters	44 (94%)	38 (100%)	35 (90%)	12 (75%)
FU1[c]	Non-eaters	8 (17%)	3 (8%)	6 (15%)	5 (31%)
	Eaters	39 (83%)	35 (92%)	33 (85%)	11 (69%)
FU2[d]	Non-eaters	8 (17%)	4 (11%)	4 (10%)	4 (25.0%)
	Eaters	39 (83%)	34 (89%)	35 (90%)	12 (75.0%)

Children were categorised as Non-eaters (0g intake), and Eaters (>0g intake): based on their mooli intake at [a]baseline baseline, [b]post-intervention, [c]FU1 and [d]FU2.

Whether a child eats any mooli is a proxy for fussiness as it is defined in relation to the child's actual behaviour (willingness to try the vegetable) rather than relying on parental reports of fussy eating. Given that many children did not eat mooli at baseline, it was important to investigate outcome by eating category. Therefore, children were categorised as 'non-eaters' (intake = 0g) or 'eaters' (intake > 0g) according to their eating pattern at baseline, post-intervention, FU1 and FU2 and these are shown in Table 3.4. In addition to this children who were non-eaters at baseline and remained non-eaters post-intervention is shown in Figure 3.8. Proportion of non-eaters reduced from baseline to post-intervention in the three intervention condition compared to the control condition. The numbers remained lower than baseline at two follow-ups. This shows that taste exposure and nutrition education intervention may help children to at least try some of the unfamiliar vegetable. Additional analyses were performed based on the eating category, however as this analysis was not the main focus of the present study, these are appended in Appendix B14.

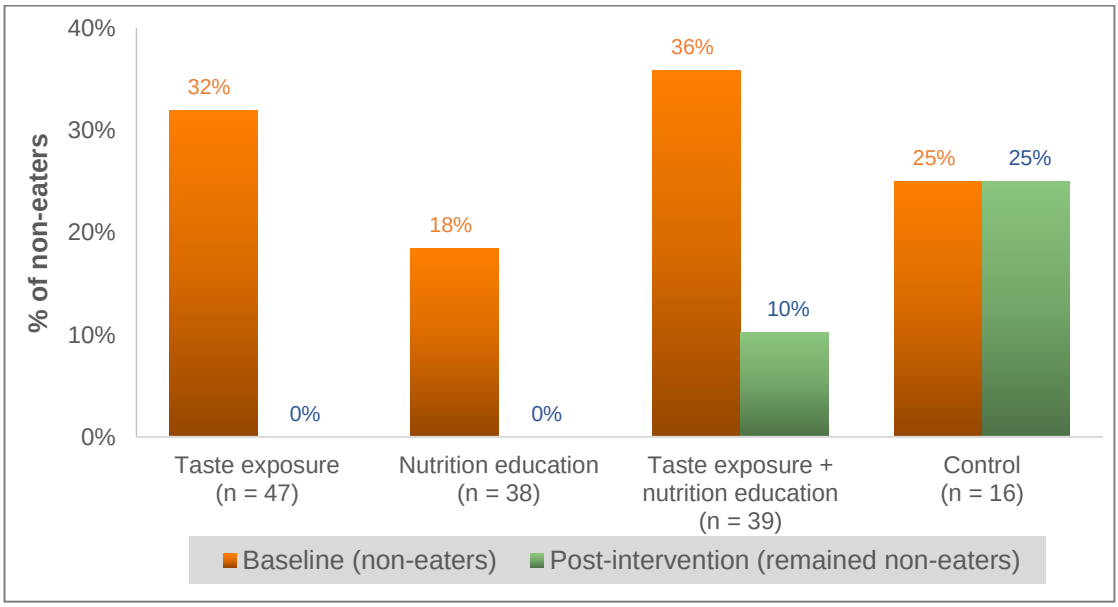


Figure 3.8 Percentage of children who were non-eaters at the baseline and those who remained non-eaters at post-intervention by condition.

3.4.6 Process evaluation

3.4.6.1 Taste exposure intervention feedback

Staff from all five nurseries in the taste exposure condition completed the evaluation survey. Relevant quantitative evaluation data for taste exposure intervention are summarised in table 3.5 and qualitative data containing examples of quotes from the evaluation feedback are presented in Table 3.6.

Table 3.5 Process feedback from nursery staff for taste exposure intervention. Mean ratings; with minimum and maximum[a].

Evaluation statement	Mean	Min	Max
The study was interesting	4.2	3.0	5.0
We found this study a hassle to deliver	2.4	1.0	4.0
We were able to integrate the study requirements into our nursery curriculum	3.2	2.0	4.0
Children were engaged during the tasting sessions	3.8	2.0	5.0
We have noticed a change in children's intake of the study vegetable from week 1 to week 12 (September - December)	3.6	3.0	4.0
We have noticed a change in children's intake of vegetables during other mealtimes in the nursery from week 1 to week 12 (September - December)	3.0	2.0	4.0
We would recommend using a repeated taste exposure technique in nursery settings at snack time	3.8	3.0	4.0
We advise using a repeated exposure technique at a meal time not snack time	3.2	2.0	4.0
[a]The evaluation questions were rated on a 5 point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree.			

For the taste exposure intervention, four out of five settings reported that the intervention was easy to deliver. These four nurseries also reported that children were engaged during the taste exposure sessions. However, only two out of five nurseries agreed that they were able to integrate the study requirements within their normal nursery curriculum. Staff in three out of five nurseries noticed an increase in intake of the target unfamiliar vegetable over the intervention period. It should be noted that the two nurseries which did not report positive change in intake were those which offered their usual nursery snacks to the children immediately after the test vegetable (quote A). Staff reported that cost and time would be the main barriers to implement a repeated taste exposure intervention in the future (quotes B and C). Some nurseries reported that they found it challenging to get some children to try the new vegetable (quote D), and two nurseries did not comply with the taste protocol as the staff continued to offer the usual snack immediately after the vegetable snack. For overall experience on a scale of 1 to 10 (where 1 is 'extremely negative' and 10 is 'extremely positive') ratings from five nurseries were as follows five, seven, eight, ten and ten. See quotes E and F and G which highlights the importance of staff commitment and their positive or negative experience of the present trial.

Table 3.6 Quotes from nursery staff for taste exposure intervention; extracted from nursery's process evaluation survey.

Quote	Extracts for Taste Exposure Intervention
Quote A	*Fitting it into routine, as we couldn't start our normal snack around it so took up most of the morning just focusing on snack, it reduced the amount of play time children got.*
Quote B	*Providing funding for repeated taste exposure vegetables. Cost implications would be a barrier.*
Quote C	*Time. Busy - day to day routine (trips, French etc.).*
Quote D	*Encouraging the children to have the initial taste. Some children were unsure due to the texture.*
Quote E	*Children remember if they didn't like it so were reluctant to try again. It was difficult having to have 2 snack times in a short time frame as children who didn't eat the radish still need snack plus milk. We found it hard having to stop the routine to monitor the individual intake. Staff tried the radish and said it tasted awful and the smell put them off.*
Quote F	*Was sometimes difficult for the staff to get the children to eat it whilst they were playing. Most children were really keen and enthusiastic to try the radish and often asked for more.*
Quote G	*The children have thoroughly enjoyed this experience showing excitement to participate in the taste exposure weekly. Staff members have supported the children and encouraged them throughout.*

3.4.6.2 Nutrition education intervention feedback

Staff from all six nurseries in the nutrition education condition completed the evaluation survey. Relevant quantitative evaluation feedback for the PhunkyFoods nutrition education intervention are summarised in table 3.7 and qualitative data are highlighted in Table 3.8. Overall feedback for the education intervention was very positive (quote H). All six nurseries reported that the PhunkyFoods resources are of a high quality (quote I). Five out of six nurseries reported that resources were easy to use, easy to deliver and engaging for the preschool children (quote J).

Whilst five out of six nurseries reported that they believed that the implementation of the education programme had an impact on healthy lifestyle awareness and knowledge (quote K), four out of six nurseries reported that the programme did not have any impact on improving children's healthy eating behaviour.

Table 3.7 Process evaluation feedback from nursery staff for PhunkyFoods nutrition education. Mean ratings; with minimum and maximum[a].

Evaluation statement	Mean	Min	Max
The PhunkyFoods key message activity ideas are simple and clear for staff to deliver	4.0	2.0	5.0
The PhunkyFoods key message activity ideas are pitched at the correct level for the children	3.7	1.0	5.0
The PhunkyFoods key message activity ideas are engaging for the children	3.8	2.0	5.0
The PhunkyFoods resources are engaging for the children	4.0	2.0	5.0
The PhunkyFoods resources are of a high quality	4.3	4.0	5.0
The PhunkyFoods resources are of sufficient variety	4.0	3.0	5.0
The PhunkyFoods resources are easy to use	3.8	2.0	5.0
The PhunkyFoods website is easy to use	4.3	3.0	5.0
The PhunkyFoods website is supportive	4.2	3.0	5.0
The PhunkyFoods website is informative	4.3	4.0	5.0
[a]The evaluation questions were rated on a 5 point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree.			

The reason for perceived lack of impact may be due to partial programme implementation, nursery food environment (Quote L) and may also be due to lack of parent engagement. Only 2 nurseries were able to involve parents in the PhunkyFoods activities (quote M). Finally, one nursery allocated to the nutrition education only intervention recognised the importance of the taste exposure technique as they commented that children did not receive enough exposure to the study vegetable and suggested to improve the programme by offering the children more exposure to the vegetable as part of the nutrition education programme (quote N).

Table 3.8 Quotes from nursery staff for PhunkyFoods nutrition education intervention, extracted from nursery's process evaluation survey.

Quote	Extracts for Nutrition Education Intervention
Quote H	*The programme has been good and has given ourselves a few new ideas to help reinforce the healthy eating and staying healthy topics we already do within our setting. Thank you for letting ourselves be part of the programme.*
Quote I	*The pack provides lots of easy thinking points. The flashcards make learning easier for children.*
Quote J	*The pack provides lots of easy thinking points. The flashcards make learning easier for children.*
Quote K	*Children are commenting more at mealtimes on the food on their plates and the health benefits to their bodies.*
Quote L	*As all children/ most children at the age of 3 meet a challenge with food. Also, nursery menu not very child friendly and high in puddings/ sugar.*
Quote M	*The parents are all aware of the programme and we discuss with them what activities we have tried and what may be good to try at home.*
Quote N	[most disappointing thing] *The children only got to try the vegetables twice. If children are to like something, they have to try it more and more.* [Improvement suggestions] *More chances to try the vegetable used in the research.*

3.5 Discussion

3.5.1 Key findings and comparison with previous studies

To our knowledge, this is the first trial to examine the efficacy of both a nutrition education and taste exposure intervention delivered together or in isolation on intake of an unfamiliar vegetable in preschool children. In partial support of the first hypothesis, findings from the present study confirmed that repeated taste exposure was an effective method to increase intake of mooli. However, there was no specific impact of the nutrition education on overall intake nor any additional benefit of combining taste exposure and nutrition education. In partial support of the second hypothesis, with the taste exposure intervention food fussy children also improved their intake. Overall, children across the study tended to increase their intake of the unfamiliar vegetable over time. This may be attributed to the mere exposure effect, since by the end of the study all children had received a minimum of four exposures to the unfamiliar vegetable (Pliner, 1982; Zajonc, Markus, & Wilson, 1974). Also this may be due, in part, to the change in children's age and development, as all children were six months older by the final follow-up and some children may become less fussy with time (Cooke, Chambers, Añez, Croker, et al., 2011).

In the taste exposure conditions, ten exposures were sufficient to increase children's consumption by a quarter of a portion (on average) of a child's vegetable intake, or 5% of their daily fruit and vegetable recommendation. The change was maintained six months after the intervention phase. This study demonstrated that once a child learned to eat a vegetable during the initial exposures they then maintained this intake over the short-midterm at follow-up when offered the same vegetable again. Findings from the current study provide support for lasting effects of taste exposure, at weeks 24 and 36. In contrast, a previous study by Cooke et al., (Cooke, Chambers, Añez, Croker, et al., 2011) found that effects of taste exposure alone (without rewards) became non-significant by three months. These differences may be attributable to use of a previously disliked rather than an unfamiliar vegetable and to differences between using a home-based rather than a preschool setting for the study. Also, these differences suggest that rewards may be needed if the effects are to endure in the home environment but may not be necessary in nurseries where other motivating factors such as peer modelling and social norms are present, in line with predictions form the Social Learning Theory (Bandura, 1977).

The findings for nutrition education intervention might be accounted for by variable compliance with all elements of the education programme or to the fact that the nutrition education was not specifically about the target vegetable (mooli). Also, based on the feedback from the nursery staff the nutrition education did not have any impact on children's eating behaviour at the nursery mealtimes. By the 2nd follow-up children's intake in the education only group appeared to be increasing. As well as children getting older, this may be because most of the nurseries with the education programme continued to use the resources up to the follow-up periods. Hence nutrition education may play a modest role in the longer term in encouraging intake of vegetables.

Nutrition education is widely used in nurseries, however the present study demonstrated that learning in a general way about vegetables is not sufficient to increase intake of an unfamiliar vegetable. However, it may set the scene for children to try the vegetable, as seen by a reduction in the number of non-eaters over time. Previous studies have found that learning specific to a target food, such as through visual exposure using picture books or sensory learning can be effective in increasing intake of a target vegetable (Heath, et al., 2014; Houston-Price, et al., 2009). Therefore, there may be some benefit to combining nutrition education with experiential learning about the target vegetable with taste exposure so that a more gradual, step-by-step approach is adopted. This approach might involve a first step of

introducing vegetables in a general way through nutrition education followed by experiential and sensory learning, and finally taste exposure. A more gradual approach may tackle children's food avoidance behaviours. For example, a study with children aged 7-9 years found that an integrated educational intervention involving taste education and culinary experience reduced children's food neophobia and increased their willingness to try novel foods (Park & Cho, 2016b). Therefore, taste exposures could be integrated within existing nutrition education programmes, but more work is needed to understand how the delivery of taste exposure can be improved as only two nurseries in the present study felt able to integrate this into their usual curriculum. The use of picture books highlighting a target vegetable or sensory play may help to facilitate taste exposures and this is an ecologically valid method to apply in the nursery (Coulthard & Sealy, 2017; Houston-Price, Owen, Kennedy, & Hill, 2019; Owen, et al., 2018).

Findings from the present study showed that children's food fussiness was associated with a small, but significant increase in intake. In line with the previous research we also found that children who scored high on food fussiness showed a lower increase in intake of the novel vegetable than children scoring low on food fussiness (Fildes, et al., 2016; Holley, Haycraft, et al., 2017). Yet, even the relatively fussy children in the present study learned to eat the new vegetable over time, consistent with previous taste exposure research (Caton, et al., 2014). This is because tasting unfamiliar foods increases familiarity with these foods which may help to alter children's food avoidance behaviours. Another factor which emerged to limit the intervention's effectiveness was offering children familiar foods immediately after the study vegetable. Research suggests that if children are given a choice between an unfamiliar or familiar food the preference for the familiar will mostly prevail over the unfamiliar (Bevelander, Anschutz, & Engels, 2012). Thus, in nurseries where children learned that their usual snack would still be available after the vegetable snack, this inhibited intake of the target vegetable.

3.5.2 Strengths and Limitations

The strengths of this study include: randomisation, allocation concealment, reduced selection bias (by using an opt-out approach at the individual level), objective data collection and a long-term follow-up. However, study results should be considered in the context of some limitations. First, a reasonable sample size was recruited, however due to the nature of the study design there was a high rate of missing data over time for the complete set of intake data including follow-ups (36%) and food fussiness data (45%). As a result of this there was a substantially smaller sample size

in the control condition. In terms of the intervention delivery, nurseries varied in the extent to which they delivered the two components of the nutrition education programme and compliance was recorded using self-report from nursery staff. Also, attendance for each child was not recorded, therefore it is unknown how much of the nutrition education was received individually. Implementation of the education programme is in line with previous research which suggests that barriers exist in implementing nutrition education interventions, hence they may be used infrequently or assigned low priority in an already crowded curriculum (Knai, Pomerleau, Lock, & McKee, 2006; Nathan, Wolfenden, et al., 2011; Sharp, Pettigrew, et al., 2017; Williams, et al., 2014). Therefore, nutrition education programmes as used in the present study are generalizable to the real world where implementation is variable. Similarly, some nurseries did not comply with the repeated taste exposure protocol as the staff continued to offer the usual snack immediately after the vegetable snack. Despite this, the effect of taste exposure was still evident in the nursery context.

Due to the low number of questionnaires returned from the parents, the present study was not able to explore the effects of taste exposure and nutrition education on usual at home vegetable intake as pre-planned. Therefore, future research should assess the effects of these interventions on the intake of the target vegetable as well as other unfamiliar and familiar vegetables at nursery and home. It is also important to investigate transfer effects, for example from nursery to home and vice versa. Children's food fussiness influences eating behaviour change, and this can affect the success of a dietary intervention. Therefore, adjusting the intervention to suit the individual needs of children, including non-eaters or fussy eaters, could improve the success of taste, or education based interventions.

3.5.3 Conclusions and implications

When supporting young children in nurseries to eat well a consistent approach in intervention delivery and commitment from the nursery staff are both essential. Taste exposure is a robust and durable strategy to promote intake of an unfamiliar food. In this study, preschool children who were willing to eat the unfamiliar vegetable increased their intake of this vegetable over time following intermittent exposure during snack time in a group setting. In contrast, nutrition education alone was not sufficient to increase intake of an unfamiliar vegetable. However, nutrition education may help to increase willingness to taste the unfamiliar vegetable. Therefore, in future, such programmes could incorporate experiential learning including taste exposure to encourage first steps towards tasting and eating a new vegetable.

Chapter 4

Storybook and Sensory Play

Chapter 4

Increasing intake of an unfamiliar vegetable in preschool children through learning using storybooks and sensory play: a cluster randomised trial

As highlighted in Chapters 1 to 3 taste exposure is an effective strategy for increasing vegetable intake in preschool children. In comparison, nutrition education programmes are widely used but the effects are small compared to taste exposure. Hence, more research is needed to understand how nutrition education programmes can be enhanced for promoting intake of unfamiliar vegetables in preschool children. For example, do children need to learn about the target vegetable before trying it and is direct learning necessary to increase willingness to try vegetables and to consume them. Chapter 4 investigates whether a nutrition education programme may be enhanced by asking two key research questions:

1. To encourage intake of a novel vegetable in preschool children, is it important that narrative storybooks and sensory play involve the target vegetable (congruent learning)?
2. Is there any additional benefit of combining storybooks with sensory play for increasing intake and willingness to try?

4.1 Steps taken

1. Designed and conducted a novel intervention study by combining both storybook and sensory play
2. Implemented robust study design and research methods to collect data
3. Pre-registered the trial at clinical trials.gov
4. Evaluated the effects of congruent and incongruent learning, with and without sensory play on intake and recognition
5. Assessed the impact of these strategies on willingness to taste
6. Completed process evaluation for both type of interventions
7. Reported finding according to the Consolidated Standards of Reporting Trials (CONSORT) statement for cluster randomised trials

4.2 Introduction

Benefits and barriers of eating vegetables are highlighted in Chapters 1 and 2. As seen from the meta-analysis (Chapter 2) interventions are more effective in increasing intake of unfamiliar or disliked vegetables than familiar/ liked vegetables. For preschool children, nurseries are appropriate environments in which to encourage children to try novel foods (Williams, et al., 2014). However, education programmes implemented in nurseries to promote healthy eating tend to focus on vegetables which are already familiar to the children. These programmes are designed to be fun, interactive and engaging yet their effects on increasing vegetable intake are small (DeCosta, et al., 2017; Nekitsing, Blundell-Birtill, et al., 2018; Nekitsing, Hetherington, et al., 2018). This may be attributed to the indirect nature of how children are exposed to vegetables in these programmes (i.e. reading about them but not handling or eating them). Learning about vegetables may increase recognition of different vegetables but may not translate to a behavioural outcome such as tasting or consuming these vegetables. It is therefore important to know whether intake of an unfamiliar vegetable might be encouraged by combining direct and indirect exposures to an unfamiliar vegetable. Furthermore, it is not clear whether this type of learning also benefits from being specific to a single vegetable (congruent learning) or whether learning about any vegetable encourages intake of an unfamiliar vegetable (incongruent learning).

Strategies such as repeated taste exposure have been successful in increasing intake of unfamiliar vegetables (Chapter 2). However, as found in the previous study (Chapter 3) many children were non-eaters and nursery staff also reported that it was difficult to get some children to try the target vegetable (mooli). For repeated taste exposure to occur, it is important that children are at least willing to try the unfamiliar food. Hence, further research is needed to support parents and caregivers to introduce unfamiliar vegetables and to test the effectiveness of alternative exposure techniques which may facilitate eventual intake (Dazeley, et al., 2012).

One way to engage with and motivate children is through picture/ storybooks (de Droog, van Nee, Govers, & Buijzen, 2017; Heath, et al., 2014; Houston-Price, et al., 2009; Owen, et al., 2018). Most children enjoy story times because these are shared interactive sessions which allow them to be active participants. Earlier research has shown that repeatedly exposing toddlers to vegetables using picture books increased their willingness to taste the depicted foods (Heath, et al., 2014; Houston-Price, et al., 2009; Owen, et al., 2018). Research by de Droog and colleagues has demonstrated that storybooks with characters and embedded social norm messages such as ‘eating carrots will make you fit and strong’ can appeal to young children (de Droog, et al.,

2014; de Droog, et al., 2017). For example, in their storybook, an animal character (Rabbit) was only able to rescue his friend after eating carrots. The authors reported an increase in children's carrot consumption, and they proposed that these books produce change by means of "narrative involvement" and "character imitation". These studies used a storybook approach to promote carrot consumption, but the use of a familiar, well liked and commonly consumed vegetable might have limited the effect size of the intervention. Therefore, a next step is to employ illustrated storybooks which feature unfamiliar vegetables.

A more direct strategy to increase vegetable acceptance in nurseries is sensory play (Coulthard & Sealy, 2017; Dazeley & Houston-Price, 2015; Hoppu, Prinz, Ojansivu, Laaksonen, & Sandell, 2015). Vegetables are disliked, in part, due to their unfamiliar odour and, at times, unusual texture, therefore activities incorporating tactile play with vegetables may be effective to reduce novelty and fear of new foods in young children (Coulthard & Sealy, 2017; Hoppu, et al., 2015). These activities may particularly help children going through a food neophobia or fussy eating phase (Coulthard & Thakker, 2015; Coulthard, Williamson, Palfreyman, & Lyttle, 2018; Nederkoorn, et al., 2015). A study by Coulthard and Sealy (2017) found that children tried more fruits and vegetables after sensory play compared to children who participated in a non-food sensory play task or those who merely watched the sensory activity (visual exposure). The study was well designed and included 8 different fruits and vegetables, but the sample size was small (~20 children per group) and the outcome measure was willingness to try rather than actual intake, with no baseline intake measures of foods. Therefore, measuring actual intake (in grams) before and after this strategy is warranted.

4.2.1 Aim and hypothesis:

The present study aimed to examine the combined effects of learning about an unfamiliar vegetable through illustrated storybooks (the term "storybook" refers to an illustrated narrative storybook throughout) with sensory play on recognition and intake of that "target" vegetable. The effect of congruency of the storybook with sensory play was predicted to produce a synergistic effect on intake. Here congruence refers to whether the vegetable featured in the storybook and used in sensory play matched or differed from the target vegetable. Congruency may facilitate learning about the unfamiliar vegetable through cognitive processes such as improved recognition and through linking the storybook to sensory play to establish perceptual learning. In

particular, the study aimed to assess whether these strategies were effective in increasing intake of an unfamiliar vegetable in children who are fussy eaters.

There were two hypotheses tested: the first hypothesis was that an illustrated, congruent storybook would increase intake of an unfamiliar vegetable (celeriac) compared to an incongruent storybook (carrot); secondly adding congruent sensory play to the storybook would produce a synergistic effect on intake of celeriac. It was predicted that the interaction between a congruent storybook with sensory play would produce a synergistic effect by both encouraging awareness and recognition indirectly through the storybook about that specific vegetable and directly through experiential learning about the appearance, smell, sound and texture of the vegetable through play. Thus, synergy was expected over and above additive effects due to combining congruency through direct and indirect learning. Also, recognition of celeriac was predicted to improve in the congruent conditions compared to the incongruent conditions through increased awareness and experiential learning of this particular, unfamiliar vegetable.

4.3 Methods

Present chapter is reported according to the CONSORT guidelines for cluster randomised trials (see Appendix C1 for the checklist).

4.3.1 Study design and setting

This study used a 2x2 factorial, parallel design, which was conducted in a cluster randomised trial. The first factor concerned whether the congruency of a vegetable was important in encouraging intake of that vegetable. Children were given experiences with either celeriac (congruent) or carrot (incongruent), and the effect on intake of celeriac was examined. The second factor concerned whether adding sensory play would impact the effect of a storybook on intake of a vegetable. The intervention was conducted over two weeks. The main outcome measure was celeriac intake (measured in grams), assessed in two sessions, before the intervention and after the intervention. The study was conducted in nurseries and the childcare staff were required to deliver the intervention. Therefore, for convenience, ease of intervention delivery, feasibility, condition concealment and to avoid disappointment in children, the same experience was delivered within each nursery using a cluster randomised design. The design is set out in Figure 4.1. The present study was registered on the ClinicalTrials.gov; identifier NCT03400566. Ethics approval was granted by the University of Leeds, School of Psychology Research Ethics Committee; reference number 17-0251.

4.3.2 Sample size, enrolment and participants

The effect of clustering was not taken into consideration when determining the sample size, since a previous cluster randomised trial of a nutrition intervention reported that clustering did not influence the outcomes in preschool children (De Bock, et al., 2012). Using G*Power to calculate the sample size for factorial ANOVA, to observe a small-medium effect size (Cohen's f = 0.20), with 80% power and alpha = 0.05, the total sample size needed to be 199; minimum 50 children in each condition (Faul, Erdfelder, Lang, & Buchner, 2007). It was predicted that three nurseries per condition would be needed to meet this target.

Sixteen private nurseries from Leeds, Brighouse and Halifax (West Yorkshire, United Kingdom) were approached in September 2017 by email and telephone (see Appendix C2 for recruitment email). Nurseries were eligible to take part if they were able to integrate the study requirements in their curriculum over two weeks in November 2017. Nursery managers were told that they could keep the illustrated, vegetable storybook used for the study (see details below) as a small incentive for taking part in the research. Twelve nurseries (with 22 classrooms) which agreed to participate in the study were randomly assigned to one of four conditions; (1) congruent storybook only, (2) congruent storybook plus congruent sensory play; (3) incongruent storybook only (4) incongruent storybook plus incongruent sensory play. The children in the congruent conditions learned about the unfamiliar, "target" vegetable (celeriac) whereas the children in the incongruent conditions learned about a familiar vegetable (carrot).

Figure 4.2 shows the flow of the nurseries and participants through the trial. The nurseries varied in size; therefore, stratified randomisation was used (Altman & Bland, 1999). The nurseries were divided into three strata, with the four largest in one stratum and the four smallest in another stratum. One nursery in each stratum was allocated to each condition, using a random number generation function within Excel. Researcher PB generated the random allocation sequence. Children included in the assessments were those who attended on the date when the intake assessment sessions were conducted. The optimal timing of this was determined by nursery managers. Nursery managers and staff were unaware of the study design and condition assignment was concealed between clusters. Staff were told that the intervention would include reading a story about vegetables and possibly some sensory play. Staff were fully debriefed about the study after the intervention was completed. Parents were given a list of possible study vegetables that could be used in the study (this included the unfamiliar, target vegetable).

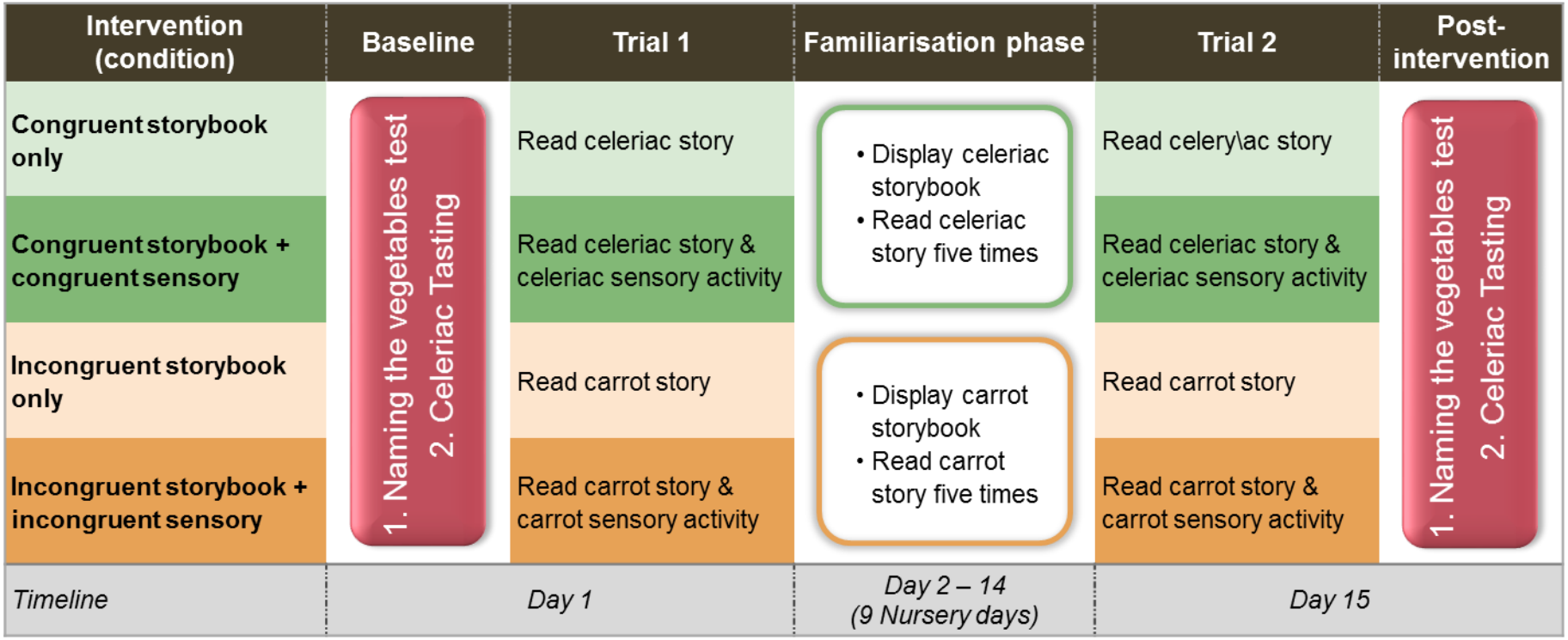


Figure 4.1 Design and timeline of the study.

Celeriac was the congruent vegetable and carrot was the incongruent vegetable. Intake of celeriac was measured at baseline and post-intervention. Children's ability to recognise both celeriac and carrot was recorded at both time points. The intervention phase consisted of two activity sessions which included a story session or story session with sensory play, depending on the condition allocation and a familiarisation phase. During the familiarisation phase storybook was displayed in the nurseries and children were repeatedly read their allocated storybook.

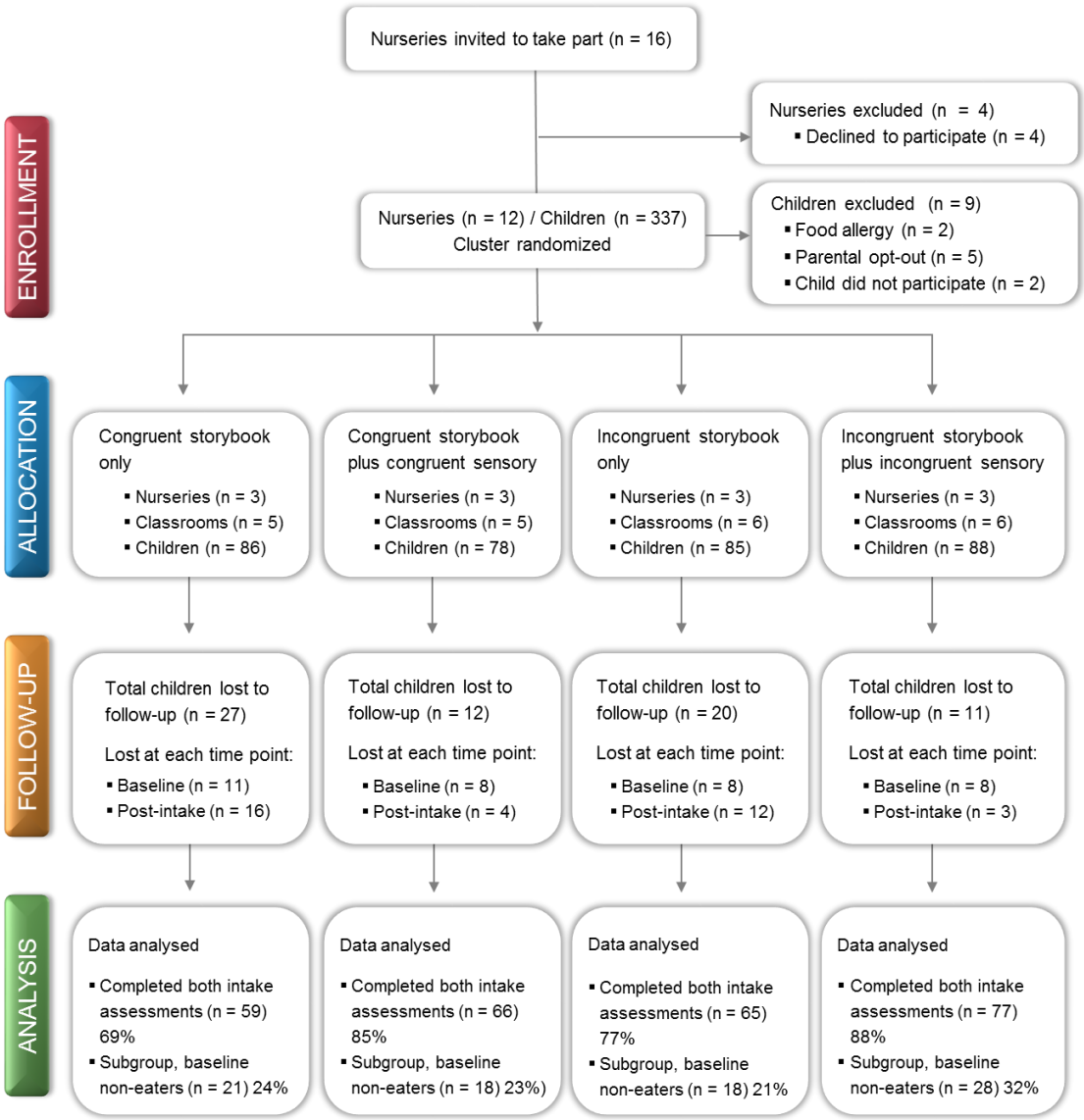


Figure 4.2 Flow of nurseries and children aged 2-5 years through the study. No clusters were lost to follow-up or excluded from the analysis. Children were classified as lost to follow-up and excluded from the analysis if they were away for either of the intake assessment days. Subgroup analysis were performed with children who were non-eaters at the baseline (0g intake).

A total of 337 children were enrolled in the study and the expected sample size was achieved for the primary analysis. Consent to participate was sought from the nursery manager at the cluster level and individually from parents using an opt-out approach in eleven nurseries and opt-in approach in one nursery (parents were required to sign consent forms in this nursery and only one parent did not consent). The nursery managers signed consent forms and during the activities children were able to decline to take part (see Appendix C3 for the nursery opt-in consent form; Appendix C4 for the poster displayed outside the nursery rooms to make parents further aware of the

ongoing research study; Appendix C5 for the parent information letter and opt-out consent form and Appendix C6 for parent opt-in consent form (used in one setting)).

As most children were involved in the present study using an opt-out approach (complete inclusion of eligible children), the selection bias was minimised. Children were eligible to take part if they were aged 2-5 years and attended the nursery class on the celeriac intake assessment days. They were excluded from the study if they had any relevant food allergies, a medical condition which prevented them from eating the study vegetable, their parents did not want them to participate, or if the child indicated that they did not want to participate at the time of assessments (Figure 4.2).

4.3.3 Materials

4.3.3.1 Target vegetable/ alternate vegetable

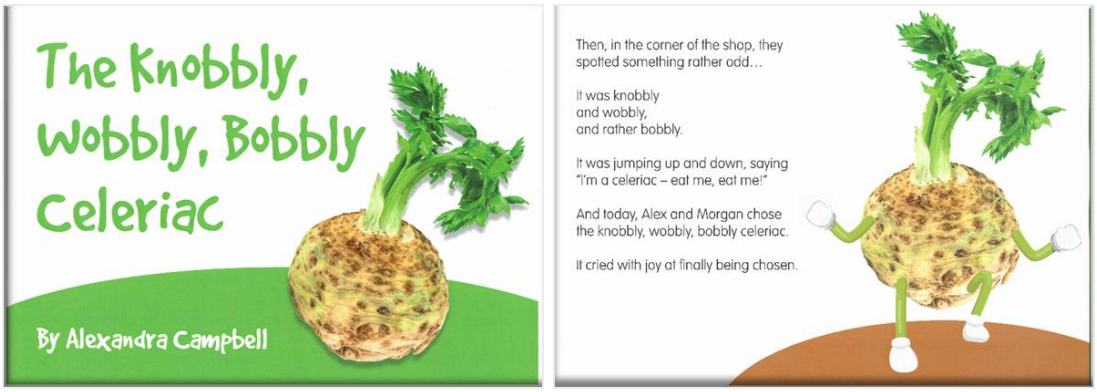
In order to determine which unfamiliar vegetable would form the “target” for this study, seven, relatively rarely eaten vegetables in their raw form which are available through the winter season in the United Kingdom were selected for sensory testing by four researchers (two senior academic researchers, a postgraduate research student and a public health nutritionist). Researchers tasted butternut squash, cauliflower, celeriac, chayote, mild pink radish, Romanesco cauliflower and turnip. Each vegetable was rated for visual acceptability, texture, flavour, odour and suitability to eat raw by small children. Researchers verbally discussed which vegetable would be suitable for the study based on these criteria. Mutually it was decided that celeriac would be a suitable target raw vegetable.

The target vegetable (celeriac) was used for learning in the congruent conditions and in comparison for the incongruent conditions a familiar vegetable (carrot) was used. A relatively familiar vegetable was used to address the research question of congruency and transfer effects, i.e. whether learning/ experience with an already familiar vegetable increases the intake of the target vegetable (celeriac). Carrot was thought to be ideal because it is one of the most familiar vegetables for children in the UK (Ahern, Caton, et al., 2013). Also, it shared some characteristics with celeriac as it is also a root vegetable. Carrot as a familiar and celeriac as an unfamiliar vegetable has been used in previous research with children aged 7-11 years (Coulthard, Palfreyman & Morizet, 2016).

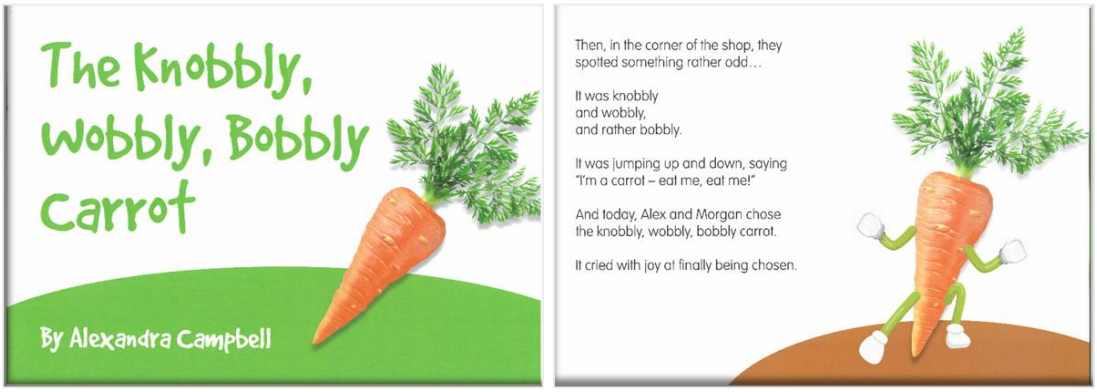
4.3.3.2 Materials - Illustrated storybooks

The storybooks were specifically designed for the present study and were the main experimental stimuli (see Figure 4.3 for the cover page and snapshot of the

storybooks). The books featured four other vegetables (runner bean, beetroot, squash and leek) in addition to the target (celeriac) or familiar (carrot) vegetable, but their presence was less emphasised. A professional illustrator created two identical A4 size (landscape) storybooks differing only in the main vegetable character (celeriac or carrot). The cover page of the story included a picture of the celeriac or carrot and was displayed in the classroom over the 2-week period (between test sessions). This was done to increase familiarity. The picture of the main vegetable story character was made from a photograph of the real vegetable (not a cartoon) with the addition of little hands and feet (see Figure 4.3). This suggestion was made by some nursery managers who advised that vegetables should be realistic for the storybook and would be better for children's learning rather than a book featuring cartoon characters which children sometimes struggle to recognise. The storybook was written by a consultant teacher, who incorporated repetition and rhyming to keep the children attentive and involved. A professional editor specialising in books for young children helped with suitable phrasing, vocabulary and length. The storybook was entitled "The Knobbly Wobbly Bobbly Celeriac" (or Carrot) and was designed to be fun, colourful and engaging.



(a) Congruent storybook



(b) Incongruent storybook

Figure 4.3 Storybooks were identical except that they featured the congruent vegetable celeriac (a) or incongruent vegetable carrot (b). The storybooks are copyright ©PhunkyFoods.

The storyline illustrated two children visiting a greengrocer's after school with their mother from Monday to Friday to choose a vegetable to eat with their tea. Each day the children picked a different vegetable which included the following vegetable characters; 'green mean runner Bean', 'root, toot and cute Beetroot', 'bish bash bosh and not so posh Squash' and 'sleek, chic, unique Leek'. Every time they picked a vegetable, they always spotted the odd-looking vegetable in the corner of the shop - the Knobbly Wobbly Bobbly Celeriac (or Carrot). They finally picked the Celeriac (or Carrot) which they had for their tea and it is depicted as the 'yummiest' vegetable they have ever tried, and they were glad to have chosen it.

4.3.3.3 Materials - Sensory play

The staff were provided with a kit which included six different forms of celeriac or carrot along with some instructions on how to use them for the sensory activity. Vegetable forms provided for the sensory play included: the whole vegetable (uncut), a half vegetable, sliced, sticks, grated and spiralized forms of the vegetable (see Figure 4.4).

Figure 4.4 Example of children engaging in sensory play during the intervention.

The activities included sound (e.g. recalling the vegetable name, tapping the vegetable to hear a sound), sight (e.g. look at different versions of the vegetable and describe the colour), touch (e.g. feel the texture of the different forms) and smell (e.g. pick and sniff the different forms) but not taste (See Figure 1.3 in Chapter 1). For detailed instructions of sensory play activity session see Appendix C8. The staff were asked to encourage every child to participate in these activities. See Figure 4.4 for example of sensory play sessions in a nursery classroom.

4.3.4 Procedure

The nursery staff were provided with all the necessary resources and some basic instructions to deliver the intervention to children in their classrooms (See Appendix C7 for an example of individual nursery plan). On the first day of the intervention, immediately following the baseline vegetable recognition test and intake assessment, the allocated storybook was read to the children (see Figure 4.5 for examples of a story session in a classroom). The children in the two congruent (target) conditions were read the celeriac story and children allocated to the incongruent (control) conditions were read the carrot story. Children who were also allocated to the sensory play conditions were encouraged to explore and play with the respective vegetable (see Figure 4.1, under Activity 1 and Activity 2). Over the next 14 days (nine nursery days), staff were requested to keep the storybooks on a clear acrylic stands provided to increase visual exposure and to read their designated storybooks for a minimum of five times. The recommended number of storybook sessions was based on a previous research (de Droog, et al., 2014).

The staff were free to read the storybook when it suited their curriculum but were asked to aim for times when most of the study children were likely to be present (different children attend nurseries on different days). The staff were also asked to keep a register of attendance so that children who were absent during the story times could be identified. On average, individual children were read their story on five occasions (ranging from two to seven) and this did not vary by condition. On the final day of the intervention, procedures of the first day were repeated. This was immediately followed by a post-intervention recognition test and intake assessment. Parents were given questionnaires to take home from the nursery. The researcher was present to observe staff on occasions, on Days 1 and 15, taking notes on delivery and compliance with the intervention. The story session lasted between 5 and 12 minutes depending on the children's age, attention span and interest in the story.

Figure 4.5 Pictures of staff reading the storybook to the children in nursery classroom during the study story session.

4.3.5 Baseline and post-intervention vegetable recognition test procedure

Children were shown two photo cards, one with a picture of the celeriac and the other with a carrot (images used for the photo cards were same as the picture on the front cover of the storybooks, see Figure 4.6). The order in which the photo cards were shown to children was randomised. Children were individually asked by the nursery teacher to name each vegetable. The response of the child was then recorded for each vegetable.

Figure 4.6 Photo cards used for vegetable recognition tests at baseline and post-intervention

4.3.6 Baseline and post-intervention intake assessment procedure

On the first day of the study, immediately before the intervention began, the children were offered 40g (1 of their '5 a day') of the raw celeriac and were encouraged to eat as much as they wanted. Fresh celeriac was peeled and cut into chunks, placed into a food processor (Veggie Bullet by NutriBullet, VBR-1001, Los Angeles, California) and cut into thin ~0.4mm bite size slices. 40g of the celeriac was placed in clear snack bags then labelled for each child and weighed individually (to the nearest 0.01g), before and after eating sessions using a digital scale (Mettler, PJ4000, Greifensee, Switzerland) by the researcher (see Figure 4.7 for preparation of celeriac for the

intake assessments). During transit, the snack bags were placed in a cool bag with ice packs and were delivered to the nurseries at least 45 minutes prior to the eating session. Staff were advised to store the celeriac in the cool bag provided before and after consumption in order to prevent any moisture loss. Also, the staff were asked to ensure that children did not swap or share their snack and any remaining food was returned back to the child's clear, plastic snack bag. However, all measurements of the celeriac intake were made by the researcher. The time of the assessment procedure was agreed with the nursery staff and was at a time when the children would usually have a snack (morning or afternoon). It was assumed that since this was a typical snack time, children would be hungry.

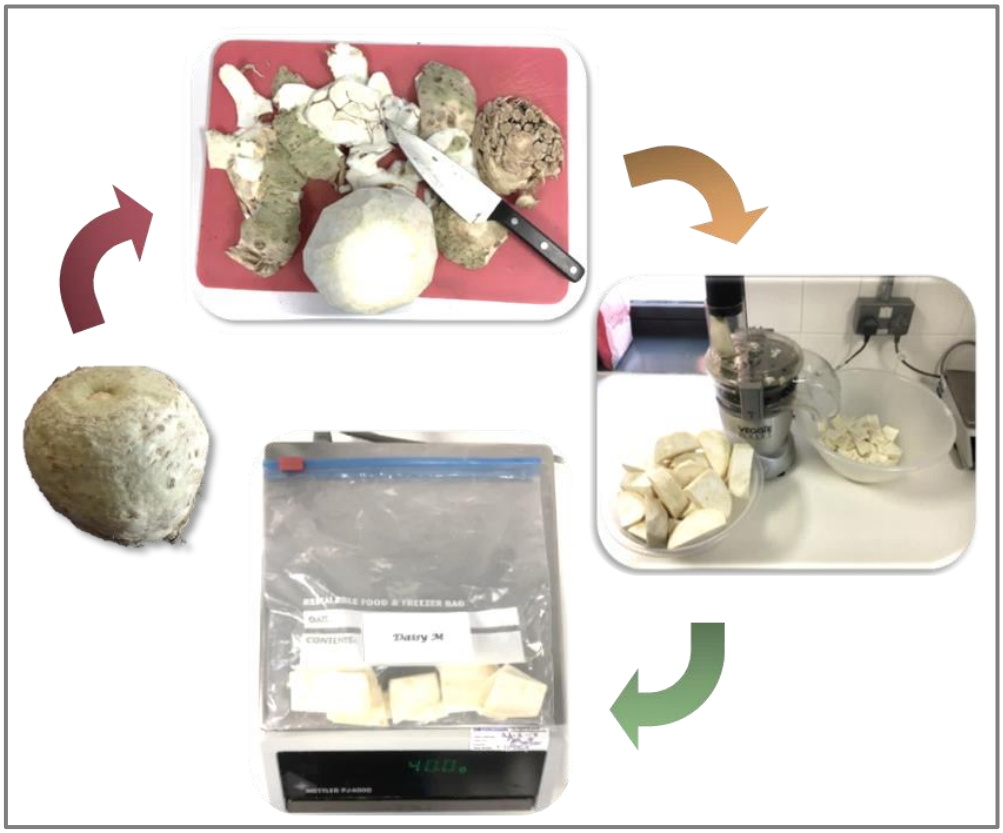


Figure 4.7 preparation of celeriac (target vegetable) for intake assessments

4.3.7 Data collection and measures

The outcome variables were measured at an individual level because factors such as child's eating traits which may affect vegetable intake vary between children.

4.3.7.1 Primary outcome

The pre-specified primary outcome was celeriac intake. This was assessed in two ways: whether the children ate any celeriac after the intervention, and the change in weight consumed from baseline (day 1) to post-intervention (day 15).

4.3.7.2 Secondary outcome

Children's ability to recognise the target vegetable was a pre-specified secondary outcome. All children were tested for their ability to name the congruent vegetable (celeriac) and incongruent vegetable (carrot) at baseline (day 1) and post-intervention (day 15).

4.3.7.3 Other measures Demographic and eating behaviour

Data for children's age and sex were provided by the nursery managers. No specific predictions were made about age or sex, but data was collected for descriptive purposes. Parents were asked to report their child's usual intake of carrot and celeriac over the last month using ratings on a 9-point scale which ranged from never or less than once per month to six plus per day, adapted from the European Prospective Investigation of Cancer (EPIC)-Norfolk Food Frequency Questionnaire (FFQ (Mulligan, et al., 2014). Parents also completed the 6-items of the Food Fussiness subscale (α = 0.92), of the CEBQ (Wardle, et al., 2001). See Appendix C9 for the study questionnaire. Mostly parents provided the information for food fussiness (n = 217), however for some children the nursery key worker completed the questionnaire (n = 26). An independent groups comparison indicated no difference in mean ratings by parents or the nursery staff.

4.3.7.4 Intervention evaluation measures

As part of the evaluation process of the interventions, staff from 22 classrooms within the 12 nurseries were asked for feedback using open and closed questions on a questionnaire which was left with staff to complete at the end of the intervention. Staff were asked about suitability, user engagement, integration, challenges, and effectiveness of the storybooks and sensory play, depending on the condition allocation. See Appendix C10 for the storybook plus sensory play evaluation questionnaire, questions about sensory play were omitted from the storybook only setting evaluation. The questionnaire consisted of open-ended questions (e.g. "How feasible would it be to include story and sensory learning sessions in your usual practice?") as well as items requiring response on a Likert scale. For example, "children were engaged and enthusiastic during the tasting sessions" (response was rated on a scale of 1 to 5, where 1 = 'extremely negative' and 5 = 'extremely positive').

4.3.8 Statistical analysis

Children were excluded from the analysis if their intake data were missing from baseline (n = 35) or post intervention (n = 35). For additional analysis 24 children with

missing food fussiness data were excluded. Food fussiness was dichotomised as high (score ≥ 3) or low (score < 3) based on previous suggestion by Steinsbekk, et al., 2017. For the subgroup analysis only the children who did not eat any celeriac at baseline were included (n = 85). Figure 4.2 shows the number of children included in the analysis by condition. Chi-square and ANOVA were conducted to check for differences in sex, age, food fussiness and baseline celeriac intake across condition, as well as between those children whose data was included and those who were originally recruited.

As children were recruited using a cluster design, it was important to determine the impact of cluster assignment. Therefore, corrections were applied to take account of the clustering into nurseries (Campbell, et al., 2000; Murray, 1998). The variance explained by the nurseries was calculated using the Restricted Maximum Likelihood Model (SPSS) based on the baseline intake data; nurseries were added as the random factors and age and food fussiness as a covariate. There was a small clustering effect observed using this method. The intra-cluster correlation (ICC) of $\rho = 0.013$ with average cluster size of 22 children per nursery indicated a design effect (DE) of 1.29. A previous study in this field reported that controlling for cluster is not necessary if the design effect is < 2.0 (De Bock, et al., 2012). However, for precision reporting, all outcomes on intake are reported after adjustments to Z / F statistics and α-values (Campbell, et al., 2000; Murray, 1998). Intake data from both time points was positively skewed as many children ate near to 0g of celeriac, therefore non-parametric Wilcoxon Signed Ranks test was conducted to investigate if the intake increased from baseline to post intervention in each condition. All other analyses were performed using the change in intake data as this was more normally distributed. The change in intake was calculated as the difference in score between the baseline intake and post-intervention intake. Bivariate correlations were conducted to investigate the association of a participant's characteristics with intake.

A 2x2 factorial ANOVA was carried out to examine the main effects of congruency (congruent or incongruent vegetable), and intervention type (storybook, or storybook and sensory play) on change in intake of celeriac. As children's food fussiness can influence intake of vegetables, a further 2x2x2 ANCOVA analysis was performed to investigate the effects of interventions by adding food fussiness level (high or low) as a between-subjects factor, and age and baseline intake as covariates. To assess effects of intervention in children who did not eat any celeriac at baseline, a 2x2 ANOVA was performed with subgroup of non-eaters (baseline intake = 0g).

For the secondary outcome, a chi-square test was used to determine if there was a significant difference between groups at post-intervention in children's ability to recognise the target vegetable. Data are reported as means with their standard errors (SEM) except for the non-parametric tests where median with interquartile range (IQR) is reported. Data were analysed using IBM SPSS Statistics, version 24 (SPSS, 2018). The α-value was set to 0.05 for most of the analysis except for the multiple non-parametric tests where Bonferroni corrections were applied.

4.4 Results

4.4.1 Participant characteristics

Two hundred and sixty-seven children (148 boys and 119 girls) with mean age of 38.9 ± 0.5 months were included in the final analyses. Table 4.1 summarises characteristics of the children and at home vegetable intake. There were small group differences for baseline intake and carrot knowledge. Children in the incongruent storybook only group ate significantly more of the unfamiliar vegetable at baseline than children in the incongruent storybook plus incongruent sensory play, therefore baseline intake was controlled for in the subsequent analysis. There were no differences observed between conditions for age, sex or food fussiness scores. Also, no differences were observed in participant characteristics or baseline intake for children who completed the intervention and those who were lost to follow-up (see Appendix C11).

4.4.2 Association of participant characteristics with vegetable intake

Correlation analysis indicated that children's age was not associated with food fussiness or baseline intake, but age was positively associated with post-intervention intake ($r = 0.21$, $p = 0.001$) and change in intake ($r = 0.16$, $p = 0.007$). This suggest that older children in the study increased their intake more over time than the younger children. Food fussiness was negatively associated with baseline ($r = -0.23$, $p < 0.001$) and post-intervention intakes ($r = -0.28$, $p < 0.001$). This shows that children who were more food fussy ate celeriac less at both time points than children who were scored as less fussy. However, food fussiness was not associated with change in intake. Baseline intake was positively correlated with post-intervention intake ($r = 0.58$, $p < 0.001$) but inversely correlated with change in intake ($r = - 0.21$, $p = 0.001$). This indicates that children who ate more at the beginning of the trial continued to eat more at post-intervention, but the children who were eating less at baseline made greater improvements in intake over time. There was no association between the number of recorded story reads with change in intake.

Table 4.1 Characteristics of nursery children and baseline intake (g) of the unfamiliar vegetable by intervention condition.

	Congruent[a] storybook only	Congruent[a] storybook + congruent sensory play	Incongruent[a] storybook only	Incongruent[a] storybook + incongruent sensory play	F / χ^2	p value
n[b]	59	66	65	77		
n per cluster	Nursery 1 = 12	Nursery 1 = 21	Nursery 1 = 6	Nursery 1 = 20		
	Nursery 2 = 17	Nursery 2 = 22	Nursery 2 = 24	Nursery 2 = 28		
	Nursery 3 = 30	Nursery 3 = 23	Nursery 3 = 35	Nursery 3 = 29		
Child sex, n (girl/ boy)	32 / 27	26 / 40	30/ 35	31 / 46	χ^2 = 3.59	0.309
			Mean ± SEM			
Age (months)	39.6 ± 0.9	39.8 ± 0.9	37.7 ± 1.0	38.8 ± 0.8	F = 1.03	0.381
Food fussiness score[c]	2.87 ± 0.1	2.64 ± 0.1	2.7 ± 0.1	2.85 ± 0.1	F = 1.058	0.367
Proportion (%) of children who eat these vegetable > once/ month at home[d]						
Carrot (%)	94%	97%	94%	95%	χ^2 = 0.60	0.898
Celeriac (%)	7%	12%	14%	8%	χ^2 = 1.91	0.591

[a]Celeriac was the congruent vegetable and carrot was the incongruent vegetable
[b]Number of children included in the analysis with complete data: celeriac intake (n = 267); food fussiness (n = 243); FFQ (n = 216).
[c]Food fussiness score measured using the Food Fussiness subscale of the Child Eating Behaviour Questionnaire (CEBQ); score range 1-5.
[d]FFQ, Food frequency questionnaire provides the percentage of children eating the selected vegetables more than once per month at home, note: FFQ celeriac intake may be over reported by some parents as it seemed to be confused with celery.

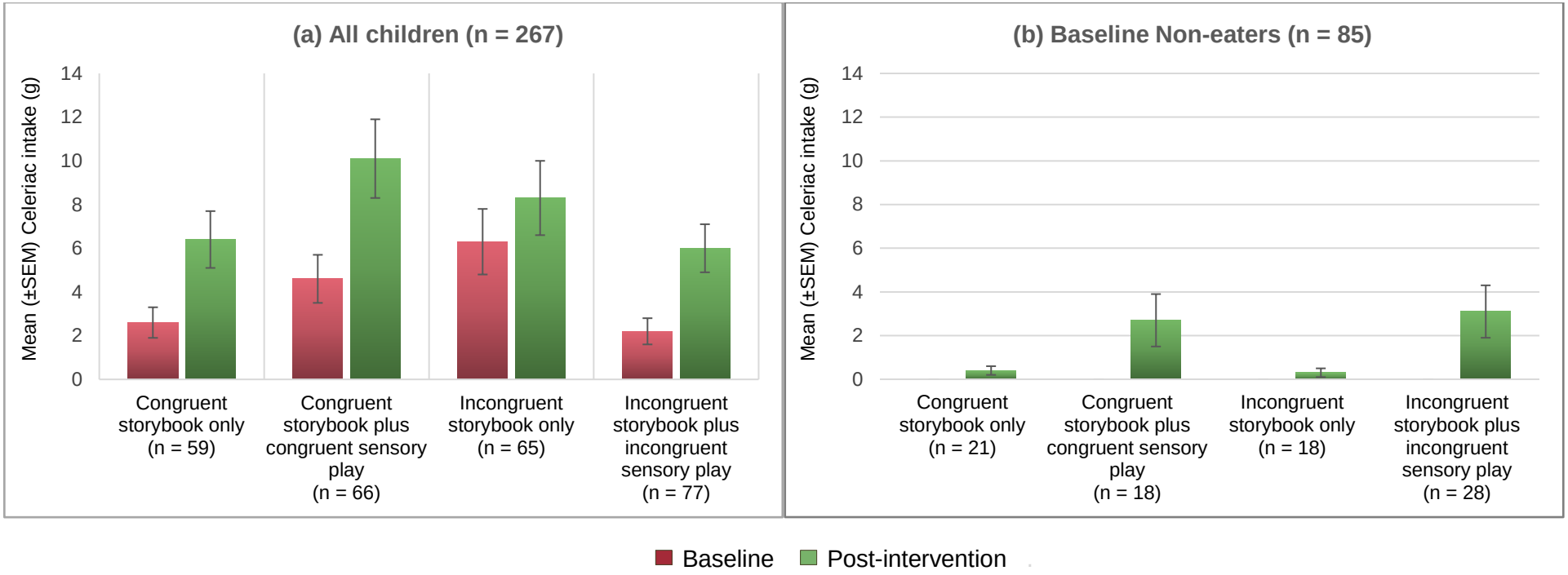


Figure 4.8 Mean (±SEM) intake (grams) of the celeriac at baseline and post-intervention by condition for (a) all children (n = 267) and (b) baseline Non-eaters (0g intake; n = 85). The number of children in each condition is given below the bars.

4.4.3 Primary analysis; celeriac intake

Mean intake of celeriac at baseline and post-intervention by condition for all children and baseline non-eaters is shown in Figure 4.8 and change in intake from baseline to post-intervention for all children and non-eaters is displayed in Figure 4.9. Wilcoxon Signed-Ranks test shown in Table 4.2 indicated that post-intervention intakes were higher than baseline ranks in all groups except for the incongruent storybook only condition. This shows that when storybook only approach is used congruency is important as when using the storybook only approach, only the children who received celeriac storybook increased their intake from baseline to post-intervention. However, congruency may not be necessary when sensory play is combined with storybook, as children in the incongruent storybook plus incongruent sensory condition increased intake from baseline to post-intervention.

Table 4.2 Median (IQR) celeriac intake at baseline and post-intervention by intervention condition.

Time-point	Baseline	Post-intervention	Z	p
	Median (IQR)			
Congruent storybook only	0.4 (0.0 - 2.7)	1.6 (0.1 – 9.0)	-2.91	0.003
Congruent storybook + congruent sensory play	0.7 (0.0 - 4.3)	2.2 (0.5 – 15.1)	-3.13	0.002
Incongruent storybook only	1.0 (0.0 - 5.4)	0.9 (0.1 – 9.3)	-1.69	0.091
Incongruent storybook + incongruent sensory play	0.2 (0.00 - 0.65)	0.5 (0.00 – 10.25)	-3.45	0.001

A 2x2 ANOVA on the change in celeriac intake indicated no main effects of vegetable congruency or intervention type, nor were there any interaction effects (maximum F (1, 267) = 1.54). Food fussiness level (high or low) was then included to assess intervention effects by this eating trait, and age and baseline intake were added as covariates because age of the children was associated with change in intake and the baseline intake significantly differed between groups. This ANCOVA revealed a main effect of food fussiness, that is children who scored low on the food fussiness scale had a greater change in intake than children who scored high on this subscale (mean difference = +4.9g ± 1.3; F (1, 242) = 10.54, p = 0.001, ηp^2 = 0.05), However, no main effects or interaction effects of vegetable congruency or intervention type were observed (maximum F (1, 242) = 3.69).

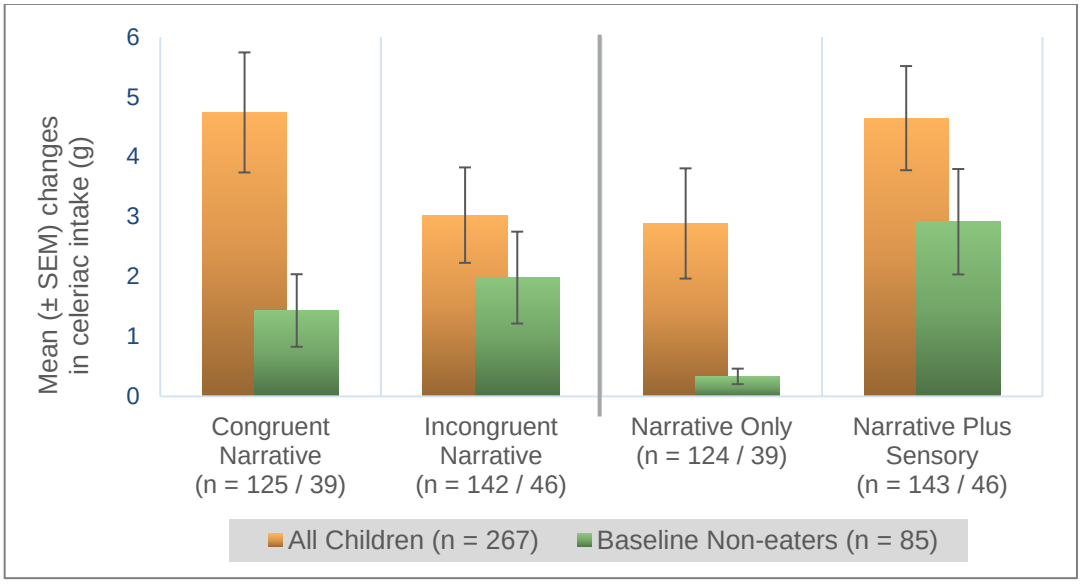


Figure 4.9 Mean (± SEM) changes in celeriac intake from baseline to post-intervention by 2x2 factorial design, for all children and baseline non-eaters.

4.4.4 Subgroup analysis with baseline non-eaters

It was pre-planned to investigate the effects of the intervention on willingness to taste. Whether children eat a vegetable is a proxy for fussiness as it is defined in relation to the child's actual intake behaviour (willingness to try the vegetable). Given that almost a third (32%) of children did not eat celeriac at baseline, it was important to investigate the outcome for these non-eaters. Figure 4.9 shows change in intake from baseline to post-intervention by 2x2 factorial design for subgroup of 85 children who did not eat celeriac at baseline. A 2x2 ANOVA indicated that the children were more likely to taste the celeriac after storybook plus sensory intervention (+2.9 ± 0.7g) compared to storybook only (+0.3 ± 0.7g; $F(1, 81) = 5.15$, $p = 0.026$, $\eta p^2 = 0.08$). No effects of vegetable congruency or interaction effects were observed (maximum $F(1, 81) = 0.07$). It is worth noting that in this subgroup 46% of the children scored high on food fussiness, 47% scored low and for 7% of the children their food fussiness level was unknown. This shows that it is not only the food fussy children who are not willing to taste new vegetables.

4.4.5 Categorisation of children based on their eating status

As many children did not eat celeriac at baseline, it was important to investigate whether number of children who did not eat celeriac declined after the intervention. Therefore, children were categorised as 'non-eaters' (intake = 0g) or 'eaters' (intake > 0g) according to their eating pattern at baseline, post-intervention (see Table 4.3 and Figure 4.10).

Table 4.3 Proportion of children in each intake category by intervention condition. Children were categorised (n) according to their baseline and post-intervention celeriac intake.

Time-point	Eating category	Congruent[a] storybook only	Congruent[a] storybook + congruent sensory play	Incongruent[a] storybook only	Incongruent[a] storybook + incongruent sensory play
		n (%)			
Baseline[b]	Non-eaters	21 (36%)	18 (27%)	18 (28%)	28 (36%)
	Eaters	38 (64%)	48 (73%)	47 (72%)	49 (64%)
Post-intervention[c]	Non-eaters	14 (24%)	7 (11%)	15 (23%)	27 (35%)
	Eaters	45 (76%)	59 (89%)	50 (77%)	50 (65%)

[a]Celeriac was the congruent vegetable and carrot was the incongruent vegetable.
Children were categorised as Non-eaters (0g intake), and Eaters (>0g intake): based on their [b]baseline celeriac intake; and [c]post-intervention celeriac intake.

Proportion of non-eaters reduced from baseline to post-intervention mostly in the congruent conditions (Table 4.3). Those who were non-eaters at baseline were more likely to be eaters in the two storybook plus sensory condition. In particular non-eaters in the congruent storybook plus incongruent sensory condition were most likely to at least try the unfamiliar vegetable (Figure 4.10). Additional analyses were performed based on the eating category, however as this analysis was not the main focus of the present study, these are appended in Appendix C12.

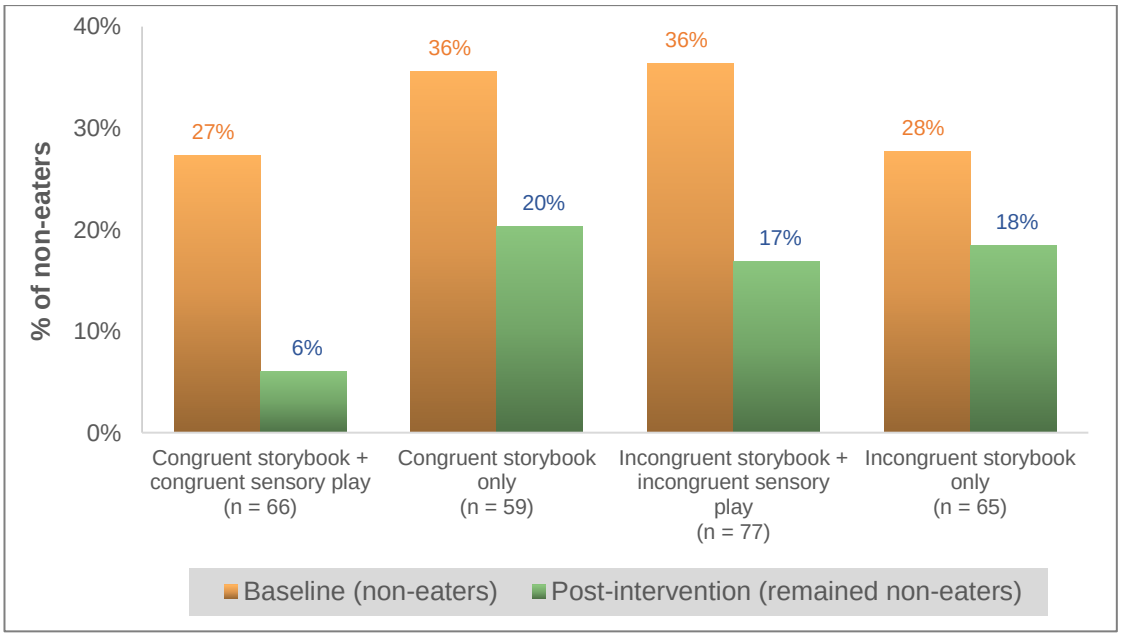


Figure 4.10 Percentage of children who were non-eaters at the baseline and those who remained non-eaters at post-intervention by condition.

4.4.6 Vegetable recognition tests

In total, 261 children completed the vegetable recognition test at both assessment points for carrot and celeriac (see Table 4.4 for proportion of children correctly naming the vegetables at baseline and post intervention, in each condition). At baseline, almost all children (91%; n = 238) correctly recognised carrot whereas none recognised the celeriac. At post-intervention 86 (33%) of the 261 children recognised the celeriac. Celeriac was correctly named by 70% of the children who were read the congruent storybook, compared to 0% of the children who were read the incongruent storybook (χ^2 (1) = 143.62, p < 0.0001). This shows that storybook congruency improved recognition of the target vegetable. Moreover, 88% of the children in the congruent storybook plus congruent sensory play condition named the vegetable correctly compared to 50% in the congruent storybook only condition (χ^2 (1) = 20.25, p < 0.0001), this indicates that congruent sensory play may further improve children's ability to recognise the vegetable through increasing familiarity.

Table 4.4 Proportion of children who correctly recognised carrot and celeriac at baseline and post-intervention in each condition

		Congruent[a] storybook only	Congruent[a] storybook + congruent sensory play	Incongruent[a] storybook only	Incongruent[a] storybook + incongruent sensory play	χ^2	p value
	N	58	64	63	76		
Carrot	Baseline	86%	97%	84%	96%	10.51	0.015
Carrot	Post-intervention	91%	100%	94%	99%	8.55	0.036
Celeriac	Baseline	0%	0%	0%	0%	- -	- -
Celeriac	Post-intervention	50%	88%	0%	0%	163.10	<0.001

4.4.7 Process evaluation data

Feedback was received from all 22 classrooms within the 12 settings. See Table 4.5 for ratings and Table 4.6 for some of the relevant quotes from the evaluation feedback. The feedback from nursery staff was mostly positive (*quotes A and B*). All respondents reported that they planned to continue to read the study storybook in their nurseries after the study and recommended using vegetable storybooks to increase vegetable intake in children. Some of the ratings varied by the intervention condition, for example when asked if children were enthusiastic about tasting the novel vegetable the scores were generally higher for the two sensory groups (see Table 4.5).

Table 4.5 Process evaluation from 22 nursery staff[a] by condition to indicate suitability, user engagement, integration, challenges, and effectiveness of a storybook and sensory play intervention. Mean ratings are presented in which higher scores indicate a more positive experience[b].

Evaluation item	Congruent storybook only[c]	Congruent storybook + congruent sensory play[c]	Incongruent storybook only[c]	Incongruent storybook + incongruent sensory play[c]	Overall
Study was interesting	4.0	4.4	3.2	3.8	3.8
Study was not a hassle to deliver	4.0	4.0	3.1	4.3	3.9
Able to integrate study requirements into curriculum	4.0	3.8	4.0	3.8	3.9
Children were engaged during the story time	4.2	4.4	4.7	4.5	4.5
Recommend vegetable stories to increase vegetable intake	4.0	4.4	4.0	4.3	4.2
Will continue to read the story	4.2	4.6	4.3	4.7	4.5
Children were engaged during the sensory activity	N/A	4.6	N/A	4.7	4.6
Recommend sensory activity to increase vegetable intake	N/A	4.6	N/A	4.5	4.5
Noticed change in knowledge of celeriac	3.6	4.6	2.3	2.5	3.2
Noticed change in knowledge of other story vegetables	3.0	4.2	3.2	3.5	3.5
Children engaged and enthusiastic during tasting session	3.6	4.0	3.3	4.0	3.7
Noticed change in intake of celeriac from pre-intake to post-intake	3.6	3.6	2.7	2.5	3.0
Overall experience[b]	8.0	9.6	7.5	7.0	8.0

[a]The response rate was 100%. Staff from 22 classrooms within 12 nurseries completed the evaluation survey.
[b]Evaluation questions were mostly rated on a 5-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree except for the question on 'overall experience of participation' for which a 10-point Likert scale ranging from 1 = extremely negative to 10 = extremely positive was used.
[c]Celeriac was the congruent vegetable and carrot was the incongruent vegetable.

Table 4.6 Qualitative data from the nursery staff's process evaluation feedback.

Quote	Extracts for Storybook and Sensory Play Interventions
Quote A	*We liked the Rhyme and all the different fruit and veg we learned about! Most children seemed to love celeriac :-) Thank you*
Quote B	*The children really engaged in the book at story times. Showing great knowledge and remembering parts of the story.*
Quote C	*We have not noticed a change in vegetable intake at mealtimes*
Quote D	*The children are discussing vegetables during mealtimes more.*
Quote E	*At snack time children are starting to taste different vegetables but we haven't used celeriac in our snack time.*
Quote F	*This could be done at nursery. Children enjoy sensory activities and story times. We could also have discussions around healthy eating and the importance of eating vegetables at group circle times.*
Quote G	*A few more stories like the one we had would help, it would help the children understand about different range of vegetables.*
Quote H	*Only barrier would be having spare vegetables to use.*
Quote I	*May be more activities and more opportunities to try the veg.*
Quote J	*Yes! Acting out the story and experimenting with preparing veg in different ways/ veg sensory*
Quote K	*Set up a healthy eating area and help the children explore lots of different vegetables.*

Some of the qualitative data collected using open questions are summarised here (see Table 4.6). Many settings reported no change to the usual vegetable intake in the nurseries (*quote C*) but some classroom staff reported that they had noticed children discussing the vegetables or trying different vegetables at mealtimes (*quotes D and E*). All respondents confirmed that it would be feasible to deliver interventions such as the storybooks and sensory play; this may be because children enjoy these activities (*quote F*). However, resources such as vegetable stories, puppets, food spiralizer, and extra vegetables for play would help to implement these activities in the nurseries *(quotes G and H*). Staff suggestions for making improvements to the study included offering a variety of vegetables and additional opportunities to taste the target vegetable (*quote I*). Finally, the staff were asked if they would include any additional

activities in their classrooms using vegetables as a result of taking part in the present study. Twenty-one of the 22 staff stated that they would include additional vegetable activities, for example: sensory activities, making soup, chopping vegetables, vegetable printing, talking about vegetables and textures, growing vegetable and having a designated area in the classroom to explore vegetables (*quotes J and K*). See Appendix C13 and Appendix C14 for research impact from this study.

4.5 Discussion

4.5.1 Key findings and comparison with other studies

To our knowledge, this is the first cluster randomised trial investigating the effects of a storybook, combined with non-taste sensory play, on intake of an unfamiliar vegetable in preschool children aged 2-5 years. The findings from the present study partially supported the primary hypothesis, that providing experience of an unfamiliar vegetable (celeriac) through an illustrated storybook together with sensory play would increase intake of that vegetable compared to a similar intervention using a different vegetable. For the full sample of children, results showed that congruency of a storybook is important when a storybook only approach was used but was not necessary when sensory play was involved, as playing with celeriac (congruent sensory) or carrot (incongruent sensory) increased children's intake from baseline to post-intervention. However, the change in intake did not vary between different conditions. For the subgroup of children who ate no celeriac at baseline, sensory play with either the congruent or the incongruent vegetable in addition to the storybook increased the likelihood of eating celeriac compared to children who received the storybook only intervention.

Children who received the congruent storybook improved in their recognition of the unfamiliar vegetable but, there was no change for children in the incongruent conditions. The best outcomes for likelihood of recognising celeriac were observed when congruency of the storybook was combined with congruent sensory play. This shows that congruency may be very important for preschoolers to recognise unfamiliar vegetables. Also, the process evaluation feedback from the nursery staff confirmed that the strategies of using storybooks and sensory play to increase vegetable consumption in nursery are feasible and children enjoyed these types of interactive activities. Therefore, the present intervention is likely to be accepted in childcare settings.

A third of the children in present study did not eat the unfamiliar vegetable at baseline. This shows that there is a need for vegetable promoting interventions in nurseries. On

average children in the congruent storybook plus congruent sensory cluster increased their intake by 6g, which is 3% of their daily fruit and vegetable consumption. This change is small but it can be impactful at a population level if the change in intake is sustained (Bere, te Velde, Småstuen, Twisk, & Klepp, 2015; De Bock, et al., 2012). Although, the intervention did not affect the amount the children ate, it did increase the probability of children eating some celeriac over a relatively short period, and this could be a means to get children to consume vegetables in order to increase intake further via repeated exposures.

Previous studies have shown that vegetable story/picture books increase willingness to taste vegetables in toddlers (de Droog, et al., 2014; Heath, et al., 2014; Houston-Price, et al., 2009; Owen, et al., 2018). The present study confirms that congruency is important in using a storybook approach. In addition, the present study demonstrates that sensory play with either vegetable encouraged intake of celeriac in children categorised as non-eaters. Previous studies have also found some generalization from playing with a specific vegetable to greater acceptance of other vegetables not included in the sensory activity (Coulthard & Sealy, 2017; Rioux, et al., 2018). There are several possible explanations for this, including that sensory play offers the opportunity for children to explore the vegetables using all senses (e.g. Sapere taste education (Hoppu, et al., 2015)). Through this type of exploration children become familiar with the appearance, smell, feel and taste of a particular vegetable which extends to other vegetables through reduced fear of novelty. Another possible explanation is through “unitization”, a feature of perceptual learning in which learning about a new object is facilitated by the fusion of pre-existing, and shared features of that object (Goldstone, 1998). Thus, sensory play with one vegetable with particular sensory features (rough exterior, cold to the touch, earthy smell) facilitates learning about other vegetables. In the present study both vegetables are root vegetables sharing some features but differing in colour, odour and flavour. Another explanation for this might be a priming effect; i.e. exposing children to food cues in the environment stimulates their desire to consume this or other related foods, similar to food consumption observed in children after television advertisements (Harris, Bargh, & Brownell, 2009).

Learning about vegetables by storybook plus sensory play may help to bridge some of the ‘knowledge-behaviour gap’. According to the systematic research review (Chapter 2), a study by Witt & Dunn (2012) which included sensory play within a nutrition education intervention had a greater effect size for vegetable consumption than nine other educational interventions which did not include sensory play. Embedding

sensory activities within educational programmes in nurseries may enhance children's willingness to try new vegetables and may present another step on the way to familiarisation.

To date, taste-exposure interventions have been reported to be most successful for increasing vegetable intake (Holley, Farrow, et al., 2017b; Nekitsing, Blundell-Birtill, et al., 2018). However, children often refuse foods prior to tasting, as demonstrated in this study by the high number of non-eaters. Repeated exposure is contingent on the child's willingness to taste the food which is required for establishing food liking (Carruth, et al., 2004; Dovey, et al., 2008). Therefore, storybooks and sensory play constitute first steps towards achieving repeated exposure. A study by Owen, et al. (2018) used targeted picture books before tasting sessions and found this facilitated tasting of disliked foods. Children assigned to the storybook and taste exposure condition liked and ate more of the target vegetable than those just receiving taste exposure. Also, storybooks were associated with smaller increases in neophobia and food fussiness over the course of the study, suggesting that familiarisation through the storybook provided additional benefits over taste exposure alone. Their study also found some support that use of picture books along with taste exposure may reduce food fussiness and food neophobia during an early onset of these behaviour traits.

In future, longitudinal research should investigate specific benefits of storybooks and sensory play alongside repeated taste exposure on vegetable intake. In particular liking and intake should be measured after a washout period to properly assess intervention effectiveness and sustainability. The effects of taste exposure are limited to the target foods (Hendrie, et al., 2016), however, combining vegetable storybooks and sensory play with taste exposure may have a synergistic effect to increase acceptance of other vegetables. It is anticipated that these techniques will work very well-together. Caution will be needed to avoid overexposure to the same foods by spacing visual/ taste exposures.

4.5.2 Strengths and Limitations

The strengths of this study include; randomisation, concealing condition allocations between clusters, reduced selection bias at the individual level, ecological validity, objective data collection and a good sample size to ensure sufficient power. However, results should be considered in the context of some limitations. First, as many children were eating a small amount at baseline and post intervention there was a problem of skewness in data, therefore analyses were performed on change in intake to address this problem. Secondly, the compressed time frame of the study may have limited

effects on intake, since larger effects on intake are observed with ten exposures over 10 weeks (Chapter 3). Thirdly, the change in intake did not vary by condition in general and this may be attributed to the fact that children in the incongruent storybook only group were already eating more of the target vegetable than other groups at the beginning. Hence, if the baseline intakes were similar across all groups than difference between interventions may have been observed. Finally, there was no control group since all children received a storybook. This means that the independent effect of the sensory activity on intake cannot be determined. A cluster design was implemented, and this was considered in the analysis, however nursery staff varied in the extent to which they engaged the children and in their enthusiasm for the storybook and sensory tasks. Therefore, in future a greater number of clusters should be recruited to account for this inconsistency. More emphasis could be placed on how the storybook and sensory tasks should be delivered using a video demonstration to minimise variability in delivery. Also, future intervention studies could collect systematic, evaluative feedback from nursery staff as this would give a more complete perspective on the experience of delivering the intervention. Overall, more research is needed to understand use of sensory play in the nursery and at home especially with food-fussy children and how effects of sensory play can be enhanced when combined with other successful strategies such as repeated taste exposure and reward.

4.5.3 Conclusion and implications

In conclusion, a congruent storybook, or sensory play method combined with either type of storybook, increased the likelihood of the children eating an unfamiliar vegetable. The congruent storybook combined with congruent sensory play increased the likelihood of the children eating and recognising celeriac. Among non-eaters, sensory play with vegetables (alongside a storybook) increased the likelihood of the children eating some of the celeriac, regardless of the congruency of the vegetable used, indicating sensory play with any vegetable may increase children’s willingness to eat a different unfamiliar vegetable. These findings could be incorporated into nutrition education programmes to increase vegetable intake and recognition of unfamiliar vegetables in preschool children.

Research image presented at the 8th Annual University of Leeds Postgraduate Research Conference, Leeds, UK, 2017

Chapter 5

Parental Strategies

Chapter 5

“I still put them on her plate even though I know she's not going to eat them”: A qualitative study exploring strategies implemented by parents to promote vegetable intake

Across the previous chapters, a range of effective vegetable promoting strategies for preschool children have emerged. However, much of this evidence is based on interventions and studies which are, by their nature, systematic and controlled but lacking in ecological validity. To understand the ways in which parents encourage vegetable intake at home a more qualitative approach is necessary. It is unclear whether parents apply the same strategies used in systematic trials or if they use different strategies for children who are fussy. Hence, Chapter 5 focuses on parents’ perspectives on strategies to promote vegetable intake in preschool children (2-5 years).

5.1 Steps taken

1. Designed and conducted in-depth interviews with 20 parents of preschool children aged 2-5 years
2. Involved parents of high (n = 10) and low (n = 10) food fussy children
3. Audio recordings were listened to multiple times
4. Recorded interviews were transcribed in writing
5. Thematic analysis was conducted to synthesis results
6. Findings are reported according to the Standards for Reporting Qualitative Research; SRQR

5.2 Introduction

Eating habits and food preferences developed in the early years of life are said to determine food choices in later life (De Cosmi, et al., 2017; Nicklaus, Boggio, Chabanet, & Issanchou, 2005). Therefore, children are encouraged to make healthy eating choices from early childhood (Birch, et al., 2007; Hetherington, Cecil, Jackson, & Schwartz, 2011; Schwartz, Scholtens, Lalanne, Weenen, & Nicklaus, 2011). As mentioned in Chapter 1, most vegetables are rich in micronutrients, dietary fibre, and phytochemicals and low in sugar, sodium, fat and energy density. Eating adequate amounts of these foods in balance with foods from other core food groups (e.g. carbohydrate, protein and fats) can significantly reduce the risk of cardiovascular disease, colorectal cancer, stomach cancer, stroke, diabetes, obesity and mortality. (Aune, et al., 2017; Boeing, et al., 2012; Hartley, et al., 2013; Lee, et al., 2017; Wang, et al., 2014). Across Europe and the US intakes fall below the recommended amounts for vegetables (Kim, et al., 2014; Lynch, et al., 2014). Vegetables may be eaten less than other foods due to their bitter taste and unfamiliar texture (Johnson, 2016; Zeinstra, Koelen, Kok, & de Graaf, 2007), as well as the emergence of food fussiness/ pickiness and food neophobia during the early years (Cooke, et al., 2007; Dovey, et al., 2008; Lafraire, et al., 2016). Moreover, during the preschool years children develop a sense of autonomy over their feeding and food choices and as a result parents may have to adapt their feeding approach to match their child's needs (Walton, et al., 2017).

Parents are the gatekeepers to child nutrition and so it is essential to understand parents' perspectives on their child's dietary habits, and the methods they use to encourage healthy eating. Parents determine the home food environment by making some foods available and accessible in homes (Krolner, et al., 2011; Rasmussen, et al., 2006). However, providing healthy foods does not mean that they will be eaten (Holley, Farrow, et al., 2017a). Therefore, inviting parents to discuss their experience of feeding their child, and how they establish food preferences in the home is necessary to develop a complete picture of how a child's eating habits are formed. For example, parents may report ways they limit certain foods and encourage others to achieve a balanced diet. A large study (n = 5926) by Inhulsen et al (2017) with children aged 3 to 7 years reported that more encouraging and controlling parental feeding styles were associated with higher consumption of vegetables. However, the study found that the use of instrumental feeding (using food to reward good behaviour) was inversely associated with vegetable intake (Inhulsen, et al., 2017). Children also learn by observing eating

behaviours of parents or peers, hence, positive modelling can significantly help young children to increase their vegetable consumption (Birch, 1980; Draxten, et al., 2014).

A number of successful interventions have been designed and trialled to improve preschoolers' vegetable consumption (Appleton, et al., 2016; Hodder, et al., 2018; Nekitsing, Blundell-Birtill, et al., 2018). But these may lack ecological validity and it is not known if they are practical for the real-world setting, particularly for fussy children. Indeed, parenting practices are not static but are dynamic, influenced by the context, the child's behaviour and characteristics. For example, parents may apply differing levels of pressure to eat depending on the fussiness of their child (Jansen, de Barse, et al., 2017; Webber, Cooke, Hill, & Wardle, 2010). It may be that children with fussy eating respond better to some strategies than others. For example, as seen in Chapter 4, children who did not eat an unfamiliar vegetable (celeriac) at baseline were more likely to eat that unfamiliar vegetable after experiencing the combination of sensory play and storybook together compared to the storybook only approach. It follows that parents may adjust their feeding strategies in response to specific circumstances including child eating traits. The present study was conducted to explore these strategies in parents whose children varied in levels of food fussiness. The present study is novel because there are few qualitative studies investigating strategies to increase vegetable intake in preschool children and none investigating strategies by level of child food fussiness. This is important because narratives from parents will help to improve knowledge and understanding of the key similarities and differences in vegetable feeding strategies implemented in homes by child's level of food fussiness and in comparison to those which are rigorously tested by scientific methods. Also, parents in the previous research by Holley, et al., (2017) did not talk about certain interventions in detail such as nutrition education and taste exposure. In the present study, questions were specifically designed to get further insight from parents about the two most commonly used vegetable promoting interventions implemented in scientific research.

5.2.1 Aims

The aim of the present study was to listen to and record parental strategies to encourage their children to eat vegetables, especially when children exhibit fussy eating. Specific objectives included investigating ways parents provided vegetables, including unfamiliar or disliked vegetables, how they dealt with food rejection and

their response to fussiness. It was predicted that parents would use a variety of strategies to encourage intake, that these might differ by fussiness level and that there would be some overlap with strategies used in the research context. A potentially important benefit of this qualitative approach is to identify challenges faced by parents in encouraging vegetable consumption and how future interventions might be improved to account for these.

5.3 Method

For the present study a mixed methods approach was adopted; the data collection and analysis were mostly based on qualitative methods, but some quantitative data from parental questionnaires were taken to identify child food fussiness. The present chapter is reported according to the Standards for Reporting Qualitative Research; SRQR (O'Brien, Harris, Beckman, Reed, & Cook, 2014), see Appendix D1 for the SRQR checklist.

5.3.1 Qualitative approach and research paradigm

The philosophical approach and research paradigm adopted for the present research is illustrated in Figure 5.1 (adapted from Saunders, Lewis, & Thornhill, 2012) analysed using thematic analysis.

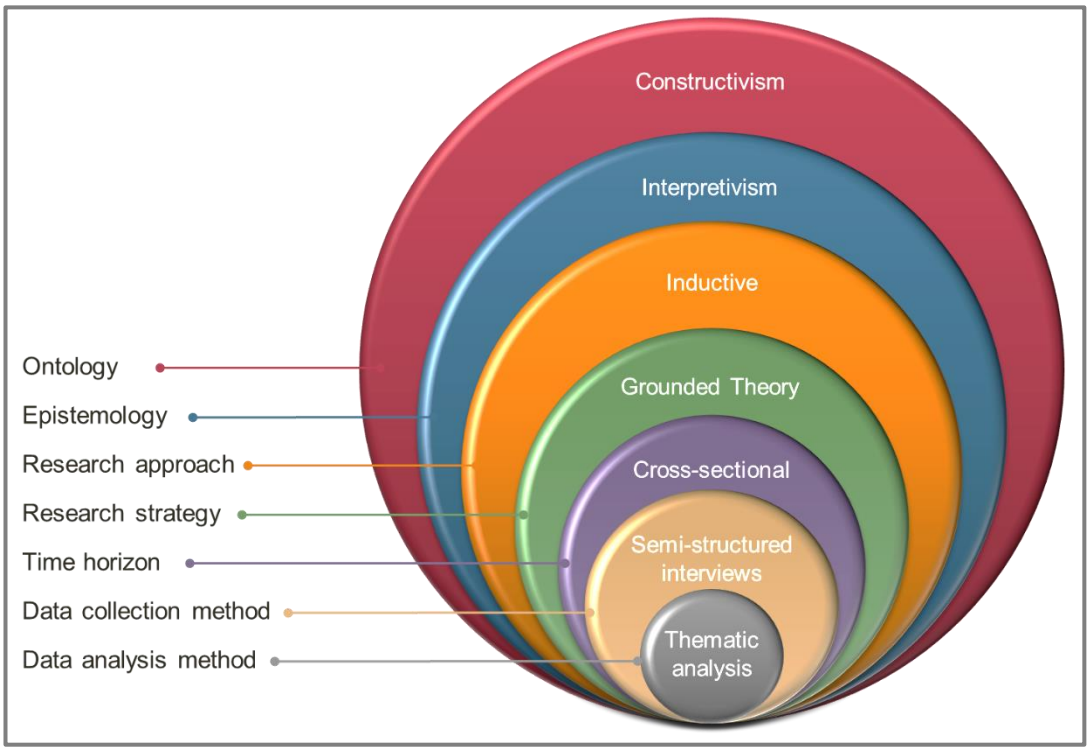


Figure 5.1 Philosophical approach and research paradigm for present study.

The assumption about the world (ontology) is constructivism (multiple realities) and how we know about it (epistemology) is based on social interaction (interpretivism). The present research has mainly taken an inductive approach as it is concerned with generating new theory emerging from the data (grounded theory). The method used to collect the qualitative data was via semi-structured interviews and this is compatible with a grounded theory approach (Duffy, Ferguson, & Watson, 2004). Each interview was collected during a single session and data were

5.3.2 Researcher characteristics and reflexivity

The main researcher (CN) who conducted and analysed the interviews is a female, aged 30 years at the time of the study, from a middle-class family, with a higher education (BSc, MSc) and at the time of the research studying for a PhD in Psychology. Moreover, the researcher is a parent to a child who was aged 3 years at the time and so was experienced in parenting a child of a comparable age to participants. The child of the researcher has also gone through a phase of fussy eating and therefore, there is potential for empathy and understanding with parents' perspectives. There is also the potential for bias since the researcher was able to find solutions to her daughter's fussy eating and this may mean that some solutions in common are more salient to the researcher. However, the researcher approached this study with an open mind and with a view to learning from other parents both as a researcher and a parent. The researcher reassured participants that she is also a parent and is aware of some of the challenges faced by parents in feeding young children. Making parents aware of this helped in building a trusting relationship between the participants and the researcher.

The researcher is also aware that parental views are likely to be personal to their experience and they should not be judged. Having done substantial quantitative research in promoting vegetable intake the researcher had a clear, practical experience of the barriers faced in different contexts when increasing vegetable consumption. Also, the researcher is British Asian, living in a multi-cultural society and so is acutely aware of cross-cultural differences in parenting methods, feeding strategies and different type of vegetables offered across different cultures.

The questions were designed with the purpose of encouraging parents to share their experiences with minimum researcher influence. The interview questions prompted parents to be as open as possible and gave them the opportunity to reflect on their feeding practices. The main researcher conducted the interviews and transcribed and checked all the written transcripts soon after the actual

interview. Nineteen of the twenty participants were not known to the researcher prior to recruitment. The only person known to the researcher was through professional association. For seven of the 20 interviews, an MSc student was present as an observer and for one of these interviews this student led on the questions for research experience, but the main researcher asked some follow-up questions during the interview to ensure all questions were covered comprehensively.

5.3.3 Ethics approval

The present study was approved by the University of Leeds, School of Psychology Ethics Committee; reference 17-010.

5.3.4 Recruitment strategy and settings

Parents who had children aged 2-5 years and were able to speak and understand English language were eligible to take part. The study was conducted from April to June 2017 and participants were recruited from West Yorkshire (United Kingdom) using A5 recruitment flyers (Appendix D2) and email advertisements (Appendix D3). They were informed that the study would involve a short questionnaire followed by an interview lasting no more than 45 min and that they would be reimbursed £10 for their time. All participants were assured of their confidentiality, anonymity and data protection and written, informed consent was obtained prior to onset of the study (see Appendix D4 for the participant information and Appendix D5 for the consent form).

A minimum of 20 participants was the target sample size with the aim to achieve data saturation, based on a previous qualitative study which used five focus groups with a total of seventeen participants to investigate the methods caregivers use to present their preschool children with vegetables and the perceived barriers to offering them (Holley, Farrow, et al., 2017a). Twenty-one participants were recruited using convenience and a snowball sampling method from an existing database of parents who participated in the previous study (Chapter 3; n = 11), word-of-mouth (n = 6), parent and child playgroups (n = 3) or a nursery (n = 1). One parent opted-out after agreeing to participate as they were unable to commit to the interview session due to their busy work schedule at the time of the study. The final sample consisted of ten parents whose children scored high on the eating trait “food fussiness” and ten parents whose children scored low on this attribute (see below in data analysis section for categorisation). The interviews took place in locations

convenient for the participants, this included their home (n = 11), the university (n = 5), local coffee shops (n = 2), local library (n = 1) and nearby nursery (n = 1).

5.3.5 Data collection

5.3.5.1 Demographic questionnaire

The demographic questionnaire asked questions about age, sex, ethnicity, education level, number of hours worked on a weekly basis, annual household income, relationship to the child, the number of other (older and younger) children in the household, as well as target child age, sex and the number of hours they attended nursery or school in a week.

5.3.5.2 Child eating behaviours

Food fussiness was measured using 6-items of the Food Fussiness subscale from the validated Child Eating Behaviour Questionnaire; CEBQ (Wardle, et al., 2001). Food Neophobia was assessed using the 6-items of the Food Neophobia Scale (Pliner, 1994). Both scales had a good internal consistency as indicated by the Cronbach's alpha value of $\alpha = 0.88$ for the Food Fussiness subscale and $\alpha = 0.91$ for the Food Neophobia scale.

5.3.5.3 One-to-one semi-structured interview

A semi-structured interview was used as this allowed the researcher to explore experiences of participants on a topic of interest with the meaning they attribute to their experience (Tong, Sainsbury, & Craig, 2007). This method was also considered more appropriate than focus groups given the nature of the topic and the constraints on time. The average duration of the interviews was thirty-six minutes and ranged in length from 24 - 59 minutes. Interview sessions were on a one-to-one basis, however on many occasions participant's child/ children were present in the same room (n = 11). One-to-one interviews were selected over group formats to facilitate free and open discussion, free from judgement and the influence of others. The semi-structured format also allowed the researcher to focus on questions related to a single topic of interest.

At the beginning of the interview session participants were reassured of their confidentiality, anonymity and their right to withdraw at any time. They were given the opportunity to ask further questions before the interview started. All interviews were digitally recorded using 2 devices (digital voice recorder and a password protected iPhone 6s; the interviews were immediately downloaded to a password protected and encrypted laptop and deleted from the original devices).

Questions for the interview were generated based on previous literature and according to the research aim and specific objectives of the present study. Interview questions were piloted with other researchers (4 senior researchers, 1 post-graduate student and 1 MSc student) before the actual interview to determine suitability of the interview questions and to estimate time required to conduct the interview session. This process resulted in refining some of the interview questions.

At the beginning of the interview, parents were given an overview of the topics covered during the session. The main question categories included: (1) opening questions, (2) questions about fussy eating, their experience and vegetable promoting strategies used around that time (3) general vegetable intake, (4) intake of unfamiliar vegetables and strategies used to introduce these, (5) dealing with vegetable refusal, and (6) closing questions. Participants were asked eighteen open-ended questions with some follow-up questions. Examples of the questions asked are highlighted in Table 5.1. Prompts and probes were also used to encourage respondents to share more details or to clarify what they have already said (e.g. please tell me more about… or what did you do?). The full interview schedule is available in Appendix D6.

5.3.6 Data processing and analysis

5.3.6.1 Quantitative data

The quantitative data generated from questionnaires in the present study provided some descriptive statistics of participants. All quantitative data was managed in IBM SPSS Statistics, Version 24. Children were considered high (score ≥ 3.0) or low (score < 3.0) in food fussiness based on suggestions by Steinsbekk, et al. (2017) where a score of 3.0 or greater on the CEBQ indicated a moderate to high level of food fussiness.

5.3.6.2 Qualitative analysis

All interview recordings were transcribed verbatim by researchers CN (10 audios) and RK (10 audios) using secure online software OTranscribe (available from: https://otranscribe.com/). This software allowed researchers to play the audio and type the text on the same platform without having to navigate between different software. The transcripts were then transferred to Microsoft Word (2016). Data management and procedures described below were performed by the researcher CN.

Table 5.1 Examples of main questions asked during the semi-structured interview

Question Category	Example Questions
Opening questions (about them/ child)	• Please tell me little bit about yourself and what you do? • Tell me about your child, what are they usually like?
Fussy eating/ Strategies used during this period	• When I say the words “fussy eating” what do you think of? • I know it may be hard to remember, but what did your child do during these times and what did you do in response? • Which foods were your child fussy about and what was it about these foods they did not like? • How did you encourage your child to eat vegetables during this period?
General vegetable intake	• What sorts of vegetable do you generally eat in your household? • Do you keep track of how much vegetables your child eats? • Do you offer vegetables to your child that you do not eat?
Unfamiliar (novel or disliked) vegetable intake/ strategies used	• What sorts of vegetables do you NOT eat generally in your household? • Do you offer vegetables to your child which are new to them or they do not like? • How do you introduce these vegetables to your child? • How often (days/ weeks) and how many times would you offer a disliked or novel vegetable to your child before you decide to stop offering?
Dealing with vegetable refusal	• Tell me about vegetables (or foods) which your child refuses to eat • What do you usually do when your child refuses to eat their veg (or other food)? • Do you offer anything else when he/she refuses to eat their veg?
Closing questions (suggestions from their experience)	• From your experience, what advice would you give to other parents on ways to get their children to eat vegetables when they are going through food fussiness? • Would you like to share anything else about how to encourage children to eat a variety of vegetables or ways to deal with food fussiness?

Procedures developed for thematic analysis by Braun and Clarke (2006) were followed for analysing the qualitative data. This involved ‘repeated reading’ of the interview transcripts (each transcript was thoroughly read multiple times, at least five per transcript). All transcripts were rechecked against the original audio recordings to ensure that content was accurately transcribed, and that formatting was consistent across all interviews. Participant’s names and any names

mentioned during the interviews were replaced by pseudonyms in the transcript itself.

During initial checking of the transcripts the researcher became more familiar with the data and began to consider possible codes and ideas emerging from the data (phase 1). After this, all transcripts were printed for manual coding and read again. This stage involved systematically working through the entire dataset by highlighting segments of text of interest to the researcher and meaningful for the research subject. Key concepts and initial codes generated from each interview were noted in the margins alongside the highlighted text (phase 2). The interview data and codes were then transferred and managed through NVivo (qualitative data analysis software, QSR International Pty Ltd, Version 11), see Appendix D7 for example of coding in the NVivo software. The segments of the text coded manually were re-assessed and codes were collated and compiled in a meaningful way to identify potential themes and overarching themes (phase 3).

The next part of the analysis process involved reading the collated extracts and reviewing and refining the themes (phase 4). At this stage the researcher was able to further understand how themes fitted together from different interviews and to build a coherent narrative from the data. The themes were further defined and refined for example, by adding additional sub-themes or giving more appropriate names to the themes which were then applied in the results section (phase 5).

The other research team members (MH, PB and JC) were not involved in conducting the interviews, nor had they read full transcripts. However, to reduce bias associated with individual and subjective coding and to improve trustworthiness of the data, a meeting was held with the research team to discuss analysis and themes. In addition to this a meeting was also held with two researchers who were experienced in qualitative data analysis. The discussions were used to reflect, understand and qualify the reliability of identified themes and to reach consensus with reporting of the results.

5.4 Results

5.4.1 Descriptive statistics

Characteristics of the children are provided in Table 5.2 and characteristics of the parents are summarised in Table 5.3. Most of the children discussed by the parents attended nursery, however the number of hours they attended varied (see Table 5.2). All children were reported as healthy at the time of the study. However, one

child was born prematurely at week 27 and another child was diagnosed with congenital heart disease at the age of ten months. Both children scored high on food fussiness; however, their parents had reported no other, specific feeding problems at the time of the study.

Most participants were mothers and a fifth of participants were fathers (see Table 5.3). They were predominantly White British, with one parent identified as Asian Pakistani and one as Black African. Three-quarters of the parents were educated to university level or higher. Most parents reported that they were working at the time of the study and 65% of them had household income of £30,000 or above. Seventy percent of the parents also had other children.

Table 5.2 Characteristics of children according to their food fussiness level and general demographic information

Child characteristics	High Food Fussy	Low Food Fussy	Overall
n (%)	10 (50%)	10 (50%)	20 (100%)
Child sex			
Girl	4 (40%)	7 (70%)	11 (55%)
Boy	6 (60%)	3 (30%)	9 (45%)
Child age (years)			
2	4 (40%)	1 (10%)	5 (25%)
3	5 (50%)	3 (30%)	8 (40%)
4	1 (10%)	5 (50%0	6 (60%)
5	0 (0%)	1 (10%)	1 (10%)
Nursery hours (weekly)			
0	3 (30%)	0 (0%)	3 (30%)
1-20	6 (60%)	2 (20%)	8 (80%)
21 – 39	1 (10%)	7 (70%)	8 (80%)
39+	0 (0%)	1 (10%)	1 (10%)
Eating Behaviours	←	**Mean ± SEM**	→
Food Neophobia	3.0 ± 0.2	2.2 ± 0.1	2.6 ± 0.1
Food Fussiness[a]	3.6 ± 0.1	2.4 ± 0.1	3.0 ± 0.2
[a] Score range from 1 – 5, score ≥ 3.0 is an indication of high food fussiness			

Table 5.3 Characteristics of parents according to children's food fussiness level

Parent characteristics	High food fussy (children)	Low food fussy (children)	Overall
		n (%)	
Parent sex			
Female (mother)	7 (70%)	9 (90%)	16 (80%)
Male (father)	3 (30%)	1 (10%)	4 (20%)
Parent age (years)			
25-35	7 (70%)	2 (20%)	9 (45%)
35+	3 (30%)	8 (80%)	11 (55%)
Ethnicity			
White British	8 (80%)	10 (10%)	18 (90%)
Black African	1 (10%)	0 (0%)	1 (5%)
Asian, Pakistani	1 (10%	0 (0%)	1 (5%)
Highest education level			
GCSE or equivalent	0 (0%)	1 (10%)	1 (5%)
A Level or equivalent	4 (40%)	0 (0%)	4 (20%)
Undergraduate or equivalent	1 (10%	5 (50%)	6 (30%)
Masters or equivalent	4 (40%)	3 (30%)	7 (35%)
PhD or equivalent	1 (10%)	1 (10%)	2 (10%)
Work hours (weekly)			
0	3 (30%)	0 (0%)	3 (30%)
1 -19	1 (10%)	0 (0%)	1 (5%)
20-29	1 (10%)	3 (30%)	4 (20%)
30-39	3 (30%)	7 (70%)	10 (50%)
39+	2 (20%)	0 (0%)	2 (10%)
Household income (per annum)			
< £16,000	2 (20%)	2 (20%)	4 (20%)
£16,000 - £29,999	3 (30%)	0 (0%)	3 (15%)
£30,000 - £59,999	2 (20%)	1 (10%)	3 (15%)
> £60,000	2 (20%)	7 (70%)	9 (45%)
I prefer not to say	1 (10%)	0 (0%)	1 (5%)
Other children			
Have other children	7 (70%)	7 (70%)	14 (70%)
Older children	5 (50%)	7 (70%)	12 (60%)
Younger children	3 (30%)	1 (10%)	4 (20%)

5.4.2 Qualitative data: 'fussiness as a phase'

All parents stated that their child experienced food fussiness at some point. In the present study parents described food fussiness as refusing to eat new or previously liked foods, eating food selectively or creating fuss at mealtimes. Many parents described food fussiness as a 'phase'. Parents identified fussiness emerging around the age of 18 months to two years. Most children used verbal behaviours to express their refusals, but many parents also recalled physical and overt behaviours such as throwing food, spitting, making themselves sick, and gagging. Parents explained that vegetables were refused by children due to their colour, taste, texture, how they were presented (overwhelmed by the amount, or not cut or cooked in the preferred way), or if their child was full, tired or unwell. Many parents also described that fussiness and refusing to eat vegetables was about their child seeking control and asserting their autonomy.

5.4.3 Thematic analysis: themes related to strategies

Analyses indicated no major differences in strategies implemented by level of fussiness. Therefore, overall themes are discussed with groups combined (Holley et al., 2017) and only where any apparent differences were observed these are identified under relevant sections. Thematic analysis revealed seven main themes encompassing sixteen strategies used by parents to increase their children's vegetable consumption (see Figure 5.2 for an illustration of themes describing parental strategies). Parents reported that some strategies worked on some occasion and others did not work at all. These included

1. Instructed knowledge
2. Experiential learning
3. Food manipulation
4. Reinforcement
5. Commitment to a food ideal
6. Encouragement of autonomy
7. Inherent values

The quotes *(italic font*) in the section below are presented to illustrate themes, they are presented alongside some identifying features such as pseudonym, parent status (e.g. mother /father), their child's food fussiness (FF) level (high or low) and age (e.g. 4 years). These quotes are provided to present the essential context of the themes extracted during analysis..

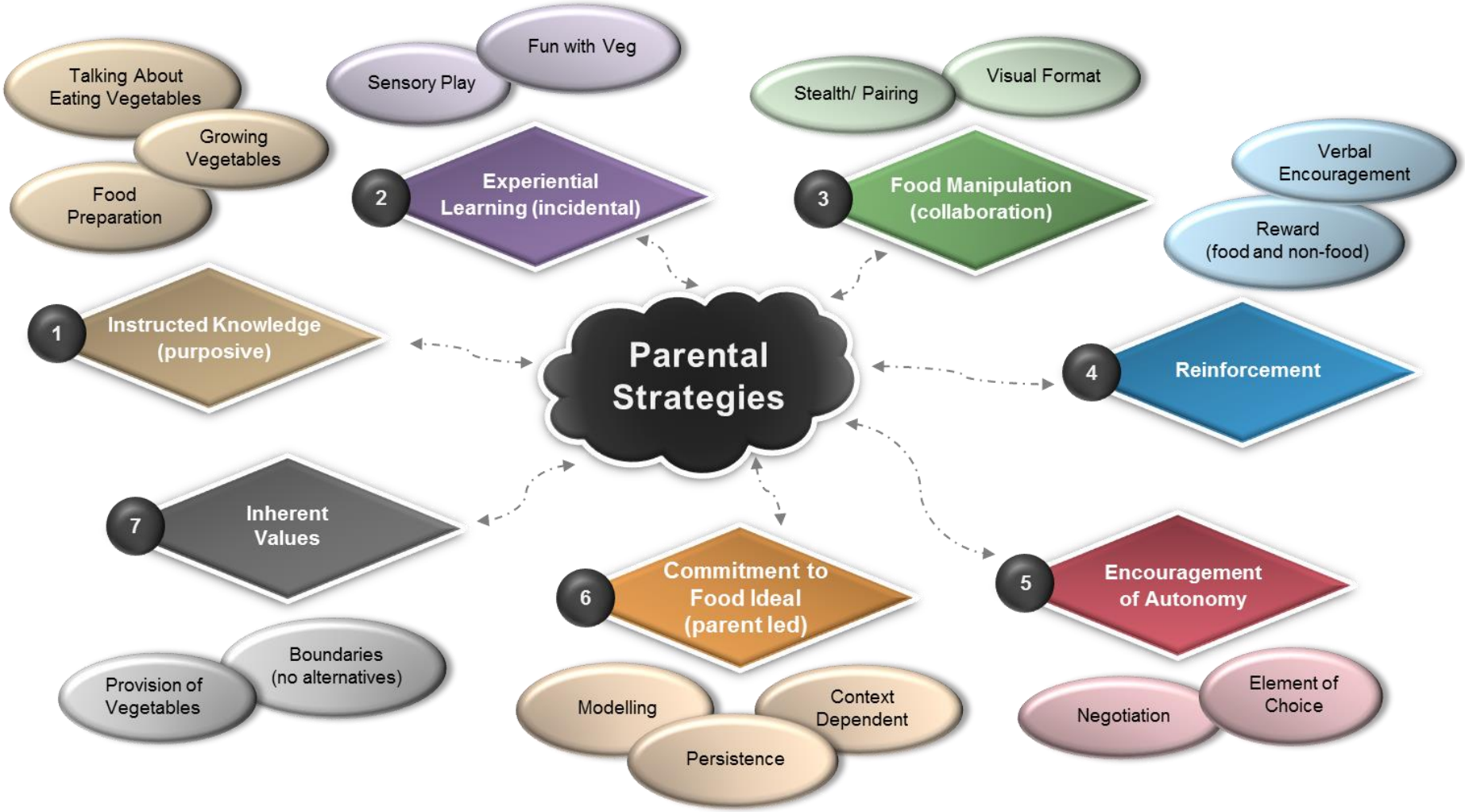


Figure 5.2 Map of identified themes contributing to parental strategies of promote vegetables intake in preschool children

5.4.3.1 Theme 1: Instructed Knowledge (purposive)

Talking about eating vegetables: one theme which was identified was the importance of teaching children about nutrition and this included eating vegetables. According to parents even young children were able to differentiate between foods which are considered healthy (e.g. fruits and vegetables) and foods considered to be less healthy (e.g. confectionery). Parents shared their experience of how they talked to their children about eating vegetables in relation to health and wellbeing. For example, linking the consumption of vegetables to their body and how they can help them to grow (e.g. see quote from Ashley).

Nutrition related educational messages were also conveyed to children in a more subtle way with parents suggesting that nutrition education was simply incorporated into normal everyday routines, such as having and discussing healthy foods at mealtimes (e.g. see quote from Sarah)In addition to teaching their children, some parents mentioned that they were reading up and teaching themselves about nutrition which may be due to concern around adequacy of the diet among parents with fussier children.

> *"We just talked to her about… I'm very into healthy eating anyway so we just talk to her a lot about where it comes from, why is it good to eat vegetables, it's good for your physical wellbeing, and it's good for your heart, it will help you grow. I think at this stage they are very interested in growing and being a big girl and say if you want to grow bigger and to be healthy and to have energy then you need to eat plenty of vegetables. But I think getting them involved, letting them see where the vegetables are grown. Things like taking them to vegetable gardens and farms. Letting them pick things, letting them cook with them, see what they are, where there come from and just educating. Educating them, talking to them, talking about why it is good to have vegetables." (Ashley, mother; child high FF, age 3)*

> *"I don't think it needs direct teaching; I think it just has to become embedded in normal family life." (Sarah, mother; child low FF, age 4)*

As explained by Ashley and other parents, conversations begin early on about why eating vegetables is a "good thing" and that this can be achieved through numerous activities.

Growing vegetables: some parents reported growing vegetables in their garden and involved their child(ren) so that they were aware of and engaged in the process of what was growing in the garden.

> *"We're growing carrots at home and we got some lettuce in the garden, we're trying to grow some tomatoes but it's not going very well but we're trying you know and that sort of makes her think where does my food come from, I think that helps." (Lauren, mother; child low FF, age 4)*

Parents mentioned making the connection between knowing where food comes from and learning to accept them. Among parents who did not grow their own, there was nevertheless efforts made to involve children in food preparation.

Food preparation: the involvement of children in food preparation activities was described by parents to enhance learning about vegetables: this included accompanying parents to the supermarket (or assisting with online shopping), storing vegetables away after shopping, involving children in meal plans, as well as peeling and chopping vegetables while cooking, making packed lunches, watching while parents cooked the meal and serving themselves at mealtimes. Parents actively involved children (aged 3 and above) in these activities believing this to support vegetable intake.

> *"Do you know if they help you to prepare their meal, they will eat it and they forget about what's inside it… With vegetables, yeah, I used to have a lot of problems but then when I used to go to classes and centres as well, that's what they suggest. So, I tried that, and it does work." (Shaheen, mother; child high FF, age 3)*

Parents reported teaching children directly about eating vegetables, and in a less didactic way through encouraging active engagement with vegetables. In addition, parents applied other, more implicit strategies.

5.4.3.2 Theme 2: Experiential Learning (incidental)

Sensory play: parents identified ways to engage which employed different senses such as smell and touch:

> *"I'd just encourage them to help in the prep as much as possible you know, play with them, touching them, smelling them and all that that sort of stuff, I think it helps." (Lauren, Mother; child low FF, age 4)*

Parents also encouraged exploration through making shapes and playing games with food.

Fun with vegetables: examples of play included making faces with vegetables, adopting appealing names (e.g. referring to broccoli as small trees) and inventing games during meals to encourage intake:

"Like the sandwiches and getting her to eat salad and cucumber and things, we'd dress it so it was like a face or a tractor or something daft to either encourage her to eat it or at least try some of it." (Jennifer, mother; child high FF, age 4)

"We used to play the pea sucking game, which was quite fun, so you have to put them on a plate and then the first one to suck erm all off the plate is the winner. That goes down well, he likes that." (Amanda, mother, child high FF, age 2)

The sense of fun and engagement conveyed by parents to support their children stands in contrast to the more stealth-oriented strategy of hiding vegetables. Here the objective is to "fool" the child as a passive recipient rather than as active agent in creative play or preparations.

5.4.3.3 Theme 3: Food Manipulation (collaboration)

Stealth/ pairing: for disliked vegetables, parents pureed or chopped them into small pieces and then "hid" them in other complex dishes, for example in mashed potatoes, soups, or sauces. Children were not generally aware that the vegetable was present in the food and sometimes parents concealed this with similar colour foods (e.g. adding sweet potatoes in carrot soup, or cauliflower in mash potatoes or describing a red pepper as a tomato).

"Mushrooms will go in a sauce really, really small but Chloe wouldn't know that they were there. She wouldn't know them as the rubbery mushroom." (Rebecca, mother; child low FF, age 4)

"I would still try, some of them I'd chop it up small and hide it in the food and then others I would just leave it big for her to proactively eat, with maybe a bit of encouragement." (Tiffany, mother; child low FF, age 3)

Offering vegetables by stealth was applied as measure to counter refusal of vegetables which children disliked. However, this strategy was risky as the effort to conceal may be detected as illustrated below:

"He's finding the bits in the food that he doesn't like, even if I'm disguising the onions in like spaghetti bolognaise or shepherd's pie or whatever he is finding the onions and he is refusing to eat them. In fact, he's refusing to eat all of it, unless the onions are taken out." (Melissa, mother; child low FF, age 4)

Parents also masked the taste of vegetables or paired a disliked vegetables with liked foods. For example, offering carrots with a new vegetable or with liked flavours such as gravy, sauce, cheese or dips. This is a modified stealth strategy since the

pairing masks the taste/ texture of the vegetable but does not entirely hide the food. Commercial vegetable products for very young children, often “hide” vegetable content. Some parents take advantage of this by offering readily available products such as vegetable smoothie drinks or vegetable pouches to ensure that their children are eating enough vegetables.

> *“He’ll have one or two of the vegetables from Ella’s kitchen, we chose the ones which has less fruit because you can get some that have like 90% apples and 3% carrot. So, the couple where you have fifty, forty-nine. Forty percent apple or pear and the rest is like sweet potato and carrots, or whatever, so he has them as… so we make sure that he is getting something the days he is not at nursery.” (Robert, father; child high FF, age 2)*

An alternative to stealth or masking was offering vegetables in a different format (e.g. raw rather than cooked; or using different shapes).

Alternate format: parents changed how the food looked in order to encourage intake. Some parents suggested that if vegetables were presented differently, for example, if they were made to look more appealing (e.g. presented in a colourful array, or made more fun by using cocktail sticks) this increased the likelihood of trying the vegetable (see the quote below by Kathrine).

> *“If you present it differently she likes it and she'll eat it - I buy a packet of stir-fry veg which is ribbons so it's ribbons of squash and carrots and all sorts of things and bean sprouts and that's really interesting shapes and interesting way to eat it and the noodles… dear God they are that long so that's really good fun and so the kids absolutely trough the lot because its good fun”. (Kathrine, mother; child low FF, age 3)*

> *“So, she wasn’t very keen on cooked pepper but she would eat raw pepper, so I'd give her raw pepper strips now when I’m prepping dinner.” (Nicole, mother; child low FF, age 2)*

Parents prepared the vegetables differently such as raw instead of cooked or chopped vegetables in a more preferred format, e.g. sticks instead of circles. Talk around different ways to offer vegetables indicates a willingness by parents to experiment and to persist. Stealth, pairing and alternative formats provide evidence of the ways in which parents are willing to adapt to encourage intake, particularly taking account of previous experience of a food being refused, or disliked. Parents also reinforced eating vegetables by using rewards and verbal encouragements along with other strategies.

5.4.3.4 Theme 4: Reinforcement

Reward (food and non-food): using a liked food as an incentive to tempt children to eat vegetables was frequently reported by parents. Parents referred to both offering and withholding foods to encourage vegetable intake. Withheld foods tended to be highly prized such as dessert (see Heather, below). Parents acknowledged that this strategy was variable in success and risky (see Brittany).

> *"Now that he is a little bit older if he doesn't sit down and eat it I'll take things away from him. Like his tablet or the TV, so if you want to watch TV you need to eat some of your tea or if you want pudding you need to eat some of your tea." (Heather, mother; child high FF, age 3)*

> *"I think offering some sort of incentive sometimes can help, but then not going overboard with that because you don't want them to just link "I'm eating the vegetables just to get a chocolate button at the end of it or whatever, cause I think that kind of goes against the point." (Brittany, mother; child high FF, age 3)*

On some occasions, parents would offer tangible rewards such as stickers or a gift and on others they might withhold access to the TV or computer. Nonetheless parents also identified the importance of praise (social reward).

Verbal encouragement: parents praised their child with comments after tasting vegetables using reinforcing comments such as 'nice', 'tasty', 'yummy' or encouraging the child by reminding them that they had tried and liked the vegetable before.

> *"Certainly, one time when he did eat them was from quite a lot of persistence in terms of go on you can try this, you had this before, have a bit of this and this. I'll say well done, so say well done after he's tried it and that's reinforced it in a positive way." (Robert, father; child, high FF, age 2).*

> *"She sometimes says she doesn't like tomatoes, but I'm like yes you do... you love tomatoes remember and she's like oh yeah." (Tiffany, mother; child low FF, age 3)*

Verbal praise, encouragement and reminders are used by parents to reinforce intake, but parents also gave children more autonomy over choices they could make to increase intake of vegetables.

5.4.3.5 Theme 5: Autonomy

Parents encouraged greater autonomy in their children to make their own food choices and to build autonomy more generally. Parents used negotiation, and choice to help children take more control over their choices.

Negotiation: offering small portions or smaller pieces as part of a negotiation to try a vegetable was a strategy used to prevent overwhelming children (see the quote below by Brittany).

> *"I think what tends to work is the portioning out, she does seem to appreciate that, I did it the other day and she quite like seeing on the plate visually okay I only need to eat that bit." (Brittany, mother; child high FF, age 3)*

Element of choice (or backup choice): providing 'an element of choice' or offering a variety also encourages autonomy:

> *"If I offer her an element of choice, she'll generally eat something so if I say to her you've got dip do you want pepper or do you want cucumber with it, then generally she'll eat one of them, again I think it's about control and just having that choice and asserting herself." (Nicole, mother; child low FF, age 2)*

> *"We do try still and give her a variety, but we always give the carrots as the backup because we know that she will at least eat the carrots." (Jennifer, mother; child high FF, age 4)*

> *"He'll go I don't like that, I'm like but it's there if you try it, if you want to. If he doesn't eat it, it's no big deal as long as he eats something else... No, well obviously he'll have a few different veg on his plate at a time, so there will be something on there that I know for sure he will definitely eat, but I'll still give him it anyway." (Amanda, mother, child high FF, age 2).*

Parents of less fussy children offered choice to ensure the child made the decision about what to eat, and parents of more fussy children used the choice as a form of a 'backup' (see quotes above from Jennifer and Amanda).

While child autonomy was important to the parents, they often took the lead to ensure that they were supporting their children to eat vegetables.

5.4.3.6 Theme 6: Commitment to a Food Ideal (parent led)

Parents appeared to be committed to an ideal of food intake which included eating "enough" vegetables. They described modelling the target behaviour themselves but that this ideal could be compromised by eating out of home.

Modelling: parents acknowledge the importance of their own eating habits (likes and dislikes) in shaping their child's intake and even invoke vegetable preferences of superheroes (see the quote below by Sarah).

> *"I think one of the important things is to demonstrate to your child yourself that you will eat a wide range of vegetables, make them part of everyday meals." (Stephanie, mother; child low FF, age 4)*

> *"We might say oh Spiderman likes this so, you know, superman eats spinach to make him strong. But, to be honest, I am not sure if that really works." (Sarah, mother; child low FF, age 4)*

> *"I just wouldn't want to buy a whole cauliflower to offer. Laila wouldn't eat it, I wouldn't like it, the mum wouldn't eat it erm so no I just don't... yeah I know I should do... but it's just I don't want to buy a broccoli just to chuck it away or a cauliflower." (Mathew, father; child low FF, age 5)*

This latter quote reveals the challenge of having a parent who themselves does not eat certain vegetables, therefore, modelling works both for and against increased intake.

Context dependent: parents recognised that context is also important in vegetable intake, so parents used opportunities outside the home to try new foods, for example, at a grandparent's house (e.g. Mathew), or restaurant or limiting choice for convenience (e.g. Shaheen).

> *"So we usually go to my parents for a Sunday dinner, like Sunday evening and erm yeah I just kind of let that stuff be done there... coz they do all that kind of stuff anyway like they eat broccoli and sprouts and yeah cauliflower and stuff so yeah he has it there." (Mathew, father; child low FF, age 5)*

> *"Like whenever I take her she's got her bag in the car and I'll just put fruit piece in there, apple, banana, so I won't put her favourites in there… and I'll say would you like apple, sometimes she'll say yeah mumma please yeah so she'll have it. So, it's not like she doesn't want it, she's fussed sometimes, especially at home when they know there is more choice there." (Shaheen, mother; child high FF, age 3)*

Persistence (keep offering): parents continued to offer disliked vegetables and persisted in offering these vegetables (see the quote below by Jennifer).

> *"Erm may be once every couple of weeks or something... I wouldn't stop buying a certain vegetable. We will just carry on eating it and every time we have it, I just offer some to Alice." (Jennifer, mother; child high FF, age 4)*

> *"We haven't done it in a very consistent manner… we will always offer him something that we know that he's not going to eat, or we know that previously*

he's refused to eat… sometimes we are like ok put some here. I know some of the advice sort of says oh you consistently put a veg that he has never eaten before on his plate then eventually he will try it but I'm sort of sceptical. I'm sceptical about that advice… I think to be honest it's just, that's just a child getting older thing rather than getting acclimatised to broccoli." (David, father; child high FF, age 2)

"If you put stuff you know he doesn't like on his plate so if you put veg on a plate with some fish which he usually eats he might refuse the whole meal because he doesn't want the veg. So, some days we kind of give him like some fish and tomatoes first so he has eaten something and then we put the veg on afterward so at least he's getting's something." (Robert, father; child high FF, age 2)

Persistence also had drawbacks (e.g. see the quotes above by David and Robert), but it is interesting to note that parents did not stop offering these nor did the parents mind occasional food waste. This suggests that they favour repeated experience over the potential for refusal or waste. Parents' commitment to the food ideal was often related to the inherent value placed on the importance of eating vegetables.

5.4.3.7 Theme 7: Inherent Values

Parents imply that eating vegetables is a "good thing", and that providing vegetables and expecting them to be eaten was something of value to strive for.

Provision of vegetables: parents appeared to value the provision of vegetables, especially parents of low food fussy children who provided a range of vegetables and other food experiences from complementary feeding encourage intake and mitigate the effects of food fussiness:

"So, the freezer is stocked with broccoli and cauliflower and peas and sweetcorn and whatever else just because they… when they ask for it, I want to be able to provide that because actually asking for the vegetables is a really positive thing." (Kathrine, mother; child low FF, age 3)

"I think offering as wide a range of foods as you can when your baby starts weaning is important... So, if you have a child who gets to the age of 5 for example who hasn't eaten very many vegetables then I think that will be really difficult to start them eating them whereas if you start off introducing them right from weaning, I think, even if they go through a fussy phase it's more likely that they'll eat a wider range of things." (Stephanie, mother, child low FF, age 4)

Boundaries: Setting boundaries during meals was also of inherent value to parents (e.g. see quote below by Nicole). These however, generated debate: for example,

parents of fussy eaters, were unsure about offering replacements after food refusal (see the quote below by Robert); and were concerned that their child was not eating enough (see the quote below by Elijah)

> *"I try not to get into the- if you don't eat that you can get this instead- because I think she needs to learn that vegetables are a normal part of life and you have to eat them as part of the balanced diet. So, I try not to sort of, well if you're not gonna eat that you can have a piece of toast instead because she will just go for the toast" (Nicole, mother; child low FF, age 2)*

> *"This is an issue of debate between myself and my wife, so I offer him alternatives after a period and there are not kind of like sweet or more palatable it's just a different savoury vegetables type meal. So, like if he refuses it then I won't be like I give him a yogurt straight away... I'll wait a little while then I'll cook something else. Whereas my partner thinks you should not do that." (Robert, father, child high FF, age 2)*

> *"Like I said, we tend to focus mostly on - is he getting enough to give him the energy for the day? So, if I mean if he's not touched his vegetables, at least he's ate his potatoes, he's ate his rice. Erm and we happy with that." (Elijah, father; child high FF, age 3)*

The ideas discussed in the present study showed that parents hold certain beliefs when feeding their child, this may be based on their past experience (e.g. forced to eat vegetables when they were young) and/ or present situation (e.g. having a child who is fussy eater). Their beliefs are likely to influence their motivation and strategies they use when encouraging their child to eat vegetables.

5.5 Discussion

5.5.1 Key findings and integration with previous studies

The present study aimed to explore strategies parents used to encourage their children to eat vegetables, especially when children exhibit fussy eating. Across the identified themes, it was clear that parents used a wide variety of ways to encourage vegetable intake. An important finding was that strategies did not differ markedly between parents of low and high fussy children. A consensus across parents was that strategies may have variable success and parents of children with high food fussiness were more likely to report this. The strategies used by parents varied from direct, didactic approaches to more implicit, incidental strategies and from reinforcement and encouragement to outright deception. The diversity of approaches reveals a willingness to experiment with different ways of encouraging vegetable intake as well as being prepared to persist. Interestingly, evidence-based recommendations include persistence and research studies investigate a variety of

strategies in common with parental practices including repeated taste exposure. Diverse strategies and persistence indicate that parents place a high value on eating vegetables as “a good thing”. Overall, the strategies reported by parents sat within broad, overarching constructs including instructive and experiential learning, collaborative efforts, parent-led and child-responsive approaches which revealed the inherent value of eating vegetables and an attempt to achieve a food ideal.

A systematic research review of qualitative studies has demonstrated that eating fruits and vegetables are key attributes of healthy eating (Bisogni, Jastran, Seligson, & Thompson, 2012). The Food Choice Process Model (see Figure 5.3) which provides a framework for understanding individuals’ food choices can also help to understand how being parents influences child’s food choices (Connors, Bisogni, Sobal, & Devine, 2001; Furst, Connors, Bisogni, Sobal, & Falk, 1996).

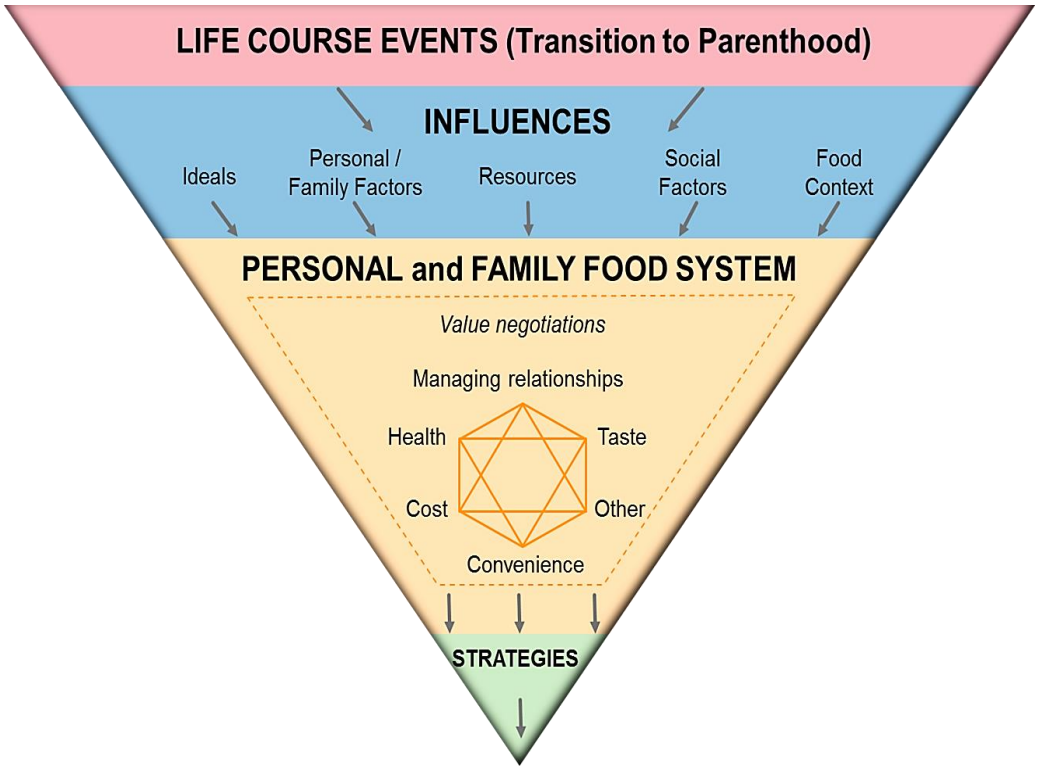


Figure 5.3 Food Choice Process Model. Adapted from Furst *et al.* 1996 and Connors *et al.* 2001

According to the Food Choice Process Model, life course events and experiences have significant influence on ideals, personal factors, resources, social factors and context, and these can shape personal values (Connors, et al., 2001). Hence,

becoming parents influences their food ideals and brings about heightened interest in healthy eating for themselves and importantly for their children (Bisogni, et al., 2012; Treiman, et al., 1996). Reported re-evaluation to make positive lifestyle changes following parenthood transition may be motivated by additional responsibility of caring for their growing family and desire to nurture children's healthy eating from the early years (Bisogni, et al., 2012; Edvardsson, et al., 2011; Haines, et al., 2019; O'Brien, et al., 2009).

In feeding children, mothers trust their own judgments in addition to, or in contrast with, professional advice (O'Key & Hugh-Jones, 2010; Underwood, Pridham, et al., 1997; Zehle, Wen, Orr, & Rissel, 2007). For example, discursive analysis of interviews with mothers showed that they distrust healthy eating messages, they believed they had sufficient intuitive knowledge and were best placed to know how to feed their children (O'Key & Hugh-Jones, 2010). Distrust may arise from the mismatch between guidelines, professional advice and parental perception and values, including what is practical (Rodriguez-Oliveros et al., 2014). According to a review of qualitative research people interpret healthy eating messages in complex and varied ways, and the meanings they ascribe are far broader than the food composition and health outcomes considered by scientists (Bisogni *et al.* 2012). For example, parents may feel threatened and judged as parents if their feeding practices diverge from healthy eating recommendations (O'Key & Hugh-Jones, 2010). How parents process child health and nutrition information is influenced by their values; these include their beliefs about the importance and relevance of certain health and nutrition information (Lovell, 2016). Lovell (2016) found that whether or not parents integrated the information into their value system was shaped by their interpretations of current information and their personal beliefs associated with their upbringing and cultural identity.

In the present study, parents sought out ways to offer vegetables to their children as something of value which may mirror their own eating habits rather than simply as a reflection of healthy eating guidelines. Though, previous research shows that some parents only prioritise healthy eating for their children and reserve separate ways of eating for themselves (Blake & Bisogni, 2003). The value parents place on the importance of their child eating vegetables is a key motivator for their continuous efforts to encourage vegetable intake in their children (Haines, et al., 2019). However, their motivation for action may be hindered by lack of resources and by barriers in the family system such as limited finances and child food

preferences or pickiness (Lovell, 2016). Discourse analysis of focus groups with children aged 7-12 years revealed that their health values were disconnected with liked foods and foods perceived as unhealthy (Frerichs, Intolubbe-Chmil, et al., 2016). This may be because they are too young to link their personal beliefs to eating, especially because what and how they eat is largely driven by other providers. Hence, Frerichs, et al. (2016) articulated that children's description of liked food was associated with taste, texture, visual appeal and familiarity, as well as with positive home and family experiences. This suggests that strategies which increases familiarity with vegetables are particularly important to children.

Most of the strategies reported by parents in the present study confirm the findings of a previous study with caregivers of 2-5 year olds using focus groups (Holley, Farrow, et al., 2017a). For example, making vegetables available, hiding, masking, fun, modelling, rewards, different forms and compromise (terms used to describe strategies varied). The present study is novel because it adds to previous research by discussing the importance of direct teaching, as parents here reported that educating children about eating vegetables was important. Also, parents discussed the different ways in which they taught their children about the importance of eating vegetables. Furthermore, use of sensory play was mentioned in the present study, and this is useful to know because this method is novel for increasing vegetable intake in preschoolers. Furthermore, the detailed findings for use of taste exposure strategy in home is particularly important, because taste exposure is reported to be the most successful method in scientific research, hence, understanding their uptake in home is crucial for future implementation. The present study demonstrated that repeated exposure in homes was not systematic and parents offered disliked or novel vegetables as and when they were bought. This finding feeds forward to future research because repeated taste exposure in experimental studies has only been tested systematically (e.g. once a day, twice a week, once a week) and more work is needed to understand if the effects of random offerings in the home are similar to systematic offerings in experimental studies. Furthermore, the present study highlighted that use of food rewards was very common among parents and although parents were aware that the approach was not ideal they persisted. Hence, additional guidelines might offer advice to parents about why food rewards (including offering healthy foods such as fruits for pudding) can be detrimental to the goal of increasing vegetable intake and offer an alternative incentives such as praise or non-food rewards (e.g. visit to park).

There was some variation in the themes identified in the present study compared to the previous research. For example, Holley, Farrow, et al. (2017a) separated strategies into three major themes; active, passive and food manipulation. This categorisation for strategies was not thought to be useful in the present study due to a considerable overlap between types of strategies discussed by parents. For example, strategies previously themed under “food manipulation” could be active (e.g. different forms) or passive (e.g. hiding vegetables). Hence, the themes developed in the present study were more numerous and overlapping (see Figure 5.2). In terms of contextual differences, Holley, Farrow, et al. (2017a) report that activities such as food preparation may be difficult for parents due to time constraints. However, parents in the present study reported numerous ways to engage children in activities which were integrated into everyday life.

The present study also confirms that parents use ways to mask vegetables but that these stealth strategies could backfire. Despite this, parents used deception or masking in order to ensure that children got the essential nutrients from the vegetables. This demonstrates that parents place an inherent value on achieving an adequate vegetable intake, even if this means using covert action. The finding that parents are willing to manipulate foods also supports results from previous qualitative research and experimental studies identifying stealth as a strategy (Caton, et al., 2011; Holley, Farrow, et al., 2017a; Spill, et al., 2011a). However, if children are unaware of the presence of a particular vegetable, they may then miss the opportunity to experience and familiarise themselves with the distinct appearance, flavour and texture of the specific vegetables. As a result, they may be less likely to develop a liking for the vegetables and less willing to eat them when they are presented alone (Pescud & Pettigrew, 2014).

Parents were accommodating and showed high levels of creativity and commitment by offering vegetables in a variety of formats to suit their child’s preference. Different preparation methods have been shown in systematic research studies to encourage greater vegetable acceptance and intake (Liem & Russell, 2019; Poelman & Delahunty, 2011).

Parents were willing to model vegetable eating in this study, indicating the inherent value they place on eating vegetables. This finding is consistent with previous research (Holley, Farrow, et al., 2017a). Modelling is an important social factor and modelling has shown to be an effective and feasible method (Holley, et al., 2015; Remington, et al., 2012; Wardle, Cooke, et al., 2003). However, this is predicated

on parents themselves buying and making accessible a range of vegetables to model rather than only those which they themselves like. People other than parents can also be effective models. A qualitative research study with slightly older children (7-9 years) found that siblings and peers had both positive and negative effects on eating (Williams, et al., 2011). Hence, more research is needed to understand the effects of adverse modelling on vegetable intake and how these can be minimised, so that the range of vegetables offered to children is not limited. This is particularly important for preschool children who are still developing their preferences and are more likely to be influenced by others (Savage, Fisher, & Birch, 2007).

Commitment to a food ideal and the inherent value parents place on eating vegetables was demonstrated through provision of vegetables, instigating boundaries (such as not offering alternatives when refusing to eat a meal), and persisting in their offering of disliked vegetables. This has been found in previous qualitative research with parents of 7-13 year old children which showed that parents exercised control by implementing 'food rules', providing access to fruits and vegetables and restricting unhealthy food items (Williams, Veitch, & Ball, 2011). Parents' positive attitudes towards healthy eating has been associated with greater consumption of vegetables in preschool children (Romanos-Nanclares, Zazpe, et al., 2018). Parents in the present study were motivated to transform their child's refusal of vegetables by being persistent in offering. Previous qualitative research termed this as "normalising offering" (p.244, Holley, Farrow et al., 2017a), where children become familiar with the vegetable over time as a simple effect of being present. Previous experiments using repeated taste exposure demonstrate that this is a robust technique to increase intake of unfamiliar (possibly disliked) vegetables in a systematic way, i.e. offering a certain number of exposures over a particular period. (Caton, et al., 2013; de Wild, et al., 2013; Holley, Farrow, et al., 2017b; Nekitsing, Blundell-Birtill, et al., 2018). In persisting with disliked vegetables, parents are applying a technique known to be effective in more systematic studies.

In contrast, parents of food fussy children reported that they faced the risk that their child may refuse to eat an entire meal if they were offered disliked vegetables. Hence, repeated exposure is potentially aversive to some children, an unintended consequence of a well-intended strategy used by parents. A less aversive method of exposure may be to provide this in the form of visual exposure or through

sensory play rather than with an expectation to taste the food (Coulthard & Sealy, 2017; Houston-Price, et al., 2019).

Parents responded to their child's perspective, by applying moderate control and encouraging autonomy by using negotiation and offering children an element of choice. Children naturally seek autonomy over their behaviour. Parents who employ feeding practices which encourage child autonomy, competence, and relatedness promote children's vegetable intake (Shim, et al., 2016). But choice offering alone may not be sufficient to encourage vegetable intake (de Wild, de Graaf, Boshuizen, et al., 2015).

Finally, in combination with other strategies parents often used reinforcements such as verbal encouragement, confirming findings from other qualitative studies (Williams, et al., 2011). For the older children in this latter study, encouragement was through educational messaging and this was mirrored in the present study with younger children (2-5 years). Here, nutrition education was communicated in various ways, both purposively and incidentally. Teaching children about the importance of eating vegetables may change their attitude towards vegetables and this contributes to their intrinsic motivation to eat vegetables (Sarti, Dijkstra, Nury, Seidell, & Dedding, 2017). This is particularly important for sustained consumption of high nutrient dense foods and again reveals the inherent value parents place on vegetable intake.

5.5.2 Strengths and Limitations

A strength of this study was the demonstration that parents used a variety of ways to encourage vegetable intake at home, some of which mapped onto techniques used in systematic research and others which have not been systematically studied. This adds to the field and highlights the importance of responding to individual differences. However, a connecting theme across the piece was the importance of the food ideal and inherent value placed on eating vegetables. The parents involved in this study may not be representative of the general population and so other parents may not hold this ideal or accept the value of eating vegetables.

A methodological strength of the present study was inclusion of parents from diverse socioeconomic backgrounds, inclusion of fathers as well as mothers and parents of children with both high and low levels of food fussiness. This enabled investigation of the methods used by parents of high and low food fussiness.

Although, there were no differences in strategies implemented by these two groups, the present study highlighted that all parents were striving to get their children to eat vegetables and this confirms the need to offer support to parents which is evidence-based. There may also be traction in offering advice to parents which is informed by parental experience.

A limitation of the present study is that most parents were White British and so future research must seek to include parents from the wider population representing different cultures and ethnicities. A further limitation with using interviews is that participants may respond in a socially desirable manner. However, the risk of social desirability may have been attenuated by the interviewer also being a parent with a preschool child, therefore in a position to empathise with successes and challenges. Bias may have been introduced inadvertently to the analysis by having a coder who scored food fussy questionnaires and conducted the interviews. For future studies, it would be better to handle these tasks separately.

5.5.3 Implications for research and practice

Collective actions articulated by parents in the present study may help to advance future interventions aiming to increase vegetable intake in preschool children. The gap between strategies used at home and evidence-based guidelines may be reduced by including parents in the design of future studies. Since caregivers do seek out information on getting children to eat vegetable from various sources (e.g. people, books, television, online) involving parents in recommendations might reduce confusion and conflict (Holley, Farrow, et al., 2017a) and improve trust in what is recommended (O'Key & Hugh-Jones, 2010). More efforts are needed to develop nutritional guidelines which are compatible with common home practices, are inclusive of different child needs and relevant within diverse populations.

Finally, some of the methods used by parents have not been explored systematically and could form part of future intervention research, such as context dependent strategies (e.g. offering certain disliked vegetables away from home), element of choice (e.g. offering a choice of dip to eat with the selected familiar vegetables or choice of vegetables with a selected dip), negotiation and portioning out (e.g. giving child a smaller target to eat from what is already served). These methods warrant further investigation to test their efficacy. Since these strategies are known to be used they are more likely to be accepted by parents.

5.5.4 Conclusion

In conclusion, parental commitment to a food ideal, formulating vegetable intake as a “good thing” and involving children in vegetable related activities are key findings from this study. Parents used a combination of strategies, in rotation depending on circumstances and context. Strategies appeared to be responsive to the child and tailored to their needs. Therefore, parental involvement in ways to promote vegetable intake is crucial for future interventions and for developing child feeding guidance.

Chapter 6

General Discussion

Chapter 6
General Discussion

6.1 Introduction

The intervention studies conducted as part of this thesis were the first to combine the effects of nutrition education with taste exposure, and storybook with sensory play. Across this thesis a number of strategies have been considered to encourage young children to eat more vegetables, but their success varies. Evidence suggests that most published interventions that aim to improve vegetable intake are successful to some extent, yet they all have some limitations which should be considered when developing future interventions (Appleton, et al., 2016). Current efforts from various stakeholders is very encouraging for promoting vegetable intake, however, these existing interventions will benefit from continuous outcome assessment and process evaluations to ensure that they work, are implemented as they were designed to be, and are suitable for a wide population, including children of different ages, cross culturally and for people from varying level of socio-economic status (especially those who are disadvantaged).

The present thesis is concerned with refining and extending understanding of strategies for promoting vegetable intake in preschool children aged 2-5 years. The final chapter of this thesis aims to evaluate and discuss evidence from Chapters 2-5. First, main findings for vegetable strategies will be summarised (see Figure 6.1) and secondly how these findings fit with existing literature and theories will be discussed. Strengths and limitations will be outlined, and finally implications for future research and practice will be highlighted.

6.2 Summary of thesis objectives and findings

The overarching aim of this thesis was to investigate strategies to promote vegetable intake in preschool children aged 2 to 5 years using a mixed methods approach. This was achieved in three phases; the first phase investigated existing evidence of vegetable promoting strategies in preschool children (Chapter 2), the second phase compiled evidence from two novel intervention studies with preschool children (Chapters 3 and 4) and finally, the third phase explored parental perspectives on ways to get children to eat vegetables (Chapter 5). Key findings by chapter are restated below and highlighted in Figure 6.1.

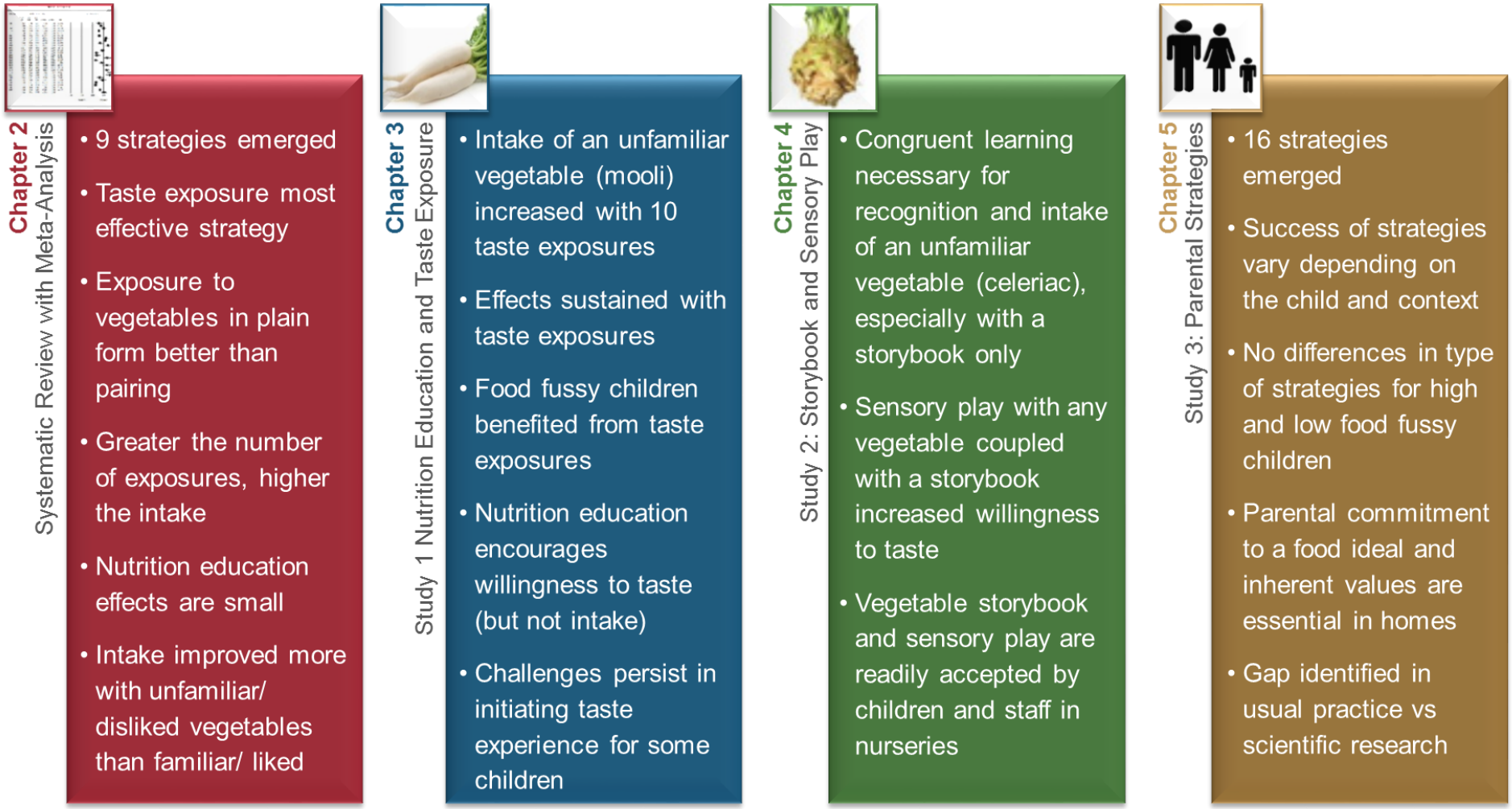


Figure 6.1 Summary of key findings for strategies to increase vegetable intake by chapter

6.2.1 Chapter 2: Synthesise existing evidence to assess which strategies are most effective for encouraging vegetable intake in preschool children

The systematic review with meta-analyses highlighted nine dominant intervention strategy for promoting vegetable intake in preschool children. Interventions with repeated taste exposures yielded best outcomes. Exposure to the vegetables on their own were more effective than pairing them with flavours or nutrients and intake increased as the number of exposures increased. Intake increased more when vegetables were unfamiliar/ disliked compared to familiar/ liked. Nutrition education strategies are widely used but their effects were small for increasing vegetable intake. No specific strategies for food fussy children were identified.

6.2.2 Chapter 3: Efficacy of a nutrition education, repeated taste exposure and their combined effects on intake of an unfamiliar vegetable; mooli (study 1)

The cluster randomised trial showed that ten exposures to the unfamiliar vegetable (mooli) increased intake of mooli in preschool children, including those who were food fussy. Effects were sustained 3 and 6 months after the intervention. However, no effects of nutrition education were observed for changing intake of the single unfamiliar vegetable, but some effects of nutrition programme were seen for children's willingness to taste. Evaluative feedback was generally positive for both types of intervention, but nursery staff reported that it was difficult to initiate taste exposure with some children.

6.2.3 Chapter 4: Effects of congruent and incongruent learning through storybook and sensory play on intake of unfamiliar vegetable; celeriac (study 2)

The cluster randomised trial highlighted that learning about the target vegetable (congruent leaning) was important for children's ability to recognise and eat the target vegetable (celeriac), especially when a storybook only approach was used. However, sensory play with any vegetable alongside a storybook increased willingness to taste celeriac, in particular for the baseline non-eaters. Evaluative feedback was very positive for both types of intervention.

6.2.4 Chapter 5: Exploring vegetable promoting strategies implemented by parents (study 3)

The qualitative study showed that parents use a range of strategies (7 major themes; 16 strategies) in different combination and alter these to suit their child and context. Effects of these strategies vary between children and within the same children at different times. There were no marked differences in strategies implemented for children who exhibited high and low levels of food fussiness. Parental commitment to a food ideal and inherent values were key to promoting vegetable intake in the home. Most importantly, the study highlighted some gaps in how strategies are tested by scientific research compared to their usual practice in a home environment.

6.3 Evidence from this thesis in relation to existing literature and theories

Figure 6.2 illustrates effect sizes (calculated using pre-post mooli / celeriac intake data) of each thesis intervention (Chapters 3 and 4) in comparison to existing studies included in the systematic review (Chapter 2). The effect sizes for the taste exposure only and nutrition education only interventions were similar to those observed in previous studies. In the present thesis, interventions involving taste exposure remained most effective followed by sensory learning for promoting vegetable intake in preschool children and the effects of nutrition education remained small for intake of an unfamiliar vegetable (Chapter 3).

6.3.1 An abundance of strategies for preschool children but their effects varies

In support of previous research, this thesis illustrates effectiveness of different strategies for encouraging vegetable intake in preschool children (Appleton, et al., 2016; DeCosta, et al., 2017; Holley, Farrow, et al., 2017a; Mikkelsen, et al., 2014). The systematic review (Chapter 2) highlighted nine dominant intervention strategies in scientific research, similarly, sixteen strategies emerged from parental discussion (Chapter 5). The present thesis extends previous research by introducing two novel approaches; i.e. combining nutrition education with taste exposure and storybook with sensory play. There was a substantial overlap in types of strategies included in research and those used by parents. However, some notable differences appeared in how these strategies are tested in research compared to how they are applied in home, this is further discussed in section 6.3.6.

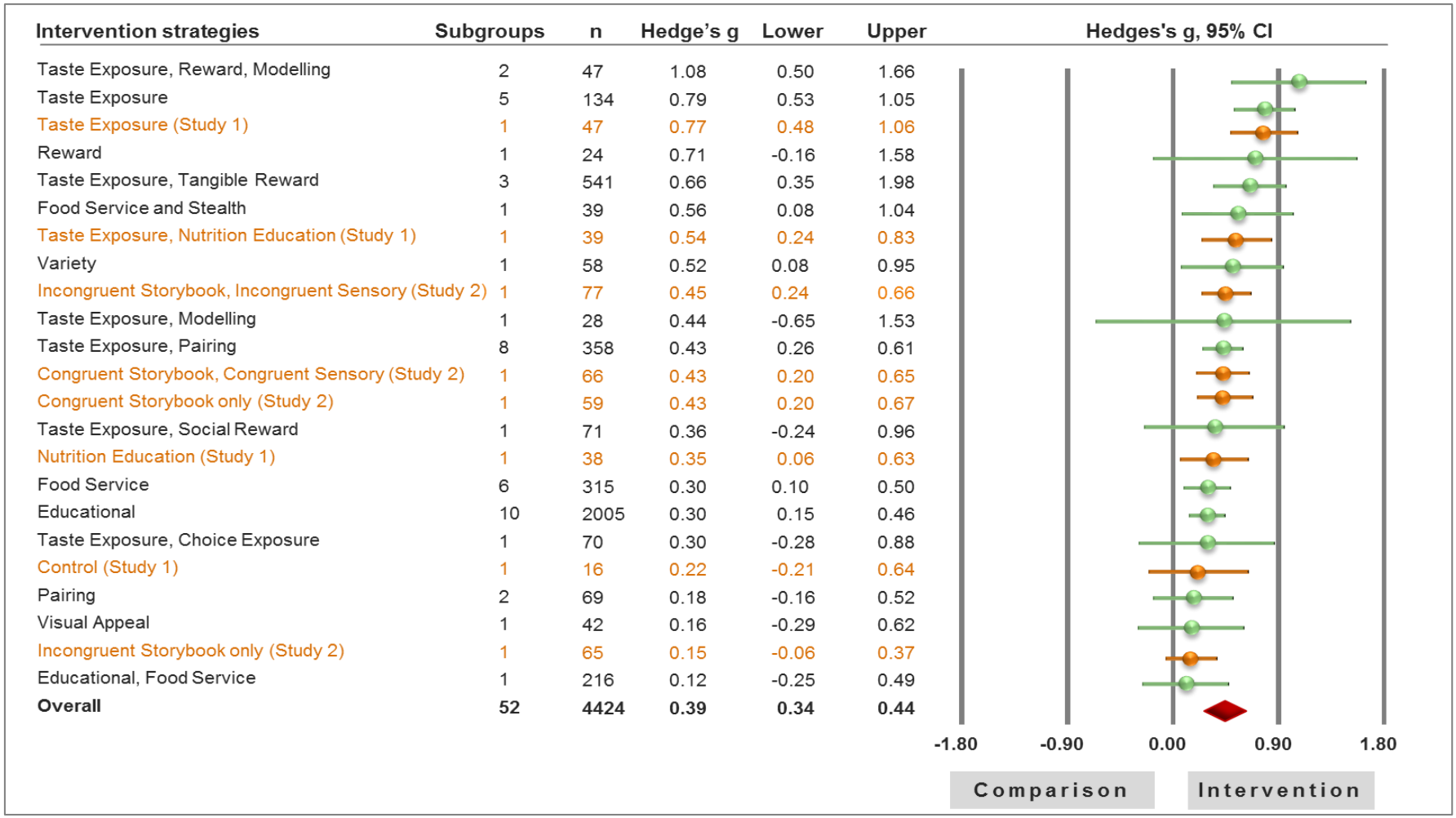


Figure 6.2 Effect sizes of thesis interventions (orange) in comparison with previous interventions included in the systematic review (green)

The systematic review and parental narratives confirmed that strategies are used in various combinations. For example, taste exposures are combined with other strategies such as modelling and verbal encouragement. Multi-component interventions are likely to be more effective than using a single approach (Evans, et al., 2012) because getting children to eat vegetables is a complex process and 'one strategy does not fit all' (Johnson, 2016). Within the same child multi-component interventions can tackle the issue from different perspectives. For example, a child may refuse a novel vegetable because it is unfamiliar to them, hence, repeated sensory play may decrease food neophobia through learned safety (Birch, et al., 1987; Mustonen & Tuorila, 2010). At the same time if they observe parents or peers eating the same food this may motivate them to accept the unfamiliar food, in line with the social learning theory (Addessi, et al., 2005; Bandura, 1977). Figure 6.3 illustrates the experience that a child may go through to accept an unfamiliar vegetable and how specific strategies may help this process.

Success of strategies vary and there are several explanations for this, including external factors such as who is delivering the strategy and the types of vegetable used (Chapter 2) and personal factors such as age and level of food fussiness (Chapters 3 and 4). For example, the systematic review showed that interventions were more effective for unfamiliar/ disliked vegetables compared to familiar/ liked vegetables. It has been previously noted that taste exposure interventions may not work for certain vegetables, particularly those which are familiar (Zeinstra, Vrijhof, & Kremer, 2018). Moreover, experimental studies showed that personal factors such as food fussiness can also influence intake of vegetables (Chapter 3 and 4).

6.3.2 The persistent problem of non-eaters (not only the food fussy children)

Food fussiness and its inverse association with intake of vegetables in preschool children are well documented (Caton, et al., 2014; Holley, et al., 2018); however, even relatively food fussy children increased their intake over time with repeated taste exposures (Chapter 3). Although, food fussy children are more likely to be non-eaters (Caton, et al., 2014), the present thesis found that a high proportion of children who were non-eaters were not identified as fussy eaters by validated instruments. For example, in Chapter 4, 32% (n = 85) of the children were baseline non-eaters, of which 47% (n = 40) were those who scored low on food fussiness. This raises a concern about using the Food Fussiness scale of the CEBQ to assess food fussiness, because opportunity may be missed to identify certain types of picky eaters (Dovey, et al., 2008; Steinsbekk, et al., 2017).

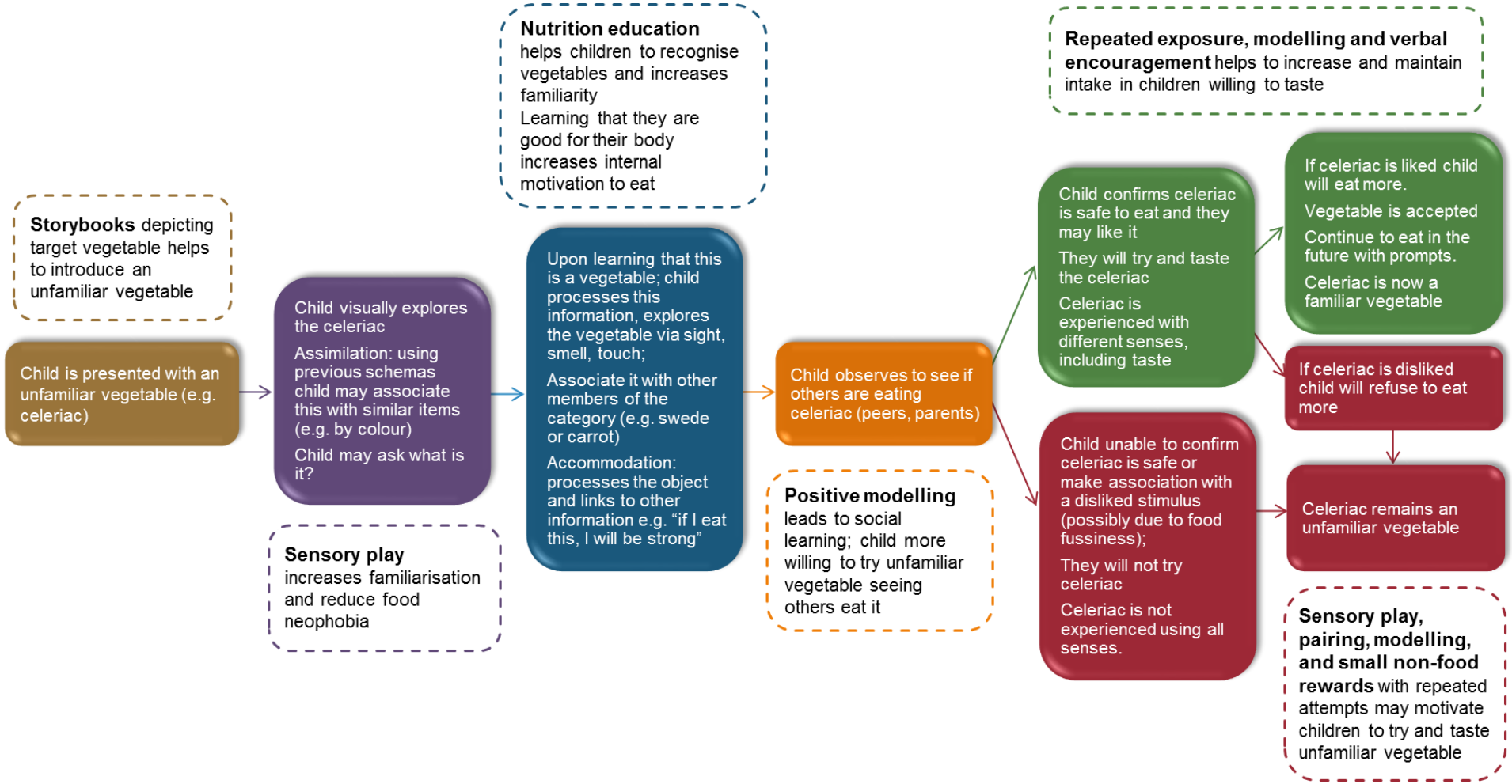


Figure 6.3 A vignette showing the learning process experienced by preschool children as they learn to accept an unfamiliar vegetable. Alongside annotation of how some strategies can assist the process.

The findings from the present study suggests that low to moderate levels of fussiness may not be useful constructs for parents or researchers, as most children seem to experience food fussiness at some point. However higher scores on the Food Fussiness sub-scales may indicate problematic eating. Nevertheless, the scoring of food fussiness by self-reported measures is open to criticism because, as evidenced from the present thesis, the ratings of these scales are dependent on parents' perception of their child's fussiness. For example, if a parent provides a limited range of foods to their child then they may not interpret their child as a fussy eater. In contrast, if a parent provides a wider variety of foods to their child but the child refuses to eat a few of those foods, parents may perceive them to be a fussy eater. Also, parents may find that their child is selective about specific categories of foods such as meat but not vegetables. Hence, labelling a child as food fussy or not may reflect parental perceptions and not the reality of accepting foods in different contexts. Researchers might usefully consider adapting the Food Fussiness scale of the CEBQ to account for specific food groups (e.g. vegetables). A more objective measure of willingness to try a food or measured intake of a new food may be a more reliable indication of food fussiness than parental perception.

Previous research has also reported high numbers of non-eaters (around 40%) for both familiar and disliked vegetables (Fildes, van Jaarsveld, et al., 2014a; Zeinstra, et al., 2017). This highlights that more research is needed to identify what works for different subgroups of children (Caton, et al., 2014; Zeinstra, et al., 2017). A possible strategy to increase willingness to try a vegetable for non-eaters, is sensory play combined with a storybook (Chapter 4). Furthermore, while nutrition education did not significantly increase mooli intake, it appeared to be impactful for increasing children's willingness to taste mooli (Chapter 3). Hence, findings based on both willingness to try as well as intake data are useful in providing an insight into subgroups of children who need extra support to improve their dietary intake (Dovey, et al., 2008; Johnson, 2016).

6.3.3 Familiarisation and learned safety - the 'master key' to encourage vegetable consumption

Figure 6.4 emphasises that familiarisation and learned safety are essential for increasing vegetable intake in preschool children.

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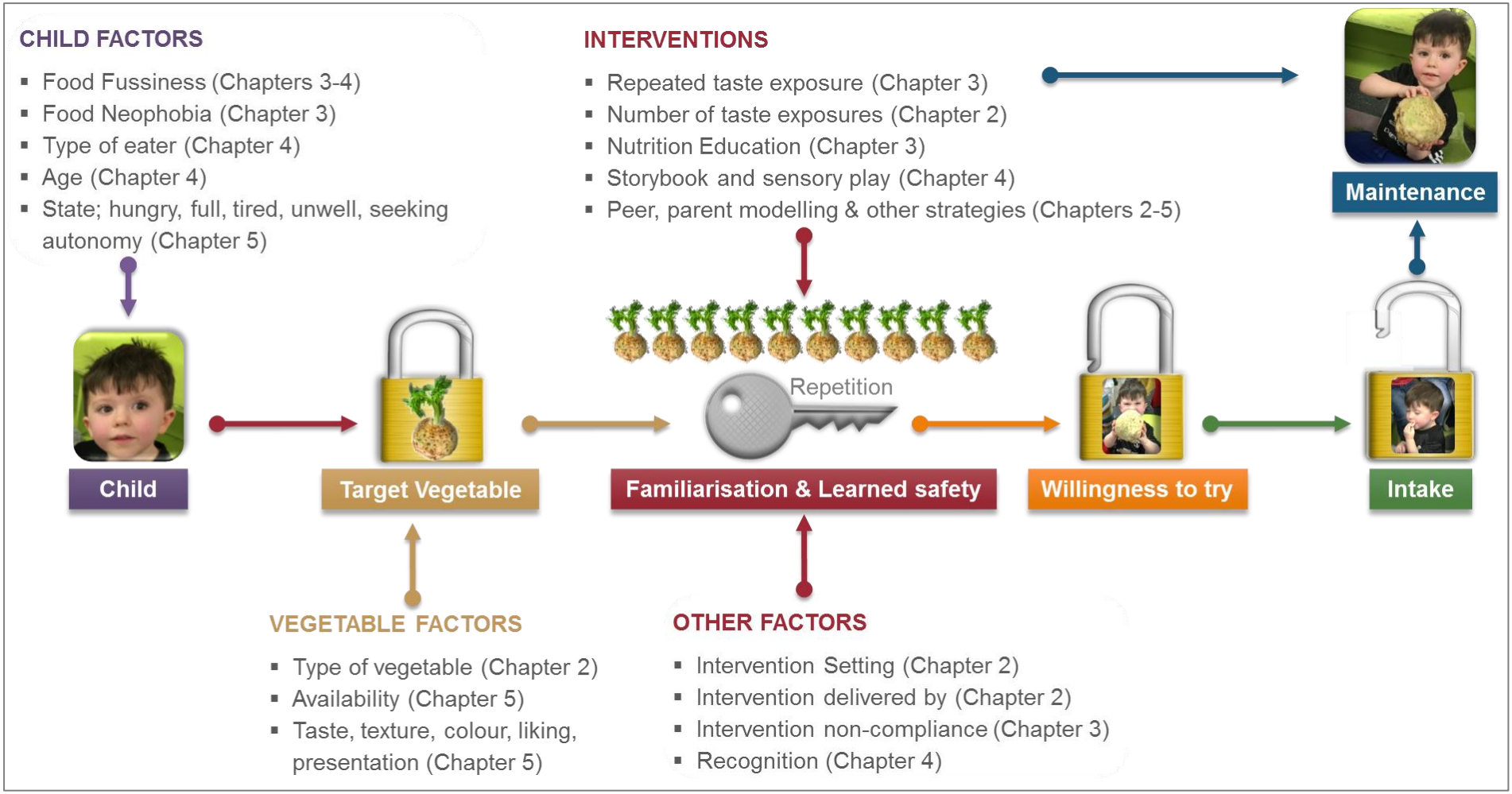

Figure 6.4 Familiarisation and learned safety increase vegetable consumption in preschool children

6.3.3.1 Familiarisation through repeated taste exposure

The present thesis found strong support for the effectiveness of repeated taste exposure interventions. It builds on the previous knowledge base, strengthening the case for strategies that increase familiarisation and learned safety with vegetables (Ahern, et al., 2014; Anzman-Frasca, et al., 2012; Birch, et al., 1987; Wardle, et al., 2003). Familiarisation is a key determining factor for whether a child accepts or rejects foods (Cooke, 2007). The concept of familiarisation is embedded within the 'mere exposure theory', which suggest that people develop a preference for things simply because they are familiar to them (Zajonc, 1968). Therefore, repeatedly exposing children to vegetable increases their familiarity with these healthful foods. In addition, exposure without negative experiences facilitates 'learned safety' (Kalat & Rozin, 1973; Rozin & Vollmecke, 1986), enabling children to trust that new foods are safe to eat. Also, the maintained effects observed for taste exposure research is possibly due to the sustained familiarity with the target foods. Hence, familiarisation and learned safety are underlying mechanism and are possibly the 'master key' for getting children to eat more vegetables (see Figure 6.4).

The process of familiarisation with a variety of vegetables should start early (see Chambers, et al., 2016). Parents in the qualitative study (Chapter 5) confirmed that a good time for children to eat vegetables starts during complementary feeding (around six months). The parents of low food fussy children discussed the importance of starting early to ensure liking and intake as the children get older. This supports Nicklaus (2009) who proposed that parents should provide children with exposure to a variety of food tastes and textures prior to onset of food neophobia, as this will encourage children to develop preferences which will endure in later life.

Hausner, et al. (2012) reported that five exposures were sufficient to increase intake of an unfamiliar vegetable in 2-3 year olds. However, it was thought that more exposure may be necessary in the present research because the average age of children was above 3 years. This is in line with previous suggestions which stipulate that children aged 2-5 years who are at the peak of food fussiness and food neophobia may require a greater number of exposures (Birch, et al., 1987; Coulthard, Harris, & Emmett, 2010)

6.3.3.2 Does the type of exposure matter?

Repeated taste exposure to vegetables in their pure form is sufficient to increase intake and pairing with flavour or nutrients adds no extra benefit above taste exposure (Chapter 2). Pairing vegetables with other flavours or nutrients may also mean that

young children are not acquainted with the particular experience of a specific vegetable flavour. Also, as discussed in Chapter 1, offering vegetables paired with other flavours may be context specific (Sullivan & Birch, 1990) and issues of generalisation detriment may arise when presenting them differently (Wheeler, et al., 2006). This is also in line with Piaget's theory of cognitive development which suggests that preschool children who are at the preoperational stage of developmental struggle with understanding reversibility (Piaget, 1936), i.e. children are unable to reverse the sequence of an event or action such as relating a vegetable soup to the component parts. Reversibility may be more challenging for a child who has never seen the vegetable in its whole form and therefore, unable to make associations between the same foods being prepared differently. Moreover, adding nutrients to vegetables may evoke 'conditioned satiation' (Brunstrom, Rogers, Myers, & Holtzman, 2015; Caton, et al., 2014). Therefore, vegetables were offered in their pure form (raw, unflavoured) in the present experimental research. Nevertheless, more research is needed to investigate if increasing familiarity and preference for vegetables in their pure form (e.g. raw) will generalise to the same vegetable prepared differently (in soup, stews) and to other vegetables (Hendrie, et al., 2016).

For generalisation of 'mere exposure' to occur some properties of the food stimuli needs to be similar to the exposed food (Gordon & Holyoak, 1983). Transfer effects of learning from one vegetable to another was evidenced in the second experimental study (Chapter 4) where sensory experience with carrot generalised to celeriac intake. This may be attributed to awareness from many senses when playing with vegetables (seeing, tasting, smelling and feeling), known as the Sapere method, and using this enhanced sensory awareness to experience the sensations of different foods (DeCosta, et al., 2017; Hoppu, et al., 2015) thus, children become familiar with multiple properties of vegetable which then extends to other vegetables. This can be further explained by the unitization theory which states that learning about a new object is facilitated by the retrieval of pre-existing, and shared features of that object (Goldstone, 1998).

The independent effects of sensory play alone were not tested in this thesis, but previous research has found generalisation effects with sensory play without a storybook (Coulthard & Sealy, 2017). The increase in intake of the unfamiliar vegetable seen in the second experimental study (Chapter 4) may also be attributed to familiarisation brought about by repeated storybook sessions, especially when the storybook depicted the target vegetable (congruent learning). However, the effects of the congruent storybook only intervention were small and this may be because

children were only read the storybook on average five times, and as discussed earlier a greater number of exposures are needed for preschool children to become acquainted with vegetables which are unfamiliar.

Another explanation is that children use their senses to learn and optimum learning occurs in multisensory environments (Shams & Seitz, 2008). This suggests that a child is more likely to become familiar with target foods when multisensory learning is employed compared to unisensory learning. Thus, when a child reads a storybook, only 2 of the 5 senses are stimulated; visual and auditory. Whereas when sensory play is involved, in addition to visual and auditory the child also experiences odour and touch. For this reason, outcomes of taste exposure interventions are perhaps most successful. Because when a child eats food they experience more than just the taste, since they see, smell, feel and hear the sound of eating the vegetable (Dazeley, et al., 2012). Moreover, an advantage of the multisensory education method is that it can engage individuals with different learning styles (Shams & Seitz, 2008).

6.3.3.3 Improving implementation of repeated taste exposure

Taste exposure is a simple technique, however, the present thesis found that both nursery staff and parents struggled to encourage repeated tastes of certain vegetables (Chapters 3 and 5). For example, parents of food fussy children feared that offering a disliked vegetable will entail refusal of entire meal. This has been evidenced in previous research which showed that children's acceptance of liked foods decreased when they came into contact with a disliked food (Brown & Harris, 2012). To ease the experience of tasting unfamiliar or disliked foods parents could perhaps engage children in sensory play with target vegetables without an immediate request to taste the food (Farrow & Coulthard, 2018),

In nursery settings taste exposures seem to work effectively for many children and this may be because of the positive environment they are situated in, such as eating with their peers and being praised for trying the unfamiliar food. An important factor often lacking in repeated exposure studies is the importance of emotional valance (Johnson, Ryan, et al., 2019). Studies show that repetition paired with positive emotions and experiences reinforces food acceptance whereas, pairing with negative environment leads to negative food preference (Johnson, 2016; Zajonc, 2001). Therefore, children should be prompted to retry vegetables without pressure and in a positive environment, e.g. encouraged and praised since this is important for 'learned safety'.

Finally, Edwards and Hartwell (2002) showed that vegetables are less acceptable than fruits with many poorly recognised by primary school children. This suggests that children's unfamiliarity with vegetables may also be a reason for low consumption. Thus, methods which enable children to better recognise vegetables such as a storybook and sensory play should be implemented, particularly within the nutrition education programmes.

6.3.4 Time to review and strengthen nutrition education interventions for increasing intake of unfamiliar vegetables?

Components of nutrition education programmes varies widely, but they generally focus on improving overall diet, and part of this includes lesson plans for increasing fruits and vegetables (Mikkelsen, et al., 2014). Education is crucial for building knowledge about eating a variety of vegetables, however simply learning about why and what vegetables we should eat does not bridge the gap between knowledge and actual consumption. For example, the systematic review (Chapter 2) found that while nutrition education is the most commonly used intervention the effect sizes are smaller for increasing vegetable intake compared to interventions involving taste exposures. Similarly, small effects of nutrition education compared to hands-on approaches such as gardening were reported in previous reviews (DeCosta, et al., 2017; Langellotto & Gupta, 2012). In nutrition education programmes which incorporate hands-on activities, such as gardening and cooking, it is not clear how these specific activities encourage intake. The systematic review in Chapter 2 showed that experiential learning such as repeated taste exposure and sensory play with vegetables are rare in previous studies including nutrition education programmes. These findings stress the importance of revising existing nutrition education programmes for promoting vegetable intake in preschoolers.

The present thesis sought to enhance nutrition education for better promotion of vegetable intake. Chapter 3 found that nutrition education does not effectively increase intake of unfamiliar vegetables. Therefore, programmes should incorporate learning about range of unfamiliar vegetables, learning should be tailored to the target vegetables and children will benefit from multisensory play (Chapter 4) and repeated opportunity to taste unfamiliar vegetables (Chapter 3). These additions will facilitate recognition and willingness to try and intake of vegetables in the preschool years.

Evaluation for nutrition education programme in study 1 also showed challenges such as engaging parents in preschool based nutrition education programmes (Chapter 3). Therefore, a parental and preschool staff evaluation which could help to build

connection between providers and parents to improve children's nutrition is needed (Dev, Byrd-Williams, et al., 2017). Perhaps a storybook can be the useful link for parental involvement in these programmes. Children can take the storybooks home which communicates key nutritional messages, includes variety of vegetables, vegetable sensory play ideas and recommends simple recipes to try at home. However, these methods will need to be assessed for practicality, implementation (e.g. frequency of use) and effectiveness on consumption of vegetables and other foods, both in nursery and at home.

In summary, nutrition education is necessary and ecologically valid in developing awareness and acceptance of vegetables. Teaching children about eating vegetables and their benefits to health will boost the child's internal motivation to eat vegetables and encourages recognition. However, in order to enhance children's nutritional knowledge and experience with healthy food, commitment to a food ideal is needed from their guardians to reinforce messaging from class based nutrition education.

6.3.5 Commitment to a food ideal and social facilitation

Parents directly shape children's eating patterns through their behaviours, attitudes, and feeding styles (Patrick & Nicklas, 2005). The qualitative study (Chapter 5) showed most parents were committed to encouraging their child's vegetable intake by; a) applying various vegetable promoting methods to accommodate their child's preference, b) were persistent in offering vegetables, and c) modelled positive behaviours to encourage children to eat vegetables. Observational learning can be effective for increasing vegetable intake (Blissett, Bennett, Fogel, Harris, & Higgs, 2016; Draxten, et al., 2014; Harper & Sanders, 1975). See Figures 6.3 and 6.4 for importance of modelling when increasing vegetable intake. According to the social learning theory (Bandura, 1977) people learn by observing others. In particular, children are highly likely to imitate behaviours of other; be it their parents, siblings, grandparents, peers, teachers or a liked television character (Birch, 1980; Hendy & Raudenbush, 2000; Holley, Farrow, et al., 2017a; Horne, Tapper, et al., 2004; Zeinstra, et al., 2017). Therefore, a commitment to a food ideal from people in their close social circle is important, especially those who are responsible for their food provision.

Parents in the qualitative study articulated that they were aware that their behaviour could impact their children's learning and therefore, modelled behaviours to facilitate their vegetable intake (Chapter 5). Social facilitation was also evident when parents praised children for eating vegetables. This is supported by the positive reinforcement

theory, which suggests that being praised by their parents would make a child more likely to eat vegetables (Thorndike, 1911). The positive findings for social praise on vegetable liking and intake have been reported in a previous study by Cooke, Chambers, Añez, Croker, et al. (2011). The authors reported that social reward (praise) was almost effective as tangible reward and added that social reinforcement was necessary for sustained behaviour change in short to mid-term (1-3 months) compared to exposure only.

However, role modelling may also negatively influence children's food preferences, liking, intake, and degree of neophobia (DeCosta, et al., 2017). This was evidenced by parents mentioning that sibling fussiness had a negative influence on children's intake at home (Chapter 5) and similarly preschool staff and parents reported peer pickiness to be a problem (Chapter 3). This makes it challenging for parents and childcare providers to adjust feeding practices to accommodate children with varying eating traits (Farrow, et al., 2009).

It was noted during the qualitative study that parents inadvertently modelled incongruent behaviours, such as not buying vegetables which they did not like or their child did not like (Chapter 5). Also, staff providing feedback from nursery reported that some staff exhibited dislike of the unfamiliar vegetable (mooli) and this may have deterred some children from trying the unfamiliar vegetable (Chapter 3). These factors are important to address, because the systematic review (Chapter 2) showed that when an intervention was delivered by a familiar person (parent/ teacher) the intake of vegetable was greater than an intervention delivered by an unfamiliar researcher. This is because these familiar people are central to children's social environment and are likely to exert influence on their eating behaviour (DeCosta, et al., 2017). Therefore, support and commitment are essential from parents and childcare providers. This includes making vegetables available and accessible, exhibiting positive feeding styles, modelling positive eating behaviours, limiting incongruent behaviours, encouraging child autonomy and accommodating child traits while still being patient and persistent in offering healthy, nutrient dense foods such as vegetables.

6.3.6 Is the gap between science and reality the answer to the gap between knowledge and behaviour?

Despite various efforts to increase vegetable consumption, there remains a substantial gap between 'what we should consume' and 'what we do consume'. Does this mean that the standards set based on scientific research and advice provided are impractical to some extent? For example, scientific research often isolates an aspect

of individual lifestyle making recommendations based on changing this aspect, when in reality, issues are more complex and multifaceted. In Table 6.1 there are some examples of differences between scientific research and real-world challenges.

Developing children's food preferences is a complex phenomenon and interventions using a single approach are not likely to cover all bases. Research must account for complex interpersonal factors when developing interventions. A more holistic approach is needed to promote vegetable intake which connects children and their close social network (parents, siblings, teachers), as well as attempts to improve vegetable intake at home and within childcare settings.

6.4 Theoretical and methodological strengths and limitations

6.4.1 Strengths

The present thesis included research on strategies for children aged 2-5 years, who are at the peak of food fussiness (Dovey, et al., 2008). It is important to include this age group including fussy eaters since there is potential to benefit children in later life. Interventions to increase the intake of unfamiliar/ disliked vegetables are more effective that those to increase the intake of familiar/ liked vegetables (Chapter 2). The effects of nutrition education are small, and their effects for unfamiliar vegetables can be enhanced by including taste exposures (Chapter 2 and 3). Also, learning needs to be tailored to the target vegetable for improving both recognition and intake (Chapter 4). These findings make a valuable contribution to the field of vegetable promotion. The intervention studies in the present thesis were followed by comprehensive evaluation, which is often lacking in other studies. The feedback helped to assess the implementation, and this can help in designing and implementing similar interventions in the future.

In terms of methodological strengths; a mixed method approach was used by combining experiments, questionnaires and qualitative interview. This provided broader and deeper understanding of the subject from various viewpoints (Creswell & Plano-Clark, 2010). In particular, qualitative evidence is limited and the parental perspective was vital for revealing the gap between science and reality. Also, the qualitative study included fathers (20%) and their perspective is essential.

Tables 6.1 Example of differences between scientific research for promoting vegetable intake and reality.

Method	Theoretical underpinning	Scientific research	What's the reality
Type of vegetable offered in research	Targeting unfamiliar or familiar depending on study aims	Test intake of a single or multiple vegetable prepared in specific way (convenient for research)	Families tend to offer familiar, culturally relevant vegetables
Repeated taste exposure	Mere exposure	Systematic exposure at regular intervals and minimum 8-10 exposures	Persistence with offering but if and when it is purchased; challenges of reoffering experienced Lower than recommended number of exposures
Modelling	Social learning theory	Positive role modelling by parents, siblings and peers	Negative influence; fussy eating behaviours of others, e.g. not buying/ eating disliked vegetables
Reward	Reinforcement theory	Use small non-food rewards e.g. sticker or social rewards (praise)	Parents often use food incentives and withdrawal of rewards such as TV and iPad
Flavour-flavour learning and flavour nutrient learning	Associative conditioning	Pairing with flavours and nutrients such as oil, apple sauce, maltodextrin, nutmeg, sucrose	Vegetables often paired with liked food and flavours preferred by the individuals e.g. cheese, sugar, butter, gravy, sauce
Nutrition education	Social cognitive theory and others	Deliver programmes as recommended Preschool nutrition programme to engage with parents and involve them in promoting child health and nutrition	Programmes are selectively and infrequently delivered Many parents do not engage in preschool based nutrition education programmes
Nutrition guidance	Various – e.g. intrinsic motivation	Eat 5 fruits and vegetables a day Avoid large amount of energy dense foods	Parents go with their beliefs and upbringing and what is convenient for them. Unable to meet the recommendation (e.g. lacking resources)
Parenting feeding style	Theory of parenting	Aim for authoritative feeding style - high responsiveness/ warmth/ high control	Parents of food fussy children exhibit indulgent feeding style as they worry their child is not eating well

The systematic review used quantitative synthesis to draw conclusions based on current evidence. Moreover, the two experimental studies were conducted using robust study designs which included, trial registration, random allocation, condition concealment, reasonable sample size and objective intake measurements (grams). The use of strong methodological quality makes evidence more reliable and strengthens the research field.

Furthermore, the analyses were performed by taking cluster variance into account and this is often overlooked. Not accounting for clusters may introduce bias in the reporting of results. This is because factors such as enthusiasm of nursery staff or variety of vegetables already offered within a nursery can impact the effectiveness of the interventions.

6.4.2 Limitations

There were also some limitations in the present thesis. First, response rate from parents for the food frequency questionnaire was very low (13%) in the first study (Chapter 3), therefore, the effects of taste exposure beyond the target vegetable (mooli) remains unknown. This is a limitation of the present thesis as well as the domain of research looking at taste exposures. Likewise, the effects of the PFP is unknown on habitual intake of familiar vegetables as this was not measured in the present thesis (Chapter 3). Also, in the first study children's attendance was not recorded, therefore, the amount of nutrition education received by individual child was unknown (Chapter 3). Learning from the first study was applied to the second study and attendance of children was recorded in the subsequent study (Chapter 4). However, the second study (Chapter 4) did not include a control or sensory only group, hence some of the effects of sensory play alone compared to sensory plus storybook remains unknown. Since this was the first study to adopt this novel approach, future research can learn from these findings.

In terms of methodological limitations; first, there was a high percentage of drop-out (36% in the first study; Chapter 3 and 21% in the second study; Chapter 4). As highlighted in the systematic review (Chapter 2), this is a general problem within this research domain. However, this was anticipated and as a result more children were recruited from the beginning. Also, no differences were observed in children who were lost to follow-up compared to those who completed the intake assessments, therefore selection bias was minimised. However, intention-to-treat analysis were not performed because there was no indication that those children who were lost to follow-up avoided the intervention or intake assessments. Additionally, the loss of participants to follow-up was evidenced across all study arms, in both studies. Reasons for child

absence on a particular test day were often common, such as, swapping nursery session to a different day, sleeping at the time of the intake assessment, on a holiday or moved to a different nursery. Imputation of missing intake data was not appropriate as a large proportion of data were missing and individual factors such as food fussiness and hunger level varied between children. Also, responses within the same child may vary at different time-points (as observed from the raw intake data of other children, e.g. a child may eat more on some days than other days). Hence, it was assumed that imputations may have introduced additional biases (e.g. guessing intake) and confounded the results, therefore, intention-to-treat analysis were omitted. It is recommended that intention-to-treat analyses are performed for randomised controlled trials to preserve the benefits of randomisation (e.g. equal groups, prognostic balance). By not performing an intention-to-treat analysis risk of biases are increased regarding the effectiveness of interventions, hence, conclusions drawn from the intervention studies in the present thesis should be interpreted with some caution (McCoy, 2017).

Second, there were issues of non-compliance from nurseries in the taste exposure intervention and this may have limited the effects of the taste exposure intervention (Chapter 3). This problem may lessened had more clusters been recruited. Hence, only inclusion of 2-3 clusters per intervention arm is another limitation of the present research.

Furthermore, the experimental studies did not record socioeconomic status, therefore, effects based on social class are unknown. Though, it is assumed that due to the introduction of free hours from the government for 2- 4 year olds, the nursery children were from varying level of socioeconomic status. Likewise, ethnicity was not recorded and predominately children from white background were recruited, therefore, findings may only be generalizable to individuals of similar background. Finally, the study design was scientifically robust but did not completely reflect the real-world because children in nurseries share snacks from a single platter rather than individually sealed zip-lock bags. Hence, the food bag may have been a barrier for some children. Therefore, in the future to enhance ecological validity of interventions, researchers must adapt design to match usual nursery practice.

6.5 Implications and directions for future research and practice

6.5.1 Future research

The present thesis has provided evidence based strategies to increase vegetable intake in preschool children and provided theoretical support for ‘mere exposure’ and

'learned safety'. In particular the present thesis demonstrated that processes of familiarisation with vegetables using storybooks and sensory learning are effective strategies to increase intake of vegetables in young children.

Some of the findings from the present thesis could be explored further. For example, challenges persist in getting children to try new vegetables - something which is essential for the success of a repeated taste exposure strategy. Therefore, a storybook with sensory play could be coupled with gradual taste exposure. Also, studies may investigate if systematic exposures are necessary or the random approach used by parents is as effective for increasing intake of disliked or novel vegetables.

To improve the effectiveness of nutrition education for recognition, willingness to try and intake, research could evaluate whether adding repeated sensory experience (including taste) with vegetables increases effectiveness. Moreover, educational programmes should be consistently evaluated to assess if they are implemented properly, are cost effective and whether their effects for vegetable uptake are sustained in short to mid-term.

Storybooks, sensory play and taste exposure were effective in increasing intake of an unfamiliar vegetable (Chapters 3 and 4) but further work is required to assess the transfer of such effects from preschool to home and vice versa. This is because children may try a vegetable in one context but not the other and key differences exists between these settings, such as the role models and their level of commitment (parent vs teacher/ peer) and this may alter the effects of intervention. Furthermore, research is needed to understand generalisation effects of these strategies for uptake of other vegetables. This will help to assess if effects of these strategies are limited to a particular vegetable or sensory characteristics of the vegetables e.g. colour, smell, taste (flavour) or textures.

Strategies discussed by parents in the qualitative study (Chapter 5) such as the element of choice, negotiation and context dependent methods need to be experimentally tested. It may also be useful to conduct a qualitative research study with children and their parents who eat the recommended '5 a day' or more of fruits and vegetables (instead of parents of low food fussy children). This would help us to understand effective ways of achieving the '5 a day' target. More work is needed to investigate individual differences (e.g. across cultures, different socio-economic status and parents with varying cooking skills), to add to evidence and to make recommendations which are more generalisable to the wider population. For example,

cultural variation exists in the type of vegetables eaten as well as food preparation methods used to cook vegetables.

The present thesis highlights that in future research interventions should be designed to be more ecologically valid and include evaluative feedback to assess their acceptance and suitability in the given context. Finally, the outcome assessments conducted should evaluate potential shifts in eating pattern such as from 'non-eaters' to 'tasters' and 'eaters', as well as the actual measured intake (in grams). This will help to effectively evaluate the impact of intervention for children who are food fussy or non-eaters.

6.5.2 Practice

The findings from the research conducted in the present thesis have implications for future practice. First, taste exposure is an effective method for many children, including for children who are food fussy and should be recommended in home and nurseries. However as evidenced in Chapters 3 there are challenges in initiating tasting of unfamiliar vegetables, therefore, a stepped approach may be needed for some children such as introduction through storybook and sensory play to encourage willingness to taste vegetables (Chapter 4). Furthermore, many children are unwilling to try unfamiliar vegetables, hence, children will benefit from exposure to wide variety of vegetables. The present thesis highlights that learning may need to be tailored to the target vegetable (Chapter 4), therefore parents and nursery staff can tailor the storybooks to target specific vegetables which are disliked by the children or are novel by using pictures from the internet or draw these with the children. Sensory activities can be implemented modestly by using whole vegetable or diced, including vegetable peelings (to minimise any food waste).

Moreover, existing guides such as "Vegetables and fruit, help your child to like them" (HabEat Project, 2014) can be further modified based on findings from the present thesis. For example, parents may benefit by knowing that exposure to disliked or novel healthy foods needs to be frequent and not limited to a set number (e.g. 8 or 10, see Chapter 2). The number of exposures should continue even after the child has learned to eat the target vegetable as this may help to maintain the uptake of a previous novel vegetable (Chapter 3) . The guide may also emphasise the use of a multi-sensory approach such as repeated exposure using sensory-play, with /without taste (Chapters 3 and 4). Carers may benefit from knowing that encouragement of both familiar and unfamiliar vegetables is necessary to improve overall intake. Also, additional information such as how strategies can be tailored, their varying success as

well as the theoretical underpinnings may be helpful to the caregivers. This would allow them to make an informed decision about the methods they choose to implement with their young children when encouraging them to eat vegetable. More importantly is it worth noting that increasing vegetable intake is not a short-term goal. It requires continuous effort to make vegetables a norm and part of everyday meals. Therefore, suggesting strategies in guidelines which are effective, simple, enjoyable, practical and tailored to individual children is likely to be accepted by caregivers.

6.6.1 Tailoring strategies to individuals and context

The qualitative study (Chapter 5) in the present thesis provided insight of how parents use and tailor their strategies to increase vegetable intake based on the child and context. Therefore, strategies tailored to individuals and their context may be more helpful for nudging children to eat more vegetables. For example, it may be useful for parents to recognise why a particular vegetable is refused by their child and implement strategies accordingly. For example, if a child refuses to eat a vegetable due to the texture it might be worth trying different preparation method (such as cooking it instead of offering it raw), if it is the flavour than consider pairing the disliked vegetable with a liked flavour such as gravy. Likewise, if a child is refusing the vegetable because it is new, then use taste exposure technique or if they are experiencing fussiness than attempt out of meal sensory play before offering them the vegetable to taste.

If caregivers are informed of a range of effective strategies they can implement, this will enhance their self-efficacy as they are better equipped to assist their child to eat more healthful foods.

6.6 Conclusions

In conclusion, the research in the present thesis has made a valuable contribution to the field by evaluating evidence on how best to increase intake of vegetables in preschool children, aged 2-5 years. Many preschool children are reluctant to eat unfamiliar vegetables and education is crucial for building knowledge about eating a variety of vegetables. More indirect learning during nutrition education lessons may be less effective than taste exposure, in increasing intake. Storybooks, sensory play and taste exposure are effective ways to increase willingness to taste and intake of vegetables.

Children benefit from having direct exposure to vegetables, therefore including experiential learning though taste exposure and sensory play would be constructive in lesson plans. However, research is needed to assess transfer effects of these

interventions to other vegetables beyond the target vegetable and to other settings. Future research could identify the most effective elements of these strategies and integrate them to produce strong intake outcomes in the early years.

Familiarisation and learned safety through repeated taste exposure is the most promising method for increasing intake of unfamiliar vegetables at home and in childcare settings. However, additional research is called to make taste exposure inventions more ecologically valid.

As demonstrated by the present thesis, each strategy plays an important role in promoting vegetable intake and different approaches (storybook first vs taste exposure first) may be necessary depending on the type of vegetables (unfamiliar vs familiar) and type of eaters (non-eaters vs eaters). Hence, guidelines should reflect this variability. Encouraging children to eat more vegetables in balance with other foods from the early years provides protective health benefits for a lifetime. Therefore, it is crucial that parents and other caregivers make a commitment to prioritise greater vegetable intakes in their daily routine using known, successful strategies which suit their specific child.

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Appendices A: Systematic Review

Appendix A1: PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) Checklist

PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported in section #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	2
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	--
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	2.2
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	2.2.1
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	2.3
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	2.3.1 – 2.3.2
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	2.3.1 - 2.3.3

Section/topic	#	Checklist item	Reported in section #
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	Appendix A2
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	2.3.2
Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	2.3.3
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	2.3.3
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	2.3.4
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	2.3.5
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	2.3.5
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	2.3.4
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	2.3.5
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	2.3.2 Figure 2.1
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	Table 2.2
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	2.3.4, 2.4.9, Figure 2.4

Section/topic	#	Checklist item	Reported in section #
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	Table 2.2 Figure 2.3
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	2.4.4 - 2.4.8
Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	2.4.9 Table 2.4, Figure 2.7
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	2.4.5 - 2.4.8
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	2.5.1 & 2.5.3
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	2.5.2
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	2.5.3
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	Acknowledgment

Appendix A2: Example of search strategy in Medline

# ▲	Searches	Results	Search Type
1	(Vegetable or vegetables or veg or F&V or FV).ti. and (Intervention or strategy or strategies or facilitators or campaign or promote or programme or initiative or factors or Trial or Liking or preference or intake or consumption or uptake or attitude or behaviour or behaviour).ab. and (Child or Children or infant or toddler or pre-schooler or preschooler or girl or girls or boy or boys or mother or maternal or father or parent or caregiver or 2 year or 3 year or 4 year or 5 year or age 2 or age 3 or age 4 or age 5).ab. and (School or nursery or Nurseries or daycare or day-care or early year or early years or preschool or playschool or playgroup or kindergarten or classroom or home).af. ?	2311	Advanced
2	limit 1 to english language [Limit not valid in Journals@Ovid; records were retained] ?	2213	Advanced
3	limit 2 to yr="2005 -Current" ?	1952	Advanced
4	**remove duplicates from 3** ?	**762**	**Advanced**

Appendices B: Study 1

Appendix B1: CONSORT checklist for cluster randomised trial (study 1)

Section/Topic	Item No	Standard Checklist item	Extension for cluster designs	Section No *
Title and abstract				
	1a	Identification as a randomised trial in the title	Identification as a cluster randomised trial in the title	3
	1b	Structured summary of trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts)	See table 2	--
Introduction				
Background and objectives	2a	Scientific background and explanation of rationale	Rationale for using a cluster design	3.2
	2b	Specific objectives or hypotheses	Whether objectives pertain to the cluster level, the individual participant level or both	3.2.1
Methods				
Trial design	3a	Description of trial design (such as parallel, factorial) including allocation ratio	Definition of cluster and description of how the design features apply to the clusters	3.3.1
	3b	Important changes to methods after trial commencement (such as eligibility criteria), with reasons		NA
Participants	4a	Eligibility criteria for participants	Eligibility criteria for clusters	3.3.2
	4b	Settings and locations where the data were collected		3.3.1
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	Whether interventions pertain to the cluster level, the individual participant level or both	3.3.4 – 3.3.6
Outcomes	6a	Completely defined pre-specified primary and secondary outcome measures, including how and when they were assessed	Whether outcome measures pertain to the cluster level, the individual participant level or both	3.3.7
	6b	Any changes to trial outcomes after the trial commenced, with reasons		3.3.7.2
Sample size	7a	How sample size was determined	Method of calculation, number of clusters(s) (and whether equal or unequal cluster sizes are assumed), cluster size, a coefficient of intracluster correlation (ICC or *k*), and an indication of its uncertainty	3.3.2
	7b	When applicable, explanation of any interim analyses and stopping guidelines		NA

Section/Topic	Item No	Standard Checklist item	Extension for cluster designs	Section No *
Randomisation:				
Sequence generation	8a	Method used to generate the random allocation sequence		3.3.1
	8b	Type of randomisation; details of any restriction (such as blocking and block size)	Details of stratification or matching if used	3.3.1
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	Specification that allocation was based on clusters rather than individuals and whether allocation concealment (if any) was at the cluster level, the individual participant level or both	3.3.1
Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	Replace by 10a, 10b and 10c	
	10a		Who generated the random allocation sequence, who enrolled clusters, and who assigned clusters to interventions	3.3.1
	10b		Mechanism by which individual participants were included in clusters for the purposes of the trial (such as complete enumeration, random sampling)	3.3.2
	10c		From whom consent was sought (representatives of the cluster, or individual cluster members, or both), and whether consent was sought before or after randomisation	3.3.2
Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how		3.3.1
	11b	If relevant, description of the similarity of interventions		NA
Statistical methods	12a	Statistical methods used to compare groups for primary and secondary outcomes	How clustering was taken into account	3.3.8.1
	12b	Methods for additional analyses, such as subgroup analyses and adjusted analyses		3.3.8.2
Results				
Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome	For each group, the numbers of clusters that were randomly assigned, received intended treatment, and were analysed for the primary outcome	Figure 3.2

Section/Topic	Item No	Standard Checklist item	Extension for cluster designs	Section No *
	13b	For each group, losses and exclusions after randomisation, together with reasons	For each group, losses and exclusions for both clusters and individual cluster members	Figure 3.2
Recruitment	14a	Dates defining the periods of recruitment and follow-up		3.2.1
	14b	Why the trial ended or was stopped		NA
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	Baseline characteristics for the individual and cluster levels as applicable for each group	Table 3.1
Numbers analysed	16	For each group, number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups	For each group, number of clusters included in each analysis	3.4.8 & Figure 3.1
Outcomes and estimation	17a	For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)	Results at the individual or cluster level as applicable and a coefficient of intracluster correlation (ICC or k) for each primary outcome	3.3.8 & 3.4.3
	17b	For binary outcomes, presentation of both absolute and relative effect sizes is recommended		NA
Ancillary analyses	18	Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing pre-specified from exploratory		3.4.4
Harms	19	All important harms or unintended effects in each group (for specific guidance see CONSORT for harms)		NA
Discussion				
Limitations	20	Trial limitations, addressing sources of potential bias, imprecision, and, if relevant, multiplicity of analyses		3.5.2
Generalisability	21	Generalisability (external validity, applicability) of the trial findings	Generalisability to clusters and/or individual participants (as relevant)	3.5.2
Interpretation	22	Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence		3.5
Other information				
Registration	23	Registration number and name of trial registry		3.2
Protocol	24	Where the full trial protocol can be accessed, if available		Available upon request

Appendix B2: Nursery recruitment email (study 1)

Dear (name of nursery manager),

I am a PhD student in the School of Psychology at the University of Leeds. We are conducting a research on promoting vegetable intake in children aged 3-5 years and would like to invite your nursery to take part in our novel research.

Our research team has lots of experience of working with early years and we are now working in collaboration with PhunkyFoods (www.phunkyfoods.com) which provides an interactive health educational programme to schools. The PhunkyFoods programme is flexible to run and can be incorporated within the usual educational curriculum. PhunkyFoods will provide the educational programme for **free** (a value of around £495) to participating nurseries and will also provide further training to the staff. For our research the nursery staff will only be required to deliver two simple components of the educational programme during the 12 week intervention period, nonetheless the nurseries will have access to the complete programme for the duration of the year.

We will invite children to try a novel vegetable (familiar to adults, but not commonly eaten by children such as broccoli or mooli) prior to the intervention, immediately after the intervention and at 3, 6 and 9 months later (if possible) to evaluate if the intervention has influenced the intake of the novel vegetable. Your nursery will be randomised into one of the 4 conditions, they will either receive: 1) an educational intervention only, 2) taste exposures only, 3) taste exposures and an educational intervention, or 4) no intervention (act as our control group). Children in the taste exposures group will be offered 1 exposure to the vegetable every week over the 12 week intervention period. The vegetable will be prepared and delivered by the research team on each test day. The nursery staff will be requested to observe children during the snack time and ensure that any spilled food is returned back to the child's container, this is to ensure that the researcher can collect remaining food and measure the intake accurately.

With the help from the nursery staff we will also take measurements of children's height and weight. All nurseries will be provided with the free interactive educational programme either during or after the intervention period.

We will provide all the parents with the details of the study along with a questionnaire. The parents who do not wish their child to participate in the research for whatever reason can opt-out of the study by sending back a form to the nursery which we shall collect, record and respect. Children with any relevant food allergies will be excluded from tasting the vegetable but they can still enjoy the educational sessions. Please see the attached documents for the consent form and ethical safeguards which are in place for this research including data protection measures.

This research aims to find the best ways to encourage young children to try novel vegetables to help them achieve a healthy diet through liking and acceptance of these foods.

Our research team would be very grateful if your nursery would consider taking part in our innovative research. We need to recruit nurseries immediately to start the study in September/ October 2016. Please let us know if you wish to take part and if you are participating in any other health or lifestyle programmes. I will call you shortly to follow up on this invitation and to answer any questions that you may have.

This study is supervised by Professor Marion Hetherington (email: m.hetherington@leeds.ac.uk) and Dr Pam Blundell (p.blundell@leeds.ac.uk) and has been approved by the School of Psychology Ethics committee (reference number: 16-0198; date approved: 25/07/2016).

We look forward to hearing from you.

Yours Sincerely,
Chandani Nekitsing & Research Team
Tel: 0113 343 8472

School of Psychology, University of Leeds, Leeds, LS2 9JT

Appendix B3: Nursery opt-in consent form (study 1)

UNIVERSITY OF LEEDS

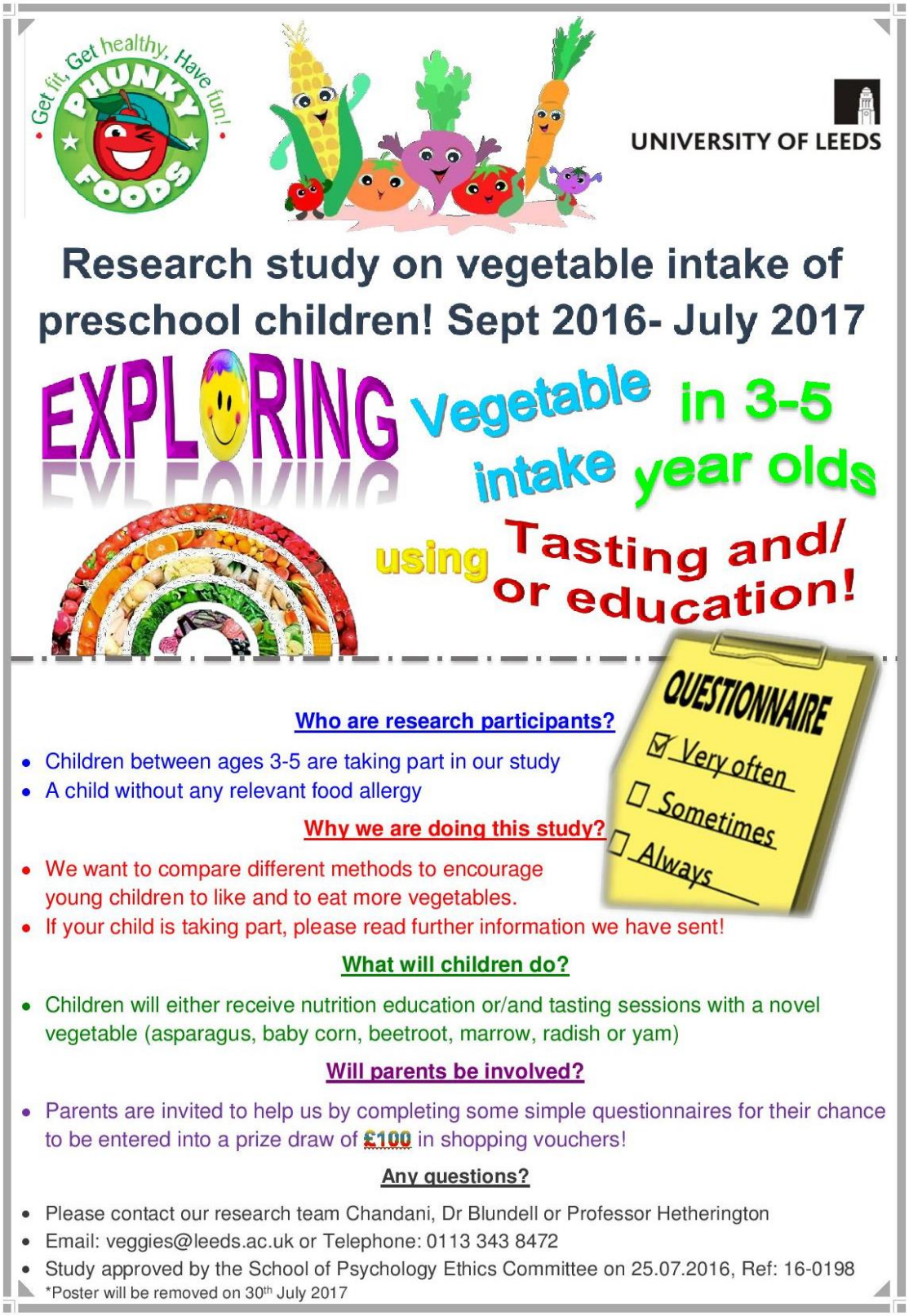
Consent to take part in: "Invitation to take part in a research study on vegetable intake of preschool children!"	Add your initials next to the statements you agree with
I confirm that I have read and understood the e-mail information and the parent information letter explaining the above research project and I have had the opportunity to ask questions about the project.	
I understand that our participation is voluntary and that we are free to withdraw at any time without giving any reason and without there being any negative consequences. In addition, should we not wish to answer any particular question or questions, we are free to decline.	
I agree for the data collection from our nursery to be stored confidentially and used in relevant future research in an anonymised form.	
I understand that relevant sections of the data collected during the study may be looked at by individuals from the University of Leeds or from regulatory authorities where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records.	
I confirm that our nursery has an up to date record of children's food allergies and I am aware that children with relevant food allergies will be excluded.	
I understand and agree to the opt-out consent process and I am aware that only trained research staff will prepare and deliver the foods in accordance with the Human Appetite Research Unit Health and Safety standards.	
I am a senior nursery member of staff and duly authorised to provide consent on behalf of the nursery. I agree for our nursery to take part in the above research project and will inform the lead researcher should anything change.	

Name of Nursery	
Head teacher/ manager	
Signature	
Date	
Name of the researcher	
Signature	
Date	

* Please keep this document safe for future reference. If you have any questions please contact Chandani Nekitsing, Dr Blundell or Professor Hetherington; email: veggies@leeds.ac.uk or phone: 0113 3438472. Study approved by School of Psychology Ethics Committee, reference number: 16-0198; date approved: 25/07/2016.

Appendix B4: Study poster displayed outside preschool rooms (study 1)

Poster was displayed outside preschool room to make parents further aware of the research study. Also, to prompt them to complete the questionnaire.



Appendix B5: Parent information letter and opt-out consent form (study 1)

UNIVERSITY OF LEEDS

Invitation to take part in a research study on

vegetable intake of preschool children!

Dear Parent or Guardian,

We are a research team at the University of Leeds looking at ways to encourage young children to eat more vegetables. The nursery your child attends has kindly agreed to help us with our research project and we are pleased to let you know how your child will be involved. Please take the time to read the information carefully and contact us if you would like further information.

What's the purpose of our research?

The purpose of this research is to compare different methods of encouraging young children to like and to eat more vegetables. We will compare a tasting strategy, an education strategy and a tasting plus education strategy to determine which method is best to promote greater liking and intake of a novel vegetable (familiar to adults, but not commonly eaten by children). The main intervention period will last for 12 weeks and intake of vegetable will be measured at 3 and 6 months after this period. The project will start from September 2016 and will end in July 2017. The start and end date will vary depending on the nursery's availability.

Why is your child invited and what will they do?

All children who are eligible (if they do not have relevant food allergies) at nursery aged 3-5 years are invited to take part in this research. Children will be offered a novel vegetable such as asparagus, baby corn, beetroot, marrow, radish or yam before the study, then some children will be offered the same vegetable weekly during their normal snack time. Some children will be given weekly lessons during this same 12 week period and others will receive the lessons after this period. At the end of the study and at follow-up liking and intake of the novel vegetable will be recorded. We hope that children will have fun taking part in this research whilst also learning about healthy eating. All foods are prepared under strict hygiene standards. If your child has a relevant food allergy they will not be offered the vegetable but can still enjoy the interactive educational programme we will provide. With help from the nursery staff we will also take measurements of children's height and weight.

Do parents need to be involved?

If you agree to participate we will also ask you some demographic questions, general questions about your child's food preferences and your feeding practices using a questionnaire which will take approximately 20-25 minutes to complete. Around 3 and 6 months later we will request you to complete a short 5 minute questionnaire. You can choose to complete the questionnaire online: **https://leeds.onlinesurveys.ac.uk/veggies** or alternatively complete the questionnaire enclosed and return it to the nursery or to the University of Leeds using the pre-stamped addressed envelope. All parents who fill in the complete questionnaires at all 3 time points will be entered into a prize draw of £100 in shopping vouchers. Please note that your child can take part in the study even if you do not wish to complete the questionnaire.

What if my child does not want to eat?

Your child's participation is voluntary and they do not have to taste the vegetable if they do not wish to. Children will not be pressured to eat at any point and if your child is not able to eat the

vegetable then their usual snack will be offered. There are no potential risks identified for taking part in this research and your child should not experience any discomfort as a result of taking part. The vegetables will be prepared and provided by a trained research staff on each test day. The nursery staff will offer the vegetable snack to children during their usual snack time and monitor their intake. Staff will be requested to return any spilled food back into the child's container for researchers to collect and weigh.

Are there any benefits in taking part?

If your child participates in our research they will get to try an unfamiliar vegetable and learn about healthy eating as part of their curriculum. Our experience tells us that children tend to enjoy the tasting sessions; they will have fun during the lessons and they will learn a lot about healthy eating. This study would greatly help us to improve our understanding of the best ways of encouraging heathy eating in preschool children.

Will data be confidential?

We will measure your child's vegetable intake to see if our intervention is working. Your child will not be identified by name but by a participant ID. All records will be kept in a safe locker at the university. The data stored on the computer will be encrypted with a password and will only be accessible by the research team.

What if I don't wish my child to take part?

Your child is not obliged to take part in our research. You have the right to withdraw your child or their data from the study at any time until 31.07.2017 and you are not required to explain your reason. If you prefer that your child does not take part, then please complete the opt-out form at the end of this information sheet.

Where will the research go next!

Our research may show new strategies nursery can employ to introduce vegetables to young children to improve their food preference. Results from our study may be published in scientific journals or presented at a conference. However, confidentiality and anonymity will be maintained at all times, so it is not possible to identify your child's individual data.

Who can I contact for details?

This study is supervised by Professor Marion Hetherington (email: m.hetherington@leeds.ac.uk) and Dr Pam Blundell (p.blundell@leeds.ac.uk) and has been approved by the School of Psychology Ethics committee (reference number: 16-0198; date approved: 25/07/2016).

Please safeguard this information sheet for future reference and feel free to contact our research team if you have any questions or would like further details of the study.
We would like to thank you for reading this information sheet.

Yours Sincerely,

Chandani Nekitsing and Research Team

Office: 0113 343 8472

E-mail: veggies@leeds.ac.uk

Response Slip to OPT-OUT

If you **DO NOT** wish your child to take part please complete the below slip and return to your child's nursery as soon as possible but **no later than 15th September 2016**.

Child's full name: …….

I do not wish my child to take part in the vegetable study (please tick) ☐

If you wish please indicate reason below:

Food allergy ☐

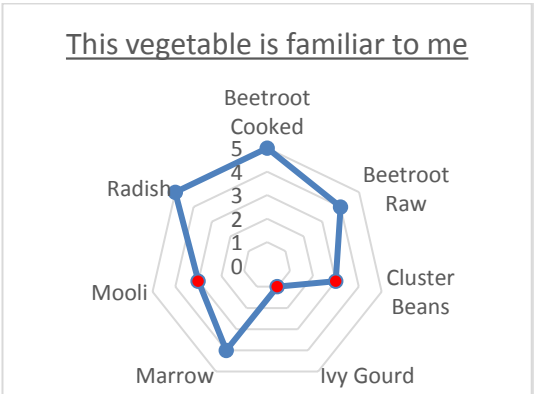
Other☐……
……
……
……

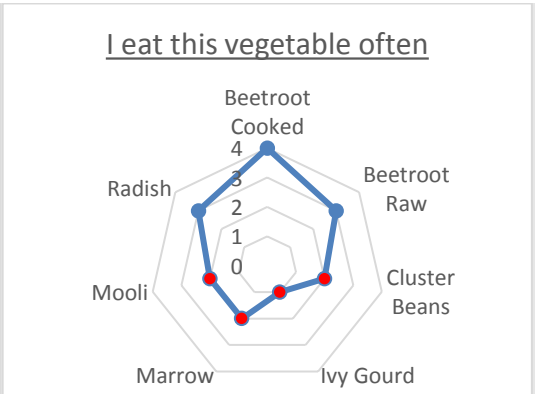
Parent/ Caregiver's signature: ……

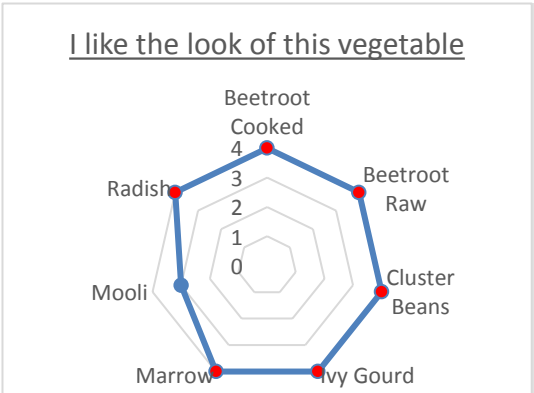
Date: ……

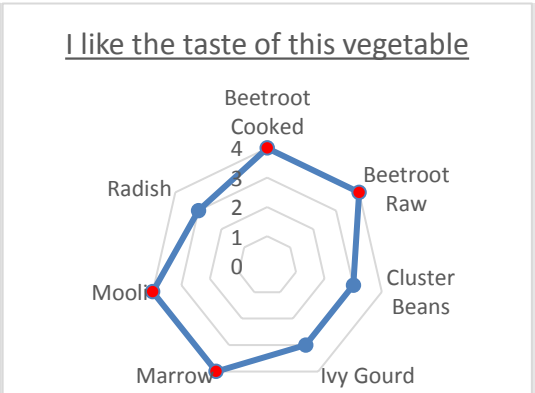
Appendix B6: Unfamiliar vegetable taste test questions and ratings

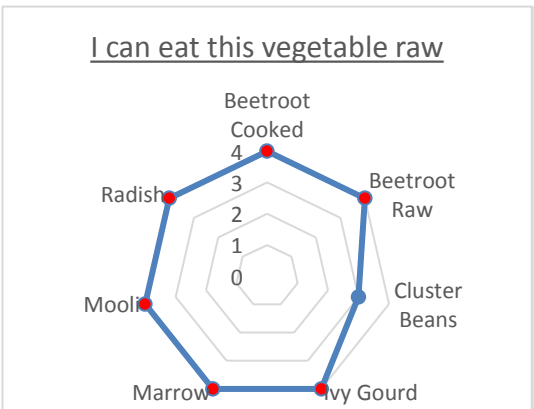
10 researchers randomly tasted and rated each of the 7 vegetables. Ratings were as follow 1= strongly disagree, 2 = agree, 3 = neutral, 4 = disagree, 5 = strongly disagree. Average scores for each question are displayed. The red dots indicates possible selection of vegetables based on the taste test question.

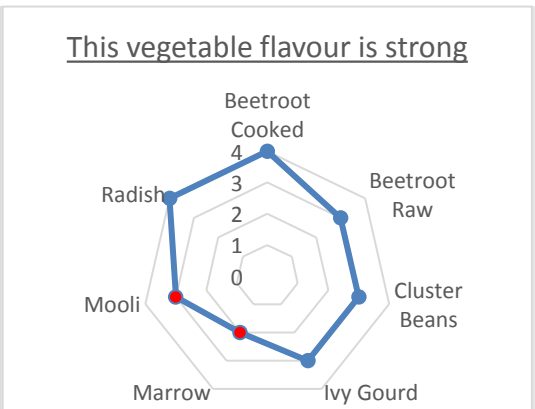


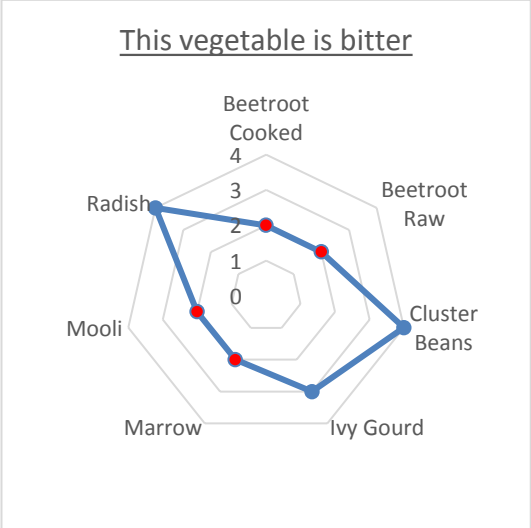


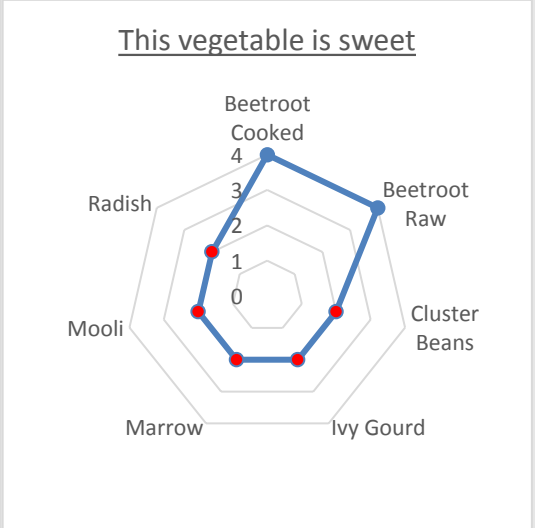


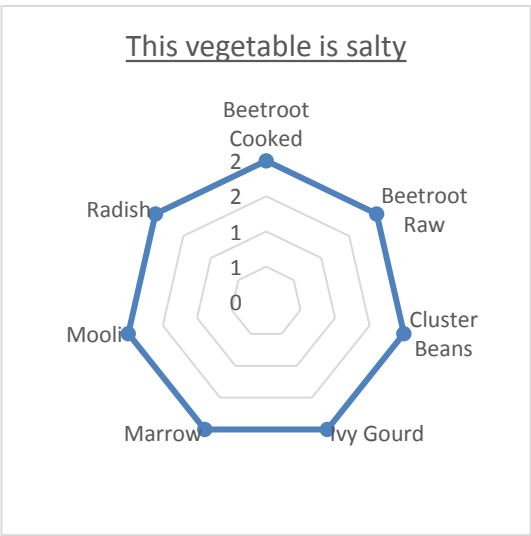


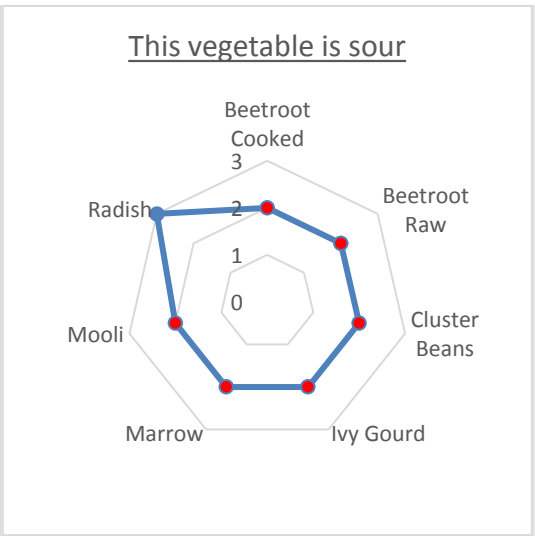


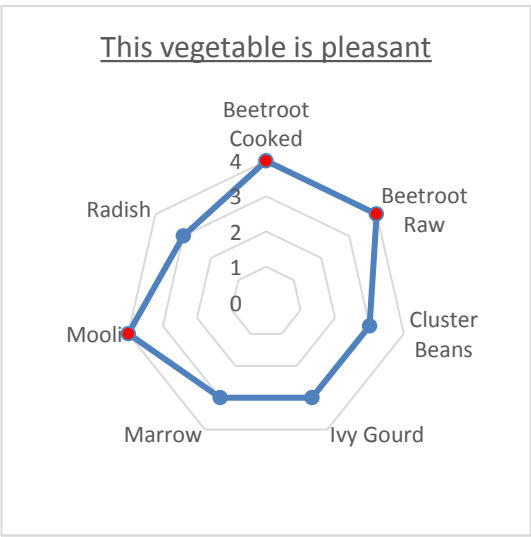


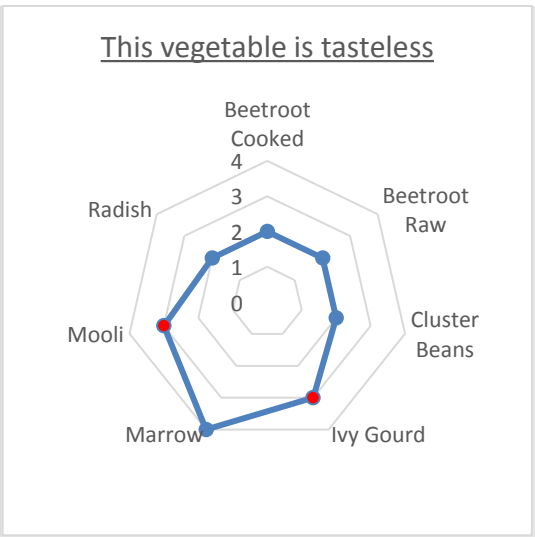

This vegetable is bitter
Beetroot Cooked
Beetroot Raw
Cluster Beans
Ivy Gourd
Marrow
Mooli
Radish
0
1
2
3
4


This vegetable is sweet
Beetroot Cooked
Beetroot Raw
Cluster Beans
Ivy Gourd
Marrow
Mooli
Radish
0
1
2
3
4

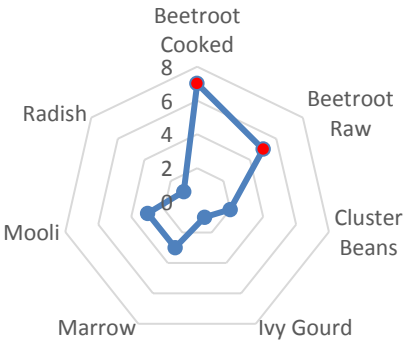

This vegetable is salty
Beetroot Cooked
Beetroot Raw
Cluster Beans
Ivy Gourd
Marrow
Mooli
Radish
0
1
1
2
2

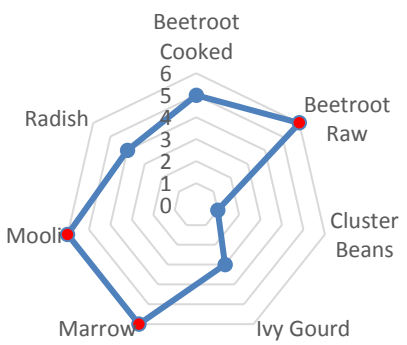

This vegetable is sour
Beetroot Cooked
Beetroot Raw
Cluster Beans
Ivy Gourd
Marrow
Mooli
Radish
0
1
2
3

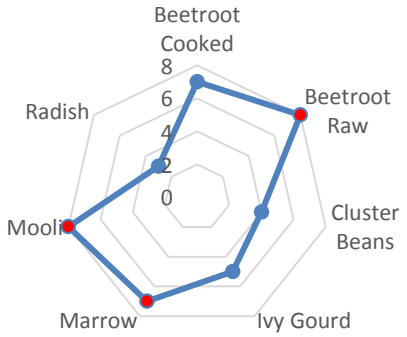

This vegetable is pleasant
Beetroot Cooked
Beetroot Raw
Cluster Beans
Ivy Gourd
Marrow
Mooli
Radish
0
1
2
3
4

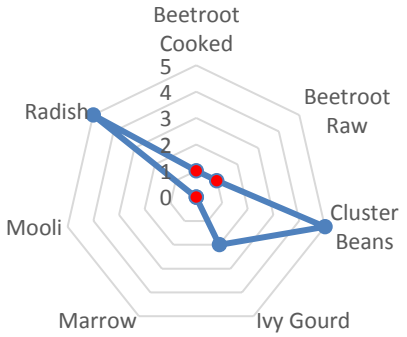

This vegetable is tasteless
Beetroot Cooked
Beetroot Raw
Cluster Beans
Ivy Gourd
Marrow
Mooli
Radish
0
1
2
3
4

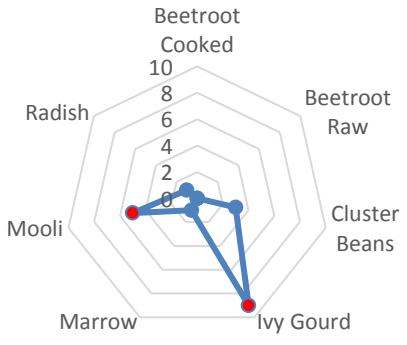
Overall ratings from the 10 panellist. Individual could make multiple selections.











Total scores based on the taste test questions were as follow:

Beetroot Cooked = 7

Beetroot Raw = 10

Cluster Beans = 5

Ivy Gourd = 8

Marrow = 10

Mooli = 14

Mooli was selected based on multiple ratings. Panel selected this vegetable as vegetable which was unfamiliar, can be eaten raw, tastes good (i.e. not too strong or sour) and was recommended for children aged 3-5 years.

Appendix B7: "Strive for 5" PhunkyFoods lesson plan

Phunky Early Years

Strive for 5!

Communication and Language

Grandad the Greengrocer Interactive Big Book CD-Rom

- Play the interactive Whiteboard Big Book "Grandad the Greengrocer"
- Recap on the story by asking the questions on the Recap Worksheet at www.phunkyfoods.co.uk/dashboard/resources/InteractiveBigBooks/
- Discuss the different places that you can buy fruit and vegetables such as the supermarket, greengrocers, market, local shop etc.
- Discuss the different types of fruit and vegetables we can eat such as frozen, tinned, fresh, juiced and dried. Explain to the children that food goes through different processes before we eat it.

Feeling Fruity ...

- This activity may be done in pairs or as a whole class activity. It may be useful to list some helpful words first to help describe the feel/touch of different fruits and/or vegetables.
- Place one fruit/vegetable into a feely bag/box and ask a child to try and identify it by touch alone. Ask the child to describe the touch of the item to the rest of the group/class and see if they can guess what the item is.

Physical Development

5-a-day

- Show the children the PhunkyFoods eatwell plate poster. Can they identify which food group contains fruit and vegetables? What do they notice about the size of the fruit and vegetable food group? How big is it compared to the other food groups?
- The fruit and vegetable food group is the biggest food group because fruit and vegetables are VERY good for us; especially vegetables. Fruit and vegetables are our super-you foods because they help our bodies grow in a healthy way; they help our bodies to fight bugs, and; they help our bodies to stay healthy.
- To be extra healthy we should eat lots of different types of fruit and vegetables too. Each colour of vegetable contains different things which help us be healthy so eating lots of different coloured fruit and vegetables will help our bodies be super healthy.
- Can the children name a range of different fruit and vegetables that are also different colours?

Eat a rainbow!

- Explain to the children that eating five different coloured fruit and vegetables every day is good for us because the different colours help our bodies in different ways.
- Show the children a picture of a rainbow. Encourage them to name fruits and vegetables for each colour.
- Allocate one fruit/veg to each child. They should draw/colour a picture of it to stick on a rainbow collage for a large wall display to remind all of the children to "Eat a Rainbow" every day!

Personal, Social and Emotional Development

Greengrocer Role Play

- Using shop role play resources children can play at shopping in a greengrocers, buying fruit and vegetables and taking it in turns to be the greengrocer and customers.

Phunky Early Years

Strive for 5!

Literacy

Reading

- Have the Grandad the Greengrocer Interactive Big Book available for children to listen and read along to.

Letters

- Ask the children to chose a letter of the alphabet, and list all of the fruit and vegetables that start with that letter (for some ideas see the A-Z of fruit and veg worksheet)
- Draw the chosen letter on a large piece of paper, writing the fruit and vegetables names inside or next to the letter. This can be decorated with pictures of the fruit and vegetables.

Mathematics

Fruit & Veggie Patterns

- Ask the children to complete the Fruit & Veggie patterns on page 11 of the PhunkyFoods Food and Health Activity Book
- Alternatively, hang fruit and vegetable pictures from a piece of string with pegs, diagonally across the corner of the room at child height. Have the children either complete patterns, or make their own patterns, by moving the pictures around. They might also like to sort the pictures into fruit and vegetables, or colours. You can download suitable pictures for colouring and laminating at www.phunkyfoods.co.uk/dashboard/resources/PhotoCardSets/

PhunkyTUNES CD: Gimme 5!

- Introduce the children to the PhunkyFoods song 'Gimme 5!'Ask the children to do the actions by holding up their fingers as they count 1-5 throughout the song.

Understanding the World

Exotic round the world fruity veg

- Make a display of exotic fruit and vegetables from around the world. Do the children know the names of the fruit/vegetables? Explore the smell and feel of the unusual fruit and vegetables
- Show the children where the fruit and vegetables came from on a world map.
- Cut up the fruit/vegetables and explore the inside. Ask the children to taste if appropriate.

Growing salad leaves

- Give each child a large plastic/clay flower pot. Ask the children to place a handful of small stones in the bottom and then add some compost until the pot is 2/3 full. Press the soil down and water it.
- Give the children a sprinkling of lettuce seeds to put on the soil, and then cover over with a thin layer of compost.
- Pots should be kept in a sunny spot and watered daily. After around a week some seedlings should start to grow. After around 3-4 weeks the leaves should be ready to eat. Break them off, wash them and eat!

Expressive Arts & Design

Fruity-veggie hats

- For each child fit cardboard strips around their head so that it fits like a hat, staple the ends together to secure.
- Give each child/group a pile of magazines and ask them to cut out pictures of different fruit and vegetables and stick them on their hats. They could also draw/paint their own fruits and vegetables to stick on, and use sequins or glitter to make them really special.

Phunky Early Years

Strive for 5!

Food Preparation & Tasting Ideas

Use these fun food preparation ideas with your children. Don't forget to send the recipe sheets home to parents too ... or better still invite the parents in to cook with the children.

Crunchy Coleslaw – see the recipe overleaf

Supercrunch Pudding - see the recipe overleaf

Display Ideas

Wall Displays

- Display the PhunkyFoods Every Day We Aim To ... poster
- Display the "Eat a Rainbow" collage

Hanging Displays

- Hang fruit and vegetable pictures from a piece of string with pegs, diagonally across the corner of the room at child height. Have the children either complete patterns, or make their own patterns, by moving the pictures around. They might also like to sort the pictures into fruit and vegetables, or colours.

Table Top Displays

- Make a display of exotic fruits and vegetables for the children to touch and explore.

Parental Involvement Opportunities

- Why not invite your parents in to do some food preparation activities using the ideas above?
- Ask the children to perform the PhunkyFoods song **'Gimme 5!'**
- Book your local Community Support Worker to run the parent workshop session 'Strive for 5!', or access the re-sources to run the session yourself at www.phunkyfoods.co.uk/dashboard/toolkit/workshops/

Appendix B8: "Eat Well" PhunkyFoods lesson plans

Phunky Early Years

Eat Well!

Communication and Language

What am I?

- Using the PhunkyFoods photo cards play the What am I? game. Lay 8 cards out on the table. Ask the children to find the food you are going to describe. Ask the children to listen very carefully to hear all of the information. Describe a food item from the pictures, gradually adding more detail. Ask the pupils to find the correct food.

Group Task

- Show the children 3 cards from the PhunkyFoods photo cards showing foods from the same food group. Discuss what they are and why they belong to the same group. Add 3 more cards to the table. Some from your chosen food group and some from another group. Ask the children to find the foods from your chosen food group.

Traditional Tales

- Using the PhunkyFood For Thought Discussion Cards ask the children to talk about their favourite tales. Follow the discussion points on the cards.

Physical Development

How can we Eat Well?

- Show the children the PhunkyFoods Every Day We Aim To ... poster. Discuss the key messages and how they can help us to 'Get Fit, Get Healthy and Have Fun!'
- Focus on the 'Eat Well!' message. Explain that this message means that we eat more of some foods, and less of others to keep healthy and this is because some foods are better for our bodies than others. So foods that are better for our bodies we should eat more of, such as fruit and vegetables; and some foods which are not so good for our bodies, such as chocolate and sweets, we should eat less of.
- Show the children the eatwell plate poster and ask the children what they notice about the size of the food groups. Are they all the same size or all they all different sizes? Ask the children which is the biggest group? Explain that this is because these are the foods which we need to eat more of for a healthy diet. Ask the children which is the smallest group. Explain that this is because these are the foods we need to eat less of. Explain that we need lots of different foods to stay healthy but that we should eat more of some foods and less of others.
- Ask the children to think of their 3 favourite foods. Which food group do they belong to? Can they decide whether they should be eating more of these foods or less of them?

eatwell Floor Mat

- Ask the children to help you sort food models or PhunkyFoods photocards (or a mixture of both) in to the correct sections of the giant eatwell plate floor mat. Use it as a discussion to reinstate the message that we should eat more of some foods and less of others to stay healthy. But the most important message is to eat a variety of foods to stay well.

Personal, Social & Emotional Development

Plan a lunch party

- Ask the children to plan a lunch party for a friend. What do they think their friend would like to eat for lunch? What do they like to eat for lunch?
- Ask the children to explore recipe books for some nice ideas. What looks delicious? Do the recipes include foods they should eat more of, or less of? How could they include more foods that are good for us at their party?
- Ask the children to write or draw the foods they are going to have at their lunch party.

Phunky Early Years

Eat Well!

Personal, Social & Emotional Development

Table manners

- This activity can be carried out either at an actual meal or as a role play activity in the home corner. Start by asking the children to lay the table. What do they need at the table and why?
- Read the children the poem; 'Table Manners' by Gelett Burgess (see overleaf). Use this as a basis to discuss what good table manners are and why they are important.

Literacy

Reading

- Gather a selection of fiction and non-fiction books for the reading area. Picture books are particularly good for this subject.

Mathematics

Ordering by size

- Using the PhunkyFoods photocards (5 x food group cards) ask the children to order the groups into sizes; from the biggest to the smallest.

Understanding the World

Alfie's Around the World Adventure CD-Rom

- Play the Interactive Whiteboard Big Book "Alfie's Around the World Adventure"
- Explain that to stay healthy it is important to eat a variety of different foods – just like Alfie did. Explain that different places in the world eat different kinds of foods and it is really fun to explore foods from other countries. Ask the children to try a selection of different foods from around the world. It is nice to display the foods alongside a map so that children can see where the foods come from.

Expressive Arts & Design

PhunkyTUNES 2 CD: It's PhunkyFoods Time!

- Introduce the children to the PhunkyFoods song 'It's PhunkyFoods Time!' Teach them the words to the chorus and ask them to make up a dance.

Phunky Placemats

- Ask the children to design some healthy eating placemats to use during the Table Manners activity above. Give the children some card and write their names on the back. Make sure they decorate their placemats in landscape view. The children could use magazine food images or maybe the PhunkyFoods characters (downloadable from the website) to design their placemat, and any other art materials they wish to.
- Laminate the placemats to enable them to wipe clean after use.
- Ask the children to take the placemats home to use for their good manners at family dinners.

Phunky Early Years

Eat Well!

Food Preparation & Tasting Ideas

Use these fun food preparation ideas with your children. Don't forget to send the recipe sheets home to parents too ... or better still invite the parents in to cook with the children.

These recipes combine all the 'eat more of' food groups with none of the 'eat less of'! Discuss the ingredients and which food group they belong to as you make them.

Super salmon dip – see the recipe overleaf

Other ideas could include **Frittata** or **Soups**

Display Ideas

Wall Displays

- Hang your PhunkyFoods Every Day We Aim To ... poster and your PhunkyFoods Plate of Health poster so the children can see them.

Hanging Displays

- Make a foodie washing line across the classroom and ask the children to spot the repeating pattern. Change the pattern daily and see if the children can recognise it!

Table Top Displays

- Leave the eatwell plate giant floor mat out with some food models/photocards for the children to play with.

Parental Involvement Opportunities

- Why not invite your parents in to do some food preparation activities using the ideas above?
- Ask the children to show and tell their work from the week to their parents.
- Book your local Community Support Worker to run the parent workshop session 'Eat Well', or access the resources to run the session yourself at http://www.phunkyfoods.co.uk/dashboard/toolkit/workshops/

Appendix B9: Staff PhunkyFoods lessons checklist

Please indicate the dates when the components were delivered (if applicable add multiple dates)		
PhunkyFoods Early Years Checklist Intervention components	**Eat Well!**	**Strive for 5!**
Communication and Language Activities	Date:	Date:
Physical Development Activities	Date:	Date:
Personal, Social and Emotional Development Activities	Date:	Date:
Literacy Activities	Date:	Date:
Mathematics Activities	Date:	Date:
Understanding the World Activities	Date:	Date:
Expressive Arts and Design Activities	Date:	Date:
Food Preparation and Tasting Ideas	Date:	Date:
Display Ideas	Date:	Date:
Parental Involvement Opportunities	Date:	Date:

Appendix B10: Parent questionnaire; Food Fussiness and Food Neophobia Questions (study 1)

Please help us to complete a quick survey

UNIVERSITY OF LEEDS

Child's Name: Completed by: Parent ☐ Staff ☐

Please tick one box on each line which is most appropriate to your child's eating behaviour	Never	Rarely	Sometimes	Often	Always
My child refuses new foods at first	☐	☐	☐	☐	☐
My child enjoys tasting new foods	☐	☐	☐	☐	☐
My child enjoys a wide variety of foods	☐	☐	☐	☐	☐
My child is difficult to please with meals	☐	☐	☐	☐	☐
My child is interested in tasting food s/he hasn't tasted before	☐	☐	☐	☐	☐
My child decides that s/he doesn't like a food, even without tasting it	☐	☐	☐	☐	☐

Please indicate how strongly you agree with the following statements:	Strongly Disagree	Disagree	Agree	Strongly Agree
My child doesn't trust new foods	☐	☐	☐	☐
If my child doesn't know what's in a food, s/he won't try it	☐	☐	☐	☐
My child is afraid to eat things s/he has never had before	☐	☐	☐	☐
My child will eat almost anything	☐	☐	☐	☐
My child is very particular about the foods s/he will eat	☐	☐	☐	☐
My child is constantly sampling new and different foods	☐	☐	☐	☐

Thank you very much for your help in completing this survey.

If you have any questions please contact our research team at veggies@leeds.ac.uk. School of Psychology Ethics committee (reference number: 16-0198; date approved: 25/07/2016).

Appendix B11: Intervention evaluation questionnaire for taste exposure

UNIVERSITY OF LEEDS

Vegetable study: repeated taste exposure feedback survey!

We would like to thank all the staff for their support during the vegetable study. We would really appreciate your feedback on the research. This questionnaire will take about 15 minutes to complete.

Your name and job title/role _____

Total number of children accessing your nursery?_____

Over the past 12 weeks children were repeatedly offered the same vegetable (also known as the repeated taste exposure technique).

Thinking about the repeated taste exposure sessions please indicate whether you agree or disagree with each statement:

	Strongly Disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
The study was interesting	○	○	○	○	○
We found this study a hassle to deliver	○	○	○	○	○
We were able to integrate the study requirements into our nursery curriculum	○	○	○	○	○
Children were engaged during the tasting sessions	○	○	○	○	○
We have noticed a change in children's intake of the study vegetable from week 1 to week 12 (September - December)	○	○	○	○	○
We have noticed a change in children's intake of vegetables during other mealtimes in the nursery from week 1 to week 12 (September - December)	○	○	○	○	○
We would recommend using a repeated taste exposure technique in preschool settings at snack time	○	○	○	○	○
We advise using a repeated exposure technique at a meal time not snack time	○	○	○	○	○

1

1. If you have noticed a change in children's study snack intake or other vegetables during the nursery mealtimes, please comment whether this change was positive or negative.

2. How feasible would it be to include repeated taste exposures in your usual practice?

   i) What would help or what barriers would there be to include repeated taste exposures in your usual practice?

3. What was least challenging about this study?

4. What was most challenging about this study?

5. What changes would you recommend for this study?

6. Overall how would you rate your experience of participating in this study on a scale of 1 – 10, where 1 is "extremely negative" and 10 is extremely positive"".

1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○

7. Please add any comments about staffs' and children's experiences during the study period (positive or negative).

Thank you for taking the time to complete this survey. We really appreciate your time and commitment.

Many thanks,
University of Leeds Research Team

Please **send your questionnaire** using the pre-stamped addressed envelope.

Appendix B12: Intervention evaluation questionnaire for Nutrition education

The PhunkyFoods nutrition education evaluation questionnaire used for the present study was an existing questionnaire used by the company for their annual programme evaluation. Only the format of the questionnaire was edited for the present study.

UNIVERSITY OF LEEDS

Vegetable study: PhunkyFoods feedback survey!

Firstly we would like to take this opportunity to thank you for your commitment to the PhunkyFoods programme to date. We would really appreciate your feedback about the programme, including how it was running in your setting and how satisfied you were with the service you have received from the PhunkyFoods team. We would very much appreciate it if you could take 15 minutes of your time to complete this questionnaire.

Your name and job title/role _____

Total number of children accessing your nursery?_____

1. Were you able to fully implement the PhunkyFoods programme or resources? If not please tell us why, and what the barriers to implementation have been.

_____

_____

_____

2. On the website (http://www.phunkyfoods.co.uk/dashboard/early-years/) there are 5 sets of detailed activity ideas for early years settings around our key healthy lifestyle messages. Which, if any, of these sets have you delivered within your setting? Please tick all that apply.

- ○ None
- ○ Our Bodies
- ○ Eat Well!
- ○ Strive for 5!
- ○ Bag A Breakfast
- ○ Get Active!

3. Which of the PhunkyFoods resources do you use in your setting on a regular basis? Please tick all that apply.

- ○ EatWell Plate Floor Mat
- ○ Grandad the GreenGrocer Interactive Story
- ○ Alfie & Emily Play Today Interactive Story
- ○ Alfie's Around the World Adventure Interactive Story
- ○ Boris the Belly Beast Interactive Story
- ○ Interactive WhiteBoard DVDs e.g. Our Body
- ○ PhunkyTunes Music CDs
- ○ PhunkyFoods Photocards
- ○ Phunky Food for Thought Discussion Cards
- ○ Healthier Choices Flashcards
- ○ Workbooks (social history/religious festivals)
- ○ Food & Health Activity Book

1

4. How often are the PhunkyFoods programme/resources utilised in your setting?

- ◯ More than once a week
- ◯ Weekly
- ◯ Fortnightly
- ◯ Monthly
- ◯ Termly
- ◯ Yearly

Other (please specify) _____

5. Who is currently responsible for delivering the PhunkyFoods programme/resources in your setting?

_____

6. Approximately how many children have been reached by the PhunkyFoods Programme (over the intervention period) in your setting?

_____

7. Please rate your agreement with the following statement from "Strongly Agree" to "Strongly Disagree".

"As a result of participating in the PhunkyFoods Programme, our Setting delivers key healthy eating & physical activity messages to children more frequently than we did before."

Strongly Agree	Agree	Neither agree or disagree	Disagree	Strongly Disagree
◯	◯	◯	◯	◯

8. How would you rate the impact of the face-to-face training day on your staff, with regard to their healthy lifestyles (healthy eating & physical activity) knowledge, confidence and delivery skills? Please rate impact on a scale of 1 to 10, where 1 is not impact at all and 10 is extremely impactful.

	1	2	3	4	5	6	7	8	9	10
Impact on healthy lifestyles knowledge	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Impact on confidence in teaching healthy lifestyles messages	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯
Impact on delivery of the programme	◯	◯	◯	◯	◯	◯	◯	◯	◯	◯

9. Has anyone from your setting completed the FREE NCFE National Level 2 Award in 'Nutrition and Health for School-Aged Children'?

- ◯ Yes
- ◯ No
- ◯ Don't know

i) If not, can you tell us why no-one has taken up this FREE Award?

_____

_____

_____

10. How would you rate the impact of the Award on your staff, with regard to their healthy eating knowledge, confidence and delivery skills?
Please rate impact on a scale of 1 to 10, where 1 is not impactful at all and 10 is extremely impactful.

	1	2	3	4	5	6	7	8	9	10
Impact on healthy eating knowledge	○	○	○	○	○	○	○	○	○	○
Impact on confidence in teaching healthy eating messages	○	○	○	○	○	○	○	○	○	○
Impact on delivery of the programme	○	○	○	○	○	○	○	○	○	○

11. Thinking about the PhunkyFoods resources you use in your setting please tell us how much you agree or disagree with the following statements:

	Strongly Disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
The PhunkyFoods key message activity ideas are simple and clear for staff to deliver	○	○	○	○	○
The PhunkyFoods key message activity ideas are pitched at the correct level for the children	○	○	○	○	○
The PhunkyFoods key message activity ideas are engaging for the children	○	○	○	○	○
The PhunkyFoods resources are engaging for the children	○	○	○	○	○
The PhunkyFoods resources are of a high quality	○	○	○	○	○
The PhunkyFoods resources are of sufficient variety	○	○	○	○	○
The PhunkyFoods resources are easy to use	○	○	○	○	○
The PhunkyFoods website is easy to use	○	○	○	○	○
The PhunkyFoods website is supportive	○	○	○	○	○
The PhunkyFoods website is informative	○	○	○	○	○

12. How would you rate the PhunkyFoods package/service to-date?

◯ Very Poor ◯ Poor ◯ Average ◯ Good ◯ Excellent

13. What is the best thing about the PhunkyFood's Programme?

14. What is the most disappointing thing about the PhunkyFood's Programme?

15. Do you have any suggestions for making improvements to the PhunkyFood's Programme?

16. Do you believe that the implementation of the PhunkyFoods programme, and/or utilisation of the PhunkyFoods resources in your setting, has had any impact on awareness and knowledge of healthy lifestyles (healthy eating and physical activity) issues for your children?

◯ Yes
◯ No

i) If yes, can you describe in what way and are you able to evidence this?

17. Do you believe that the implementation of the PhunkyFoods programme, and/or utilisation of the PhunkyFoods resources in your setting, has had any impact on improving healthy eating behaviour for your children?

- ○ Yes
- ○ No

i) If yes, can you describe in what way and are you able to evidence this?

18. Do you believe that the implementation of the PhunkyFoods programme, and/or utilisation of the PhunkyFoods resources in your setting, has had any impact on increasing physical activity levels for your children?

- ○ Yes
- ○ No

i) If yes, can you describe in what way and are you able to evidence this?

19. Are there any ways in which you attempt to engage parents/families with the PhunkyFoods Programme?

- ○ Yes
- ○ No

i) If yes, how is this done and how successful are you finding it?

20. Please rate your agreement with the following statement from 0 - 10, where 0 is "do not agree at all" and 10 is "completely agree".

"The PhunkyFoods Programme has made it easier to engage with parents/carers around the healthy lifestyles agenda."

0 Do not agree at all	1	2	3	4	5	6	7	8	9	10 Completely agree
○	○	○	○	○	○	○	○	○	○	○

Are there any other comments you would like to add about the PhunkyFood's programme or our research study?

Thank you very much for taking the time to complete this survey. Your cooperation and time is greatly appreciated.

Many thanks,
University of Leeds Research Team

Please **return your questionnaire** using the pre-stamped addressed envelope.

Appendix B13 Comparison of children retained in analysis and those lost to follow (study 1)

Supplementary Table 1 Baseline characteristics and mooli intake of children who were retained in the study and those lost to follow-up.

	Data analysed	Lost to follow-up	F / χ^2	p value
Child sex, n (girl/boy)	70 / 70	32 / 47	$\chi 2$ = 1.83	0.205
Mean and SEM				
Age (months)	40.6 ± 0.4	40.6 ± 0.5	F = 0.01	0.970
BMIz	0.9 ± 0.8	1.9 ± 1.2	F = 1.38	0.241
Food Fussiness (CEBQ)	2.4 ± 0.1	3.1 ± 0.1	F = 1.39	0.241
Food Neophobia	2.5 ± 0.1	2.4 ± 0.0	F = 1.52	0.219
Mooli intake (grams)	4.5 ± 0.8	7.1 ± 1.5	F = 2.90	0.099

There were no differences observed in baseline characteristics and mooli intake of children who were retained in the study and those who were lost to follow-up.

Appendix B14 Additional analysis based on eating category (study 1)

Additional statistical analysis based on eating category

As children were recruited using a cluster design it was important to account for the impact of cluster assignment. Additionally, for repeated measures each data point was clustered within child. Therefore, all the models described below corrected for this using the complex samples procedure within SPSS to incorporate the contribution of these variance components to the data.

Intake data for all time points results in a positive skew as many children ate 0g of mooli. Therefore, a complex samples logistic regression analysis was conducted to examine what factor predicted children eating at least some of the mooli (classed as "eaters"). Next a complex samples general linear repeated measures analysis of variance was performed to examine the predictors of the amount consumed, when children ate some of the mooli. In both analyses the effects of taste exposure, nutrition education, taste exposure + nutrition education, time of follow-up (immediately post intervention, 3 month follow up, 6 month follow up) and their interactions, produced any effects on willingness to eat some mooli, and for the eaters, whether the amount consumed was affected by condition, controlling for age and baseline consumption.

Additional results based on eating category

Given that many children did not eat mooli at baseline, the data were significantly skewed. Therefore, children were categorized according to their eating pattern at post-intervention, FU1 and FU2 (non-eater, eater) and these are shown in Table 3.3. Eating status is a proxy for fussiness as it is defined in relation to the child's actual behaviour (willingness to try the vegetable) rather than relying on parental reports of fussy eating.

Logistic regression indicated that at post-intervention, there was an interaction between taste exposure and nutrition education, (x^2 (1) = 4.67, p = 0.031), which indicated that children in the control condition were less likely to be eaters than in any of the other conditions (OR = 0.20, 95% CI 0.05 – 0.87). In particular, children in the nutrition education conditions had higher odds of eating the mooli than children who were not in the nutrition education conditions (OR 6.43, 95% CI 1.5 – 27.8; x^2 (1) = 5.73, p = 0.017). taste exposure did not affect whether children were classified as eaters or not (OR = 1.65, 95% CI 0.37 – 7.44; x^2 (1) = 0.24, p = 0.63). There was no main effect of time on eater status (x^2 (2) = 5.82, p = 0.054).

A second analysis was conducted to examine, only in those children who ate the mooli, what predicted their intake (see supplementary Table 1 below). While there are

issues of regression to the mean, there is no reason to think this will be differentially affected by the different conditions. In this analysis, significant effects of condition were found indicating that intake increased significantly in the taste exposure condition ($F(1,135) = 11.21$, $p = 0.001$).

There was also a main effect of time ($F(2,134) = 9.02$, $p < 0.001$). There was no significant effect of nutrition education ($F(1,135) = 0.47$, $p = 0.49$) and no significant interactions (largest $F = 1.17$). Contrasts revealed that the significant effect of time was due to children eating more at FU2 than at post intervention ($t(135) = 2.20$, $p = 0.029$). Overall, within the taste exposure conditions, 10 exposures were sufficient to increase average intake by ~10g which represents a quarter of a portion (on average) of a child's vegetable intake, or 5% of their daily fruit and vegetable recommendation. The change was maintained up to six months after the intervention phase. Thus, following 10 taste exposures children who were willing to consume the vegetable initially had learned to accept more of this vegetable over time and this was sustained long term when offered the same vegetable again.

Supplementary Table 2 Amount (g) eaten of the unfamiliar vegetable (mooli) among children categorised as Eaters (>0g intake) at each time point by intervention condition presented as mean (± SEM).

Time	Taste Exposure		Nutrition Education		Taste Exposure +Nutrition education		Control	
	n	*Intake (g)*	*n*	*Intake (g)*	*n*	*Intake (g)*	*n*	*Intake (g)*
Baseline	32	4.7 ± 1.4	31	5.5 ± 1.8	25	11.0 ± 2.9	12	3.5 ± 2.7
Post-intervention	44	17.0 ± 2.7	38	8.0 ± 1.7	35	17.8 ± 3.1	12	6.1 ± 2.8
Follow-up 1	39	17. 9 ± 2.7	35	11.5 ± 2.1	33	23.9 ± 4.0	11	9.5 ± 4.6
Follow-up 2	39	20.1 ± 2.5	34	17.6 ± 2.8	35	20.8 ± 2.9	12	10.3 ± 3.9

Appendices C: Study 2

Appendix C1: CONSORT checklist (study 2)

Section/Topic	Item No	Standard Checklist item	Extension for cluster designs	Section No *
Title and abstract				
	1a	Identification as a randomised trial in the title	Identification as a cluster randomised trial in the title	4
	1b	Structured summary of trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts)	See table 2	--
Introduction				
Background and objectives	2a	Scientific background and explanation of rationale	Rationale for using a cluster design	4.2
	2b	Specific objectives or hypotheses	Whether objectives pertain to the cluster level, the individual participant level or both	4.2.1
Methods				
Trial design	3a	Description of trial design (such as parallel, factorial) including allocation ratio	Definition of cluster and description of how the design features apply to the clusters	4.4.1
	3b	Important changes to methods after trial commencement (such as eligibility criteria), with reasons		NA
Participants	4a	Eligibility criteria for participants	Eligibility criteria for clusters	4.3.2
	4b	Settings and locations where the data were collected		4.3.1
Interventions	5	The interventions for each group with sufficient details to allow replication, including how and when they were actually administered	Whether interventions pertain to the cluster level, the individual participant level or both	4.3.3 – 4.3.4
Outcomes	6a	Completely defined pre-specified primary and secondary outcome measures, including how and when they were assessed	Whether outcome measures pertain to the cluster level, the individual participant level or both	4.3.7
	6b	Any changes to trial outcomes after the trial commenced, with reasons		NA
Sample size	7a	How sample size was determined	Method of calculation, number of clusters(s) (and whether equal or unequal cluster sizes are assumed), cluster size, a coefficient of intracluster correlation (ICC or *k*), and an indication of its uncertainty	4.3.2
	7b	When applicable, explanation of any interim analyses and stopping guidelines		NA

Section/Topic	Item No	Standard Checklist item	Extension for cluster designs	Section No *
Randomisation:				
Sequence generation	8a	Method used to generate the random allocation sequence		4.3.1
	8b	Type of randomisation; details of any restriction (such as blocking and block size)	Details of stratification or matching if used	4.3.1
Allocation concealment mechanism	9	Mechanism used to implement the random allocation sequence (such as sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	Specification that allocation was based on clusters rather than individuals and whether allocation concealment (if any) was at the cluster level, the individual participant level or both	4.3.1
Implementation	10	Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	Replace by 10a, 10b and 10c	
	10a		Who generated the random allocation sequence, who enrolled clusters, and who assigned clusters to interventions	4.3.1
	10b		Mechanism by which individual participants were included in clusters for the purposes of the trial (such as complete enumeration, random sampling)	4.3.2
	10c		From whom consent was sought (representatives of the cluster, or individual cluster members, or both), and whether consent was sought before or after randomisation	4.3.2
Blinding	11a	If done, who was blinded after assignment to interventions (for example, participants, care providers, those assessing outcomes) and how		4.3.1
	11b	If relevant, description of the similarity of interventions		NA
Statistical methods	12a	Statistical methods used to compare groups for primary and secondary outcomes	How clustering was taken into account	4.3.8
	12b	Methods for additional analyses, such as subgroup analyses and adjusted analyses		4.3.8
Results				
Participant flow (a diagram is strongly recommended)	13a	For each group, the numbers of participants who were randomly assigned, received intended treatment, and were analysed for the primary outcome	For each group, the numbers of clusters that were randomly assigned, received intended treatment, and were analysed for the primary outcome	Figure 4.2

Section/Topic	Item No	Standard Checklist item	Extension for cluster designs	Section No *
	13b	For each group, losses and exclusions after randomisation, together with reasons	For each group, losses and exclusions for both clusters and individual cluster members	Figure 4.2
Recruitment	14a	Dates defining the periods of recruitment and follow-up		4.3.1
	14b	Why the trial ended or was stopped		NA
Baseline data	15	A table showing baseline demographic and clinical characteristics for each group	Baseline characteristics for the individual and cluster levels as applicable for each group	Table 4.1
Numbers analysed	16	For each group, number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups	For each group, number of clusters included in each analysis	4.3.8 & Figure 4.1
Outcomes and estimation	17a	For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)	Results at the individual or cluster level as applicable and a coefficient of intracluster correlation (ICC or k) for each primary outcome	
	17b	For binary outcomes, presentation of both absolute and relative effect sizes is recommended		4.3.8 & 4.4.3
Ancillary analyses	18	Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing pre-specified from exploratory		NA
Harms	19	All important harms or unintended effects in each group (for specific guidance see CONSORT for harms)		4.4.4
Discussion				
Limitations	20	Trial limitations, addressing sources of potential bias, imprecision, and, if relevant, multiplicity of analyses		4.5.2
Generalisability	21	Generalisability (external validity, applicability) of the trial findings	Generalisability to clusters and/or individual participants (as relevant)	4.5.2
Interpretation	22	Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence		4.5.2
Other information				
Registration	23	Registration number and name of trial registry		4.3
Protocol	24	Where the full trial protocol can be accessed, if available		Available upon request

Appendix C2: Nursery recruitment email (study 2)

"Effects of experiential learning on intake of a novel vegetable in preschool children!"

Dear Nursery Manager,

I am a PhD student in the School of Psychology at the University of Leeds. We are conducting a research on promoting vegetable intake in children aged 2-5 years and would like to invite your nursery to take part in our novel research. Our research team has lots of experience of working with early years and we are now working in collaboration with Phunky Foods (www.phunkyfoods.com) which provides an interactive health educational programme to schools. This research aims to find the best ways to encourage young children to try novel vegetables to help them achieve a healthy diet through liking and acceptance of these foods.

For this study we would like to introduce a new vegetable, celeriac, to the children in nursery. Children will first be offered a portion of celeriac to eat. Staff will then read the children a story we will provide, which will feature vegetables. We may request some nurseries to include some interactive elements during this session (e.g. smelling, looking, and feeling the vegetable). The story book will stay in nursery, and staff should read it to the children five times over the two week period. After this, staff will read the story a final time, with interactive elements as before if requested. We will then provide a portion of celeriac again, and see how much the children eat. They are at liberty to eat as little or as much as they like of the celeriac. Their knowledge of the vegetable story will be tested using photo cards or by recalling the story. The nursery staff will be requested to observe children during the snack time and ensure that any spilled food is returned back to the child's snack bag, this is to ensure that the researcher can collect remaining food and measure the intake accurately. The nurseries can keep the story book after the study.

Before the research begins we will provide all the parents the details of the study along with a simple 6 question survey (please see attached documents). The parents who do not wish their child to participate in our research for whatever reason can opt out of the study by sending back a form to the nursery which we shall collect, record and respect. Children with any relevant food allergies will be excluded from tasting the vegetable but they can still enjoy the story time. Please see the attached documents for consent form and ethical safeguards which are in place for this research including data protection measures. We will require the nursery manager to sign the consent form and we will also provide you a signed copy to keep for your record.

Our research team would be very grateful if your nursery would consider taking part in our innovative research. The study will begin in October 2017. I will call you shortly to follow up on this invitation and to answer any questions that you may have.

This study is supervised by Professor Marion Hetherington (email: m.hetherington@leeds.ac.uk) and Dr Pam Birtill (p.birtill@leeds.ac.uk) and has been approved by the School of Psychology Ethics committee (reference number: 17-0251 approved on 02/10/2017). The research is funded by a collaborative ESRC PhD studentship.

We look forward to hearing from you.

Yours Sincerely,
Chandani Nekitsing & Research Team

Tel: 0113 343 8472
School of Psychology. University Road, University of Leeds, LS2 9JT
Research ethics

Risks & Benefits: Children will benefit from the story time and vegetable snack offered in an interactive, familiar and social setting. Predicted benefits are that children may learn to like a new vegetable and will learn about the vegetable in the story time. Children with relevant food allergies will be excluded from tasting the study foods. There are no foreseeable risks associated with participating in this research.

Informed Consent: Story time and providing vegetables falls within the range of usual curriculum and other institutional activities, and poses no additional risks than is already experienced. Therefore, consent will be sought from relevant senior member of staff within the nursery as permitted under the BPS Code of Human Research Ethics (p17). Under this permission we will use an opt-out method so that parents and guardians may withdraw their child from any part of the study if they wish. The nursery head teacher/ manager, staff and parents will be provided with the written information sheet. The senior manager/nursery head has been given the informed consent seeking their agreement to the opt-out consent process to allow children to take part in the research. This will include confirmation that they have appropriate information regarding food allergies, and that children with a relevant food allergy will be excluded from consuming the vegetable. Along with the information sheet parents will be sent the questionnaire pack and an opt-out consent form if they do not wish their child to take part. The parent information sheet will make it clear that their children can still take part in research even if they do not wish to complete the questionnaire. In order to increase the awareness of the study, posters will also be displayed around the nursery (see attached poster). If the nursery agrees an email will be sent to parents of the children involved in the research to make them aware of the study. The study involves providing relatively novel vegetables to children, and we have identified celeriac as something which is novel to children. All nurseries that are accepted in the study will have a record of any child with any known food allergies (this is standard practice in childcare settings and is conventional across private and public nurseries). Therefore, we can exclude children with relevant food allergies. The nursery will be asked to consent to preparation and delivery of foods in line with Human Appetite Research Unit safety standards and best practice. Staff or parents can contact the investigators at any time for further details of the study or if they have any queries. The nursery will be fully informed about the different condition after the experimental session.

Vulnerable participants: The nature of the study requires working with children aged 2-5 years old. The primary researcher has obtained a DBS check. Participants will not be obliged to eat the study foods and staff and parents will be reassured about this. The study will be delivered by the nursery staff so that children are familiar with the person delivering the intervention. The primary investigator has experience of working in nursery setting and conducting similar research.

Participant confidentiality and anonymity: Participants will only be required to provide information relevant to the study. Parents can choose not to answer a question if they do not wish. The child's name and first initial of surname if more than one children with same name in the class will be available to the primary investigator so that the data can be collected and matched to the questionnaire. However, as soon as all data has been matched each participant will be given a random ID number such as KA528. Names on the questionnaires will be removed and replaced with the relevant ID after it has been matched to the intake data.

Right to withdraw: Both parents and nurseries have the right to withdraw from the study at any time without giving reasons. They can withdraw specific child data until 30/03/ 2018, after this date, all data will be anonymised.

Data protection: All data will be stored on a password protected university PC. The individual files will also be protected and only the research team will have access to these. All paper questionnaires will be stored in a locked cabinet and personal details such as name will be replaced with a random ID. Parents/ guardian and nursery staff will be aware from the information sheet that the results from the study may be disseminated in journals articles and presented at conferences. As this project is funded by the ESRC we are required to keep the data for 10 years. However there is no way that your child will be identified from these records because the name of your child will be replaced by a unique unidentifiable ID.

Appendix C3: Nursery opt-in consent form (study 2)

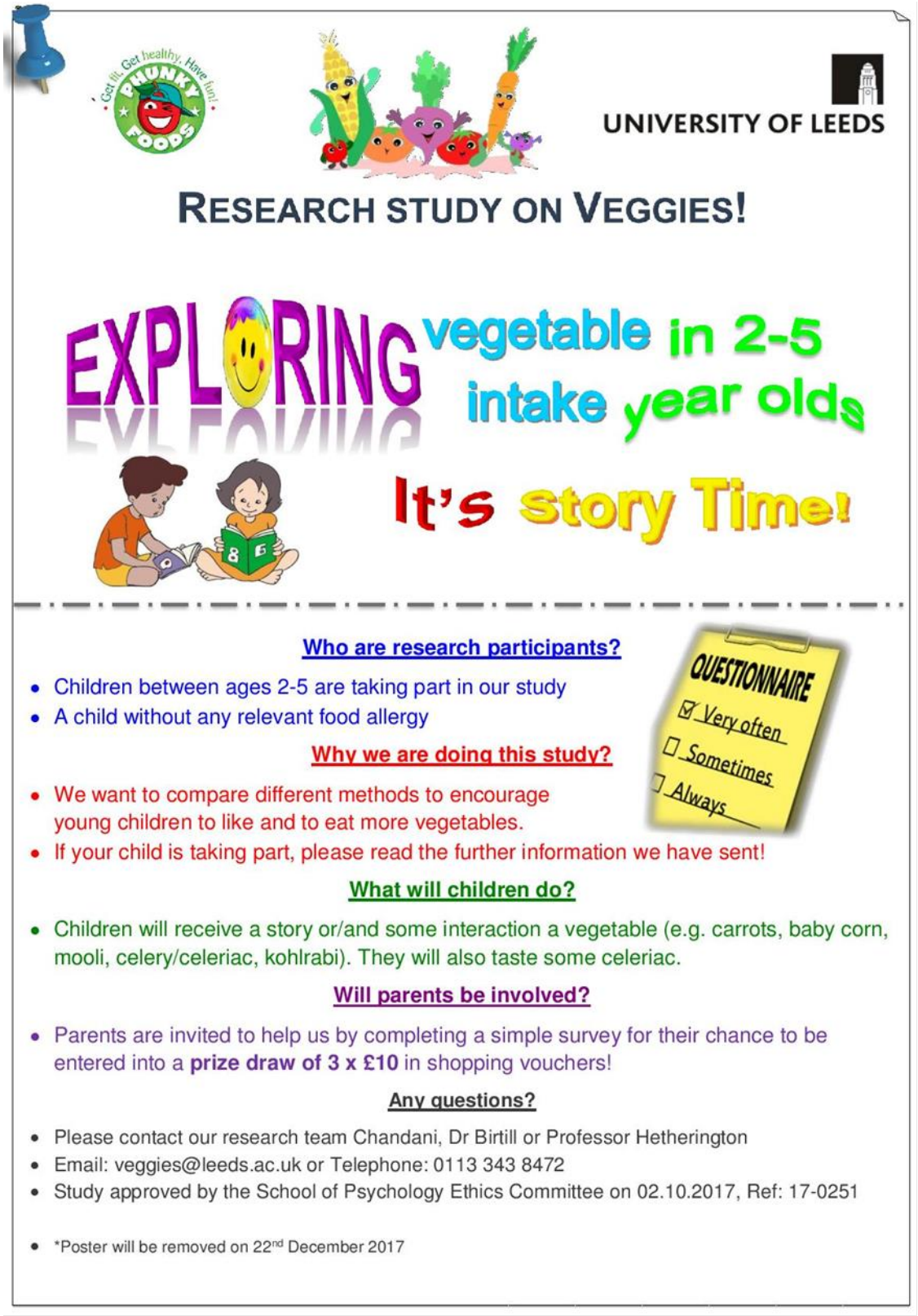
UNIVERSITY OF LEEDS

Consent to take part in: **"Effects of experiential learning on intake of a novel vegetable in preschool children!"**	Add your initials
I confirm that I have read and understood the e-mail information and the parent information letter explaining the above research project and I have had the opportunity to ask questions about the project.	
I understand that our participation is voluntary and that we or parents are free to withdraw the child or their data without giving any reason and without there being any negative consequences until 30th March 2018, after this date, all data will be anonymised. I understand that once requested to remove the data, any records will be destroyed as soon as reasonably possible. In addition, should we not wish to answer any particular question or questions, we are free to decline.	
I agree for the data collection from our nursery to be stored confidentially and used in relevant future research in an anonymised form. The data will be anonymised by removing the child's name and replacing it with a random ID number e.g. 528. The anonymised data may be archived or shared with other scientific researchers upon consent from the research supervisor. I have been informed that this project is funded by the ESRC and researchers are required to keep the anonymised data for 10 years.	
I understand that relevant sections of the data collected during the study may be looked at by individuals from the University of Leeds or from regulatory authorities where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records.	
I confirm that our nursery has an up to date record of children's food allergies and I am aware that children with relevant food allergies will be excluded.	
I understand and agree to the opt-out consent process (and parental opt-in, if additionally requested by your nursery setting) and I am aware that only trained research staff will prepare and deliver the foods in accordance with the Human Appetite Research Unit Health and Safety standards.	
I am a senior nursery member of staff and duly authorised to provide consent on behalf of the nursery. I agree for our nursery to take part in the above research project and will inform the lead researcher should anything change.	

Name of Nursery	
Head teacher/ Manager	
Signature	
Name of the Researcher	
Signature	
Date	

* Please keep this document safe for future reference. If you have any questions please contact Chandani Nekitsing, Dr Birtill or Professor Hetherington; email: veggies@leeds.ac.uk or Telephone: 0113 3438472. Study approved by School of Psychology Ethics Committee on 02/11/2017, Reference number: 17-0251.

Appendix C4: Study poster displayed outside preschool rooms (study 2)



Appendix C5: Parent information letter and opt-out consent form (study 2)

UNIVERSITY OF LEEDS

Invitation to take part in an ongoing research study
"Effects of experiential learning on intake of a novel vegetable in preschool children!"

Dear Parent or Guardian,

We are a research team at the University of Leeds looking at ways to encourage young children to eat more vegetables. The nursery your child attends has kindly agreed to help us with our research project and we are pleased to let you know how your child will be involved. Please take time to read the information carefully and contact us if you would like further information.

What's the purpose of our research?

The purpose of this research is to compare different methods to encourage young children to like and to eat more vegetables. The project will start from October 2017 and will end in January 2018. The research day will vary depending on the nursery's availability.

Why is your child invited and what will they do?

All children who are eligible (if they do not have relevant food allergies) at nursery aged 2-5 years are invited to take part in this research. We will ask staff at the nursery to read a story about a vegetable. The story book will then be available in the nursery for two weeks. After this we will ask the staff to read the story once again. We may also ask nursery to include some interactive elements such as looking, smelling and feeling a vegetable during the first and last story session. The children will be offered celeriac vegetable to eat at the beginning and at the end of two weeks, they are at liberty to eat as little or as much as they like of this vegetable. Their intake of the novel vegetable will be recorded and knowledge of the vegetable will be tested using photo cards or by recalling the story. We hope that children will have fun taking part in this research whilst also learning about a new vegetable. All foods are prepared under strict hygiene standards. If your child has a relevant food allergy they will not be offered the vegetable but can still enjoy the story time. We will ask the nursery to provide details of each child's age in months and their gender.

Do parents need to be involved?

If you agree to participate we will also ask you to complete a quick six question survey which will take less than 5 minutes to complete. **Please kindly return the questionnaire to the nursery as soon as possible.** If you prefer, we can request the child's key worker to complete this questionnaire on your behalf if they know the child's eating behaviour well. We can also provide an electronic copy upon request (veggies@leeds.ac.uk). All parents who fill in the questionnaires will be entered into a prize draw of 3 x £10 in shopping vouchers.

What if my child does not want to eat?

Your child's participation is voluntary and they do not have to taste the vegetable if they do not wish to. Children will not be pressured to eat at any point and if your child is not able to eat the vegetable then their usual snack will be offered. There are no potential risks identified for taking part in this research and your child should not experience any discomfort as a result of taking part. We will ask nursery to confirm that your child has no known allergy to the vegetable we will provide. We would also like to request you to complete the slip attached to this letter and/or indicate if your child has allergy to celery or celeriac. The vegetables will be prepared and provided by trained research staff on the test day. The nursery staff will offer the vegetable snack to children during snack time and monitor their intake. Staff will be requested to return any spilled food back into the child's container for researchers to collect and weigh.

Are there any benefits in taking part?

If your child participates in our research they will get to try an unfamiliar vegetable. Our experience tells us that children tend to enjoy the tasting sessions, they will have fun during the interactive story time and they will learn about a new vegetable. This study should provide a benefit in improving our understanding of the best ways to encourage heathy eating in preschool children.

Will data be confidential?

We will measure your child's vegetable intake to see if our intervention is working. We will ask nursery for your child's first name and also the first initial of the surname if more than one children with same name in the class. This is so we can match their intake data with the questionnaire which you will be requested to complete. We will also ask the nursery to provide details of the child's gender and age in months to see if these have impact on their intake. Names will be replaced with an ID code as soon as all data collection is complete (at latest by 30th March 2018). All records will be kept in a safe locker at the university. The data stored on the computer will be encrypted with a password and will only be accessible by the research team. As this project is funded by the ESRC we are required to keep the data for 10 years. However there is no way that your child will be identified from these records because the name of your child will be replaced by a unique unidentifiable ID.

What if I don't wish my child to take part?

Your child is not obliged to take part in our research. You have the right to withdraw your child or their data from the study at any time until 30th March 2018, after this date, all data will be anonymised. Please note you are not required to explain your reason. Once the request to remove the data has been received by the research team, any records will be destroyed as soon as reasonably possible. If you prefer that your child does not take part, then please complete the opt-out form below this information sheet and return it back to your child's nursery as soon as reasonably possible. We thank you for your time.

Where will the research go next!

Our research may show new strategies nursery can employ to introduce vegetables to young children to improve their food preference. Results from our study may be published in scientific journal, presented at a conference, as an eThesis or on a website. However, confidentiality and anonymity will be maintained at all times, so it is not possible to identify your child's individual data.

Who is funding this research?

This research is funded by the Economic and Social Research Council (ESRC) in collaboration with Phunky Foods, Purely Nutrition, which provides an interactive health educational programme to schools.

Who can I contact for details?

This study is supervised by Professor Marion Hetherington (email: m.hetherington@leeds.ac.uk) and Dr Pam Birtill (p.birtill@leeds.ac.uk) and has been approved by the School of Psychology Ethics committee (reference number: 17-0251 approved on 02/10/2017).

Please keep this information sheet for future reference and feel free to contact our research team if you have any questions or would like further details of the study.

We would like to thank you for reading this information sheet.

Yours Sincerely,

Chandani Nekitsing and Research Team

Office: 0113 343 8472

E-mail: veggies@leeds.ac.uk

Response Slip to OPT-OUT

If you **DO NOT** wish your child to take part please complete the below slip and return to your child's nursery as soon as possible but **no later than 31st October 2017**.

Child's name: ……..

I do not wish my child to take part in the vegetable study (please tick) ☐

If you wish please indicate reason below:

Food allergy ☐

Other ☐

……

Parent/ Caregiver's signature: ……

Date: ……

Appendix C6: Parent opt-in consent form (study 2)

UNIVERSITY OF LEEDS

School of Psychology

Consent to take part in: "Effects of experiential learning on intake of a novel vegetable in preschool children!"	Add your initials next to the statements you agree with
I confirm that I have read and understood the e-mail information/ parent information letter explaining the above research project on vegetable intake in children and I have had the opportunity to ask questions about the project.	
I understand that my child's participation is voluntary and I am free to withdraw my child or their data without giving any reason and without there being any negative consequences until 30th March 2018. After this date all records will be anonymised.	
I understand that personal data collected, such as the first name of my child will be kept confidential and replaced with a random ID (e.g. 528).	
I agree for the data collected from my child to be stored confidentially and used in relevant future research in an anonymised form (without being identified).	
I confirm that my child has no known allergy to celery or celeriac OR my child has not tried celeriac before, but I am happy for my child to take part.	
I am the legal guardian for child named on this form and I agree for my child to take part in the research looking at "effects of experiential learning on intake of a novel vegetable in preschool children".	

Child's Name	
Parent's Name	
Signature	
Name of the Researcher/ Nursery staff	
Signature	
Date	

* Please keep copy of this document safe for future reference. If you have any questions please contact Chandani Nekitsing, Dr Birtill or Professor Hetherington; email: veggies@leeds.ac.uk or Telephone: 0113 3438472. Study approved by School of Psychology Ethics Committee on 02/11/2017, Reference number: 17-0251.

Appendix C7: Nursery study timeline (tailored to individual nursery)

Information	Day 1			Day 2 – 13 (9 preschool days)	Day 14			
Date	*06th November*			*07– 17th November*	*20th November*			
Task	Test Knowledge	Celeriac Tasting	Read Story / Sensory Play	Read Story 5 times (Please complete the story timesheet and register on these days) 	Read Story / Sensory Play	Test Knowledge	Celeriac Tasting	Evaluation (can send it back by email or post)
Time duration	10min	15min	10min + 15 min sensory	10-15 min each session	10min + 15 min sensory	10min	15min	15min

Please remind parents to return their questionnaires. Additional copies provided to complete in preschool

Appendix C8: Cue cards for celeriac and carrot sensory play activity

This sensory activity will take about 15 minutes

Please try to encourage every child to participate in these activities.

At the end of the session, please return all of the Celeriac back to the box. These will be collected later.

This sensory activity will take about 15 minutes

Please try to encourage every child to participate in these activities.

At the end of the session, please return all of the carrots back to the box. These will be collected later.

1. Sound activities

1. Show children the whole vegetable ask them **"What vegetable is this?"**
2. Tell them **"It's a CELERIAC!"**
3. Ask children again. **"What is it"?**
4. **"Let's tap the CELERIAC** (whole vegetable) **and listen to the sound it makes"**. Pass the CELERIAC around to the children and ask them to have a go.

1. Sound activities

1. Show children the whole vegetable ask them **"What vegetable is this?"**
2. Tell them **"It's a CARROT!"**
3. Ask children again. **"What is it"?**
4. **"Let's tap the CARROT** (whole vegetable) **and listen to the sound it makes"**. Pass the CARROT around to the children and ask them to have a go.

2. Sight activities

1. While passing the whole CELERIAC ask the children **"What colour is the CELERIAC?"**
2. **"That's a whole CELERIAC".**
3. **"Now, lets see how the CELERIAC looks once its cut."** (in the following order half, chunk, sliced, sticks, grated and spiralized. Say the following.

A.(Half veg, remove from the snack bag), **"This is how CELERIAC looks when it is cut in half!"**
B.(Sliced container) **"This is how CELERIAC looks when it is peeled and sliced!"**
C.Sticks (container) **"This is how CELERIAC looks when it is cut into sticks!"**
D.Grated (container) **"This is how CELERIAC looks when it is grated!"**
E.Spiralized (container) **"This is how CELERIAC looks when it is in spiral shape!"**

2. Sight activities

1. While passing the whole CARROT ask the children **"What colour is the CARROT?"**
2. **"That's a whole CARROT".**
3. **"Now, lets see how the CARROT looks once its cut."** (in the following order half, chunk, sliced, sticks, grated and spiralized. Say the following.

A.(Half veg, remove from the snack bag), **"This is how CARROT looks when it is cut in half!"**
B.(Sliced container) **"This is how CARROT looks when it is peeled and sliced!"**
C.Sticks (container) **"This is how CARROT looks when it is cut into sticks!"**
D.Grated (container) **"This is how CARROT looks when it is grated!"**
E.Spiralized (container) **"This is how CARROT looks when it is in spiral shape!"**

3. Touch, feel and smell activities

1. Encourage the children to touch and smell the CELERIAC **"Shall we see how all different textures of CELERIAC feel and smell"**

During this part, please allow the children to play with the CELERIACS

2. Tell the children that these CELERIACs needs to go back in the box.

Thank you for completing this activity with the children!

3. Touch, feel and smell activities

1. Encourage the children to touch and smell the CARROT **"Shall we see how all different textures of CARROT feel and smell"**

During this part, please allow the children to play with the CARROTS

2. Tell the children that these carrots needs to go back in the box.

Thank you for completing this activity with the children!

Appendix C9: Study 2 parent questionnaire: Food Fussiness and Food Frequency Questions

"Effects of experiential learning on intake of a novel vegetable in preschool children!"

Please complete this questionnaire for us. :-)

£10 PRIZE DRAW!

Child Eating Behaviour Questions

Child's Name and first initial of Surname: _____. ___

ALLERGY

I confirm that my child IS NOT allergic to CELERY or CELERIAC (please tick the box) ☐

Please tick one box on each line which is most appropriate to your child's eating behaviour

	Never	Rarely	Sometimes	Often	Always
My child refuses new foods at first	☐	☐	☐	☐	☐
My child enjoys tasting new foods	☐	☐	☐	☐	☐
My child enjoys a wide variety of foods	☐	☐	☐	☐	☐
My child is difficult to please with meals	☐	☐	☐	☐	☐
My child is interested in tasting food s/he hasn't tasted before	☐	☐	☐	☐	☐
My child decides that s/he doesn't like a food, even without tasting it	☐	☐	☐	☐	☐

Please indicate how often, your child has eaten each vegetable during the last month.

Vegetable	ESTIMATED INTAKE LAST MONTH								
	Never or less than once/ month	1-3 per month	Once a week	2-4 per week	5-6 per week	Once a day	2-3 per day	4-5 per day	6+ per day
Carrot	☐	☐	☐	☐	☐	☐	☐	☐	☐
Celeriac	☐	☐	☐	☐	☐	☐	☐	☐	☐

THANK YOU very much for completing this questionnaire

Please return it to your child's nursery!

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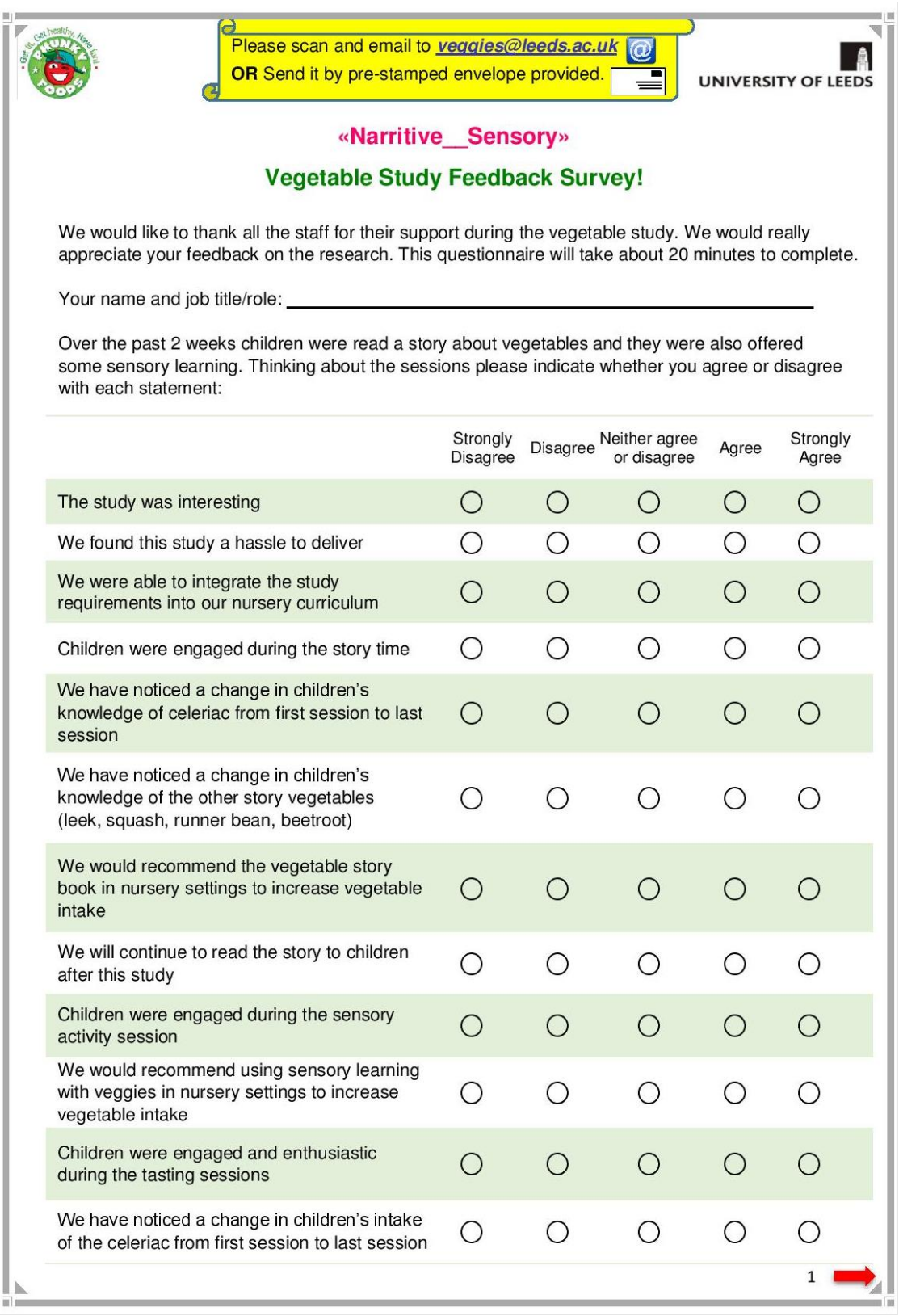
Appendix C10: Intervention evaluation questionnaire for storybook and sensory play



Please scan and email to veggies@leeds.ac.uk
OR Send it by pre-stamped envelope provided.

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«Narritive__Sensory»

Vegetable Study Feedback Survey!

We would like to thank all the staff for their support during the vegetable study. We would really appreciate your feedback on the research. This questionnaire will take about 20 minutes to complete.

Your name and job title/role: _____

Over the past 2 weeks children were read a story about vegetables and they were also offered some sensory learning. Thinking about the sessions please indicate whether you agree or disagree with each statement:

	Strongly Disagree	Disagree	Neither agree or disagree	Agree	Strongly Agree
The study was interesting	○	○	○	○	○
We found this study a hassle to deliver	○	○	○	○	○
We were able to integrate the study requirements into our nursery curriculum	○	○	○	○	○
Children were engaged during the story time	○	○	○	○	○
We have noticed a change in children's knowledge of celeriac from first session to last session	○	○	○	○	○
We have noticed a change in children's knowledge of the other story vegetables (leek, squash, runner bean, beetroot)	○	○	○	○	○
We would recommend the vegetable story book in nursery settings to increase vegetable intake	○	○	○	○	○
We will continue to read the story to children after this study	○	○	○	○	○
Children were engaged during the sensory activity session	○	○	○	○	○
We would recommend using sensory learning with veggies in nursery settings to increase vegetable intake	○	○	○	○	○
Children were engaged and enthusiastic during the tasting sessions	○	○	○	○	○
We have noticed a change in children's intake of the celeriac from first session to last session	○	○	○	○	○

1

1. Was the story book displayed in your classroom during the two weeks?

   Yes ☐ No ☐ Other, please specify:

2. If you have noticed a change in children's intake of celeriac or other vegetables during the nursery mealtimes, please comment whether this change was positive or negative.

3. How feasible would it be to include vegetable story and sensory learning sessions in your usual practice?

   i) What would help or what barriers would there be to include vegetable story time and sensory learning in your usual practice?

4. What was least challenging about this study?

5. What was most challenging about this study?

6. What changes would you recommend for this study?

7. After taking part in this research, would you include any additional activities in your settings using veggies? If any, please let us know some of your ideas (e.g. making celeriac soup with children)

8. Overall how would you rate your experience of participating in this study on a scale of 1 – 10, where 1 is "extremely negative" and 10 is "extremely positive".

1	2	3	4	5	6	7	8	9	10
○	○	○	○	○	○	○	○	○	○

9. Please add any comments about staffs' and children's experiences during the study period (positive or negative).

Please answer the following questions specific to the storybook:

	Yes	No	Unsure
Is the purpose of the book clear?	◯	◯	◯
Does the text seem appropriate for the age group?	◯	◯	◯
Does the text read smoothly?	◯	◯	◯
Are the illustrations appropriate for the age group?	◯	◯	◯
Do the illustrations reflect the mood of the book, consistent with the text?	◯	◯	◯
Did the storybook hold your children's attention?	◯	◯	◯
Do you think the children enjoyed the story?	◯	◯	◯

How do you feel about the length of the story?

Too long ☐ Just right ☐ Too short ☐

In your opinion is this a good story book?

Very Good ☐ Good ☐ Average ☐ Poor ☐ Very Poor ☐

Any other comments or feedback on the content of the storybook (text or illustrations) would be greatly appreciated:

_____

_____

_____

_____

_____

_____

_____

_____

Thank you for taking the time to complete this survey. We really appreciate your time and commitment.

Many thanks,
University of Leeds Research Team

Please **scan and email** or send your questionnaire using the **pre-stamped** addressed envelope.

Appendix C11: Comparison of children retained in analysis and those lost to follow (study 2)

Supplementary Table 3 Baseline characteristics and celeriac intake of children who were retained in the study and those lost to follow-up.

	Data analysed	Lost to follow-up	F / χ^2	p value
Child sex, n (girl / boy)	119 / 148	38 / 32	$\chi 2 = 2.28$	0.084
Mean and SEM				
Age (months)	38.9 ± 0.5	38.4 ± 0.9	F = 0.43	0.512
Food Fussiness (CEBQ)	2.8 ± 0.1	2.7 ± 0.1	F = 0.27	0.601
Celeriac intake (grams)	3.9 ± 0.5	2.4 ± 1.2	F = 0.92	0.338

There were no differences observed in baseline characteristics and celeriac intake of children who were retained in the study and those who were lost to follow-up.

Appendix C12: Additional analysis based on eating category (study 2)

Additional statistical analysis based on eating category

As children were recruited using a cluster design, complex samples models in SPSS were used to take account of the clustering into nurseries. Intake data from both time points were positively skewed as many children ate none of the celeriac. Therefore, children were classified as 'eaters' if they consumed some celeriac following the intervention, and 'non-eaters' if they ate no celeriac after the intervention. A two-part statistical analysis was conducted in which a logistic regression analysis was used to examine what factors predicted intake of at least some of the celeriac (classed as "eaters"). In this analysis, factors such as congruency of intervention, sensory play, and their interaction with covariates of age in months and pre-intervention (baseline) consumption, were tested as predictors of classification as eaters or non-eaters. Next a general linear analysis was conducted to examine whether these same predictors (congruency, sensory play, their interaction) influenced intake by children within the eater category, controlling for age and baseline consumption. It is accepted that there are issues of regression to the mean, but there is no reason to think this will be differentially affected by the different conditions. In order to examine whether the intervention was effective specifically for those children who ate nothing at the baseline test (baseline non-eaters), a subgroup analysis was performed with 85 children who ate none of the celeriac at baseline. Again there may be a tendency for regression to the mean, but no reason to believe this would differ by condition. Therefore, it is useful to examine the effect of intervention on this subgroup.

Additional results based on eating category

The proportion of children categorized as eaters and non-eaters by intervention conditions at baseline and post intervention are shown in Table 4.2. The distribution of children by eating category at baseline was similar across the four conditions ($\chi^2(3) = 5.689$, $p = 0.434$). In the two incongruent storybook conditions the percentage of children who ate the celeriac was relatively constant from baseline (68%) to post-intervention (70%). In contrast, in the two congruent storybook conditions, the percentage of eaters increased from baseline (69%) to post-intervention (83%). The distribution of eater category post-intervention was different by condition assignment ($\chi^2(3) = 12.47$, $p = 0.003$).

Logistic regression analysis demonstrated that at post-intervention, children in the congruent storybook conditions were slightly more likely to be eaters than children in

the incongruent storybook conditions (OR 1.16, 95% CI 0.56-2.40; $\chi^2(1) = 16.60$, $p < 0.001$). It should be noted here that although the Wald test is highly significant, the OR crosses the null boundary, suggesting this should be interpreted with caution. The sensory play had no effect on whether children ate any celeriac (OR 0.78, 95% CI 0.38-1.57; $\chi^2(1) = 2.70$, $p = 0.1$). However, there was an interaction between storybook and sensory play such that children receiving the combined congruent storybook plus congruent sensory play condition were more likely to be eaters than any of the other conditions (OR 3.25, 95% CI 1.47-7.23; $\chi^2(1) = 9.45$, $p = 0.002$). These findings show that combining the storybook with congruent sensory play increased the likelihood of eating some celeriac.

A second analysis was conducted to examine what predicted intake post-intervention among eaters. The mean intakes ($\pm$ SD) in each condition were as follows: congruent storybook intake = 8.45 $\pm$ 10.53g; congruent storybook with congruent sensory play intake = 11.27 $\pm$ 14.63g; incongruent storybook intake = 10.79 $\pm$ 14.65g; incongruent storybook with incongruent sensory play intake = 9.31 $\pm$ 10.47g. There were no effects of congruency, or sensory play, or any interaction (largest $F = 1.76$, $p = 0.199$) on these intakes. However, there were effects of age ($b = 0.24$, $F(1,21) = 5.4$, $p = 0.03$) and of baseline intake ($b = 0.68$, $F(1,21) = 90.53$, $p < 0.001$). These findings suggest that those already willing to eat celeriac at baseline continued to do so at post-intervention and they tended to be older.

Subgroup analysis with baseline non-eaters

Among the 85 children who ate none of the celeriac at baseline, the percentage of those who ate something after the intervention was slightly higher in the congruent storybook conditions (59%) compared to incongruent storybook conditions (56%); (OR 1.45, 95% CI 0.61-3.45; $\chi^2(1) = 6.36$, $p = 0.012$). While the Wald test was significant, the OR included the null, so this should be interpreted with caution. However, children were more likely to be eaters at post-intervention if they had either type of sensory play (63%) compared to children who received the storybook only intervention (38%); (OR 2.28, 95% CI 1.09-4.72; $\chi^2(1) = 17.55$, $p < 0.001$). There was no interaction between congruency and sensory play on the likelihood of being an eater at post-intervention in this subgroup (OR 2.04, 95% CI 0.62-6.68; $\chi^2(1) = 1.58$, $p = 0.21$). This suggests that among the children who ate none of the celeriac at baseline, sensory play with either vegetables alongside storybooks was more effective in encouraging some intake than the storybooks alone.

Appendix C13: Research impact beyond the study

After the intervention was over there were some positive outcomes from the interventions which are worth mentioning here as this helps to understand impact of this type of intervention (beyond the research).

Impact on staff: One staff member from incongruent storybook plus incongruent sensory condition has stated in the feedback form that they have started to eat celeriac at home since the intervention (*"I myself (Anna) have been eating celeriac at home with family"*).

Impact at home: One parent who's child was in the congruent storybook plus congruent sensory condition wrote about their experience of when their child introduced them to the celeriac. It is worth noting that this child only increased her intake of celeriac from 0g at baseline to 5g at post-intervention which may suggest that the intervention effects were very small but beyond the study phase this child has demonstrated great transfer effects from preschool to home.

Email dated 11.01.2018

"Dear Chandani

I just wanted to write my experience of celeriac outside of preschool.

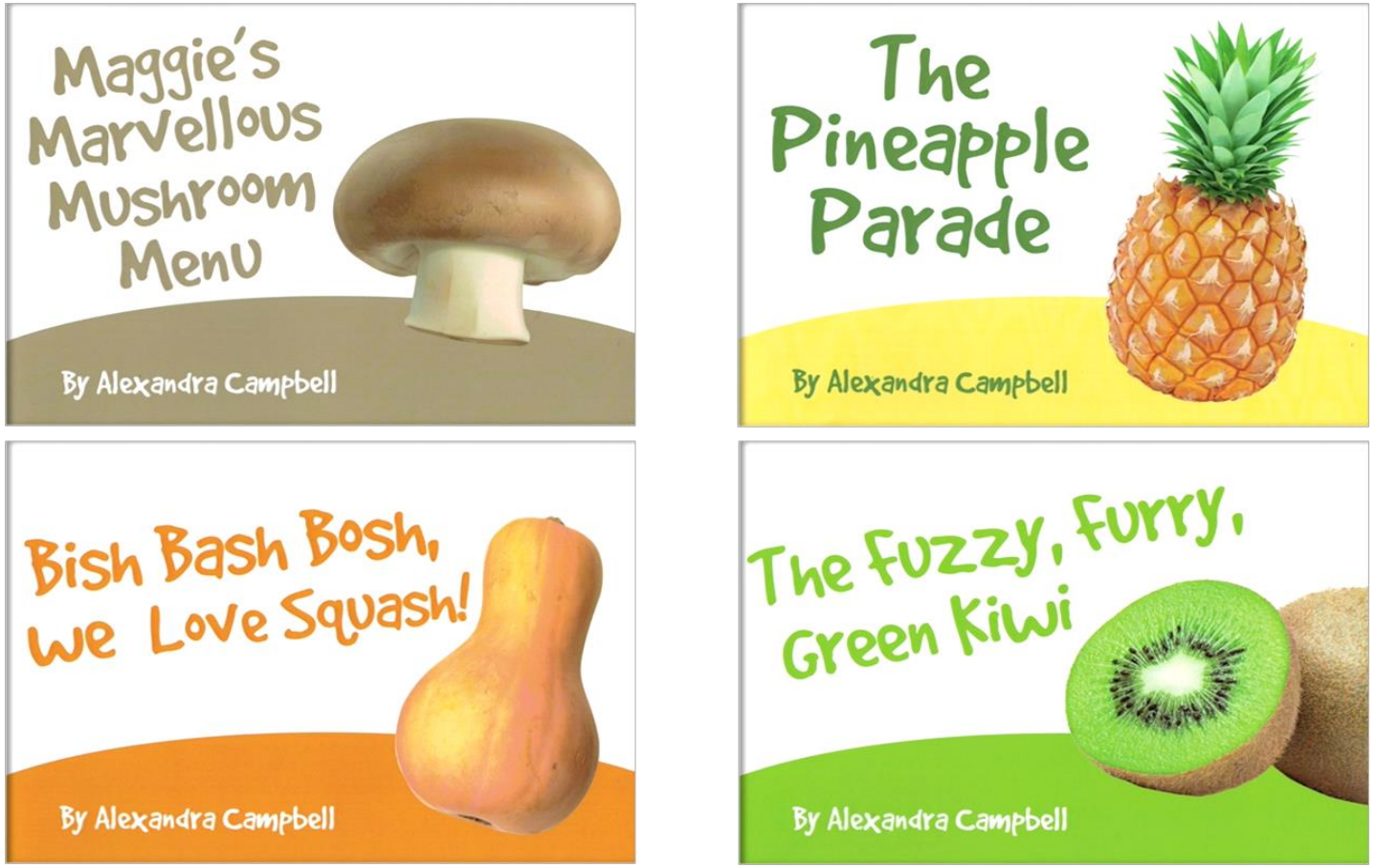
Since my daughter Mia (4) tried the celeriac in the Centre she has subsequently wanted to look for the vegetable at the supermarket. Mia found the vegetable and pointed it out to her sister Sophia (8). Having never had celeriac myself, I was reluctant to buy one as I didn't really know what to do with it! The second time we visited the supermarket Mia pointed it out again and said "shall we buy one" I agreed and it sat in the fridge for a few days! I made Gordon Ramsey's beef casserole (that actually has celeriac in the ingredients) and all the family including myself enjoyed it! I will certainly buy celeriac again!").

Thank you

Helen"

Impact in a nursery: One preschool classroom who were in the incongruent storybook only condition stated that they would include celeriac to their snack menu. They did some sensory activity with the children and made celeriac soup after the intervention was over. They also sent some pictures to the study team saying *"We made celeriac soup with the children . P.S It tasted amazing"*. See pictures below.

Appendix C14: Research impact – new addition to PhunkyFoods educational resources



As a direct result of the research PhunkyFoods has now published a series of picture books on vegetables (including the celeriac storybook) and fruits. The storybooks include recipes and ideas for sensory play.

Appendices D: Study 3

Appendix D1: Standards for Reporting Qualitative Research (SRQR) checklist

Standards for Reporting Qualitative Research (SRQR)*

http://www.equator-network.org/reporting-guidelines/srqr/

Title and abstract	**Section**
Title - Concise description of the nature and topic of the study Identifying the study as qualitative or indicating the approach (e.g., ethnography, grounded theory) or data collection methods (e.g., interview, focus group) is recommended	5
Abstract - Summary of key elements of the study using the abstract format of the intended publication; typically includes background, purpose, methods, results, and conclusions	--

Introduction

Problem formulation - Description and significance of the problem/phenomenon studied; review of relevant theory and empirical work; problem statement	5.2
Purpose or research question - Purpose of the study and specific objectives or questions	5.2.1

Methods

Qualitative approach and research paradigm - Qualitative approach (e.g., ethnography, grounded theory, case study, phenomenology, narrative research) and guiding theory if appropriate; identifying the research paradigm (e.g., postpositivist, constructivist/ interpretivist) is also recommended; rationale**	5.3.1
Researcher characteristics and reflexivity - Researchers' characteristics that may influence the research, including personal attributes, qualifications/experience, relationship with participants, assumptions, and/or presuppositions; potential or actual interaction between researchers' characteristics and the research questions, approach, methods, results, and/or transferability	5.3.2
Context - Setting/site and salient contextual factors; rationale**	5.3.4
Sampling strategy - How and why research participants, documents, or events were selected; criteria for deciding when no further sampling was necessary (e.g., sampling saturation); rationale**	5.3.4
Ethical issues pertaining to human subjects - Documentation of approval by an appropriate ethics review board and participant consent, or explanation for lack thereof; other confidentiality and data security issues	5.3.3

Data collection methods - Types of data collected; details of data collection procedures including (as appropriate) start and stop dates of data collection and analysis, iterative process, triangulation of sources/methods, and modification of procedures in response to evolving study findings; rationale**	5.3.5
Data collection instruments and technologies - Description of instruments (e.g., interview guides, questionnaires) and devices (e.g., audio recorders) used for data collection; if/how the instrument(s) changed over the course of the study	5.3.5.3
Units of study - Number and relevant characteristics of participants, documents, or events included in the study; level of participation (could be reported in results)	5.3.5.3
Data processing - Methods for processing data prior to and during analysis, including transcription, data entry, data management and security, verification of data integrity, data coding, and anonymization/de-identification of excerpts	5.3.6
Data analysis - Process by which inferences, themes, etc., were identified and developed, including the researchers involved in data analysis; usually references a specific paradigm or approach; rationale**	5.3.6
Techniques to enhance trustworthiness - Techniques to enhance trustworthiness and credibility of data analysis (e.g., member checking, audit trail, triangulation); rationale**	5.3.6

Results/findings

Synthesis and interpretation - Main findings (e.g., interpretations, inferences, and themes); might include development of a theory or model, or integration with prior research or theory	5.4.3
Links to empirical data - Evidence (e.g., quotes, field notes, text excerpts, photographs) to substantiate analytic findings	5.4.3

Discussion

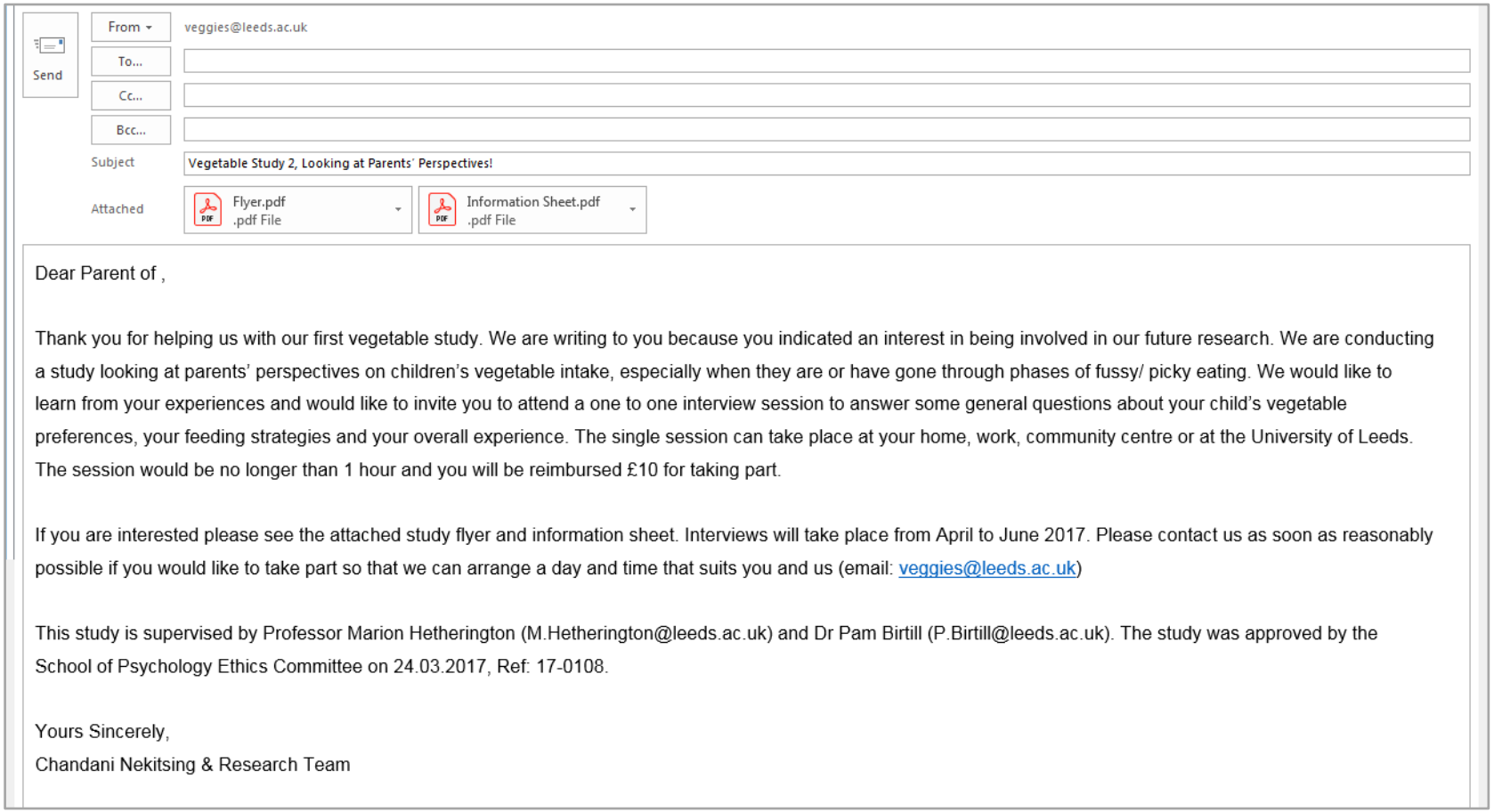
Integration with prior work, implications, transferability, and contribution(s) to the field - Short summary of main findings; explanation of how findings and conclusions connect to, support, elaborate on, or challenge conclusions of earlier scholarship; discussion of scope of application/generalizability; identification of unique contribution(s) to scholarship in a discipline or field	5.5
Limitations - Trustworthiness and limitations of findings	5.5.2

Other

Conflicts of interest - Potential sources of influence or perceived influence on study conduct and conclusions; how these were managed	NA
Funding - Sources of funding and other support; role of funders in data collection, interpretation, and reporting	Acknowledgment

Appendix D2: Study recruitment flyer (study 3)

Appendix D3: Recruitment email (study 3)



Send | From ▾ veggies@leeds.ac.uk | To... | Cc... | Bcc... | Subject: Vegetable Study 2, Looking at Parents' Perspectives! | Attached: Flyer.pdf .pdf File; Information Sheet.pdf .pdf File

Dear Parent of ,

Thank you for helping us with our first vegetable study. We are writing to you because you indicated an interest in being involved in our future research. We are conducting a study looking at parents' perspectives on children's vegetable intake, especially when they are or have gone through phases of fussy/ picky eating. We would like to learn from your experiences and would like to invite you to attend a one to one interview session to answer some general questions about your child's vegetable preferences, your feeding strategies and your overall experience. The single session can take place at your home, work, community centre or at the University of Leeds. The session would be no longer than 1 hour and you will be reimbursed £10 for taking part.

If you are interested please see the attached study flyer and information sheet. Interviews will take place from April to June 2017. Please contact us as soon as reasonably possible if you would like to take part so that we can arrange a day and time that suits you and us (email: veggies@leeds.ac.uk)

This study is supervised by Professor Marion Hetherington (M.Hetherington@leeds.ac.uk) and Dr Pam Birtill (P.Birtill@leeds.ac.uk). The study was approved by the School of Psychology Ethics Committee on 24.03.2017, Ref: 17-0108.

Yours Sincerely,
Chandani Nekitsing & Research Team

263 Appendices D: Study 3

Appendix D4: Participant information sheet (study 3)

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Invitation to take part in a research study

Parents' perspectives on their child's vegetable intake!

Dear Parent,

We would like to invite you to take part in our research study. Please read the following information carefully and feel free to ask us questions. We are a research team at the University of Leeds looking at ways to encourage young children to eat more vegetables. We are looking to parents whose children are between the ages of 2 and 5 years.

What's the purpose of our research?

The purpose of this research is to understand the best ways to encourage children to eat more of the vegetables that are liked and a wide range of vegetables, especially when they are going through phase of fussy/ picky eating. This is when children are more selective about the foods they eat and will refuse to eat certain foods which are familiar as well as unfamiliar to them.

Why have I been chosen?

You have been chosen as you have suggested during our previous research that you may be interested in a future study or you have shown interest to take part by responding to flyer advertisement.

What do I have to do?

The overall session will take between 45 minutes to an hour. If you could spare some time to talk to us then we would like to ask you some general questions about how you introduced vegetables to your children and how they responded to these, especially vegetables which are new or disliked. We are keen to learn more from your experience on ways you dealt with vegetable refusal. There will also be a short questionnaire to complete including general questions about your family and some specific questions about your child's eating.

When and where will the research take place?

The research interviews will take place from April to June 30th 2017. We will arrange a date and time that suits you and the research team member. The single session can take place at your home, work, community centre or at the University of Leeds. If you visit the university, you will be reimbursed for expenses incurred in travelling (we will reimburse reasonable expenses and will require proof e.g. train/bus tickets or petrol receipts).

Will I be recorded, and how will the recorded media be used?

We will record the interview using a voice recorder, these will be used only for analysis (typing up transcripts) and for conference presentations (anonymously). No other use will be made of them without your written permission, and no one outside the project will be allowed access to the original recordings. We may use direct quotations from your interview to publish in a journal paper, however this will be done in writing and anonymously so you will not be personally identified (e.g. participant 1 or mother/ father 1).

What if I do not want to take part?

Your participation is completely voluntary. Questions we will ask during the interview are general everyday questions and you should not experience any discomfort as a result of taking part. You can choose not to answer a particular question and you are free to withdraw at any point of the study. You also have the right to withdraw your data from the study at any time until 31 July 2017 and you are not required to explain your reason.

Are there any benefits/ risks for in taking part?

As a small thank you for your time, you will be offered £10 in cash. Your participation in this study would greatly help us to improve our understanding of ways of encouraging heathy eating in children. In future this may help other parents to understand what they can do to encourage their children to eat more vegetables. There are no risk identified for taking part in this research and you should not experience any distress. The primary investigator has obtained Disclosure and Barring Service check and is also a parent themselves.

Will data be confidential?

All information you provide to us is confidential and we will never share your personal details. All records will be kept in a safe locker at the university. The audio

recorded data will be stored on the computer which will be encrypted with a password and will only be accessible by the research team.

Where will the research go next!

Our research may show new strategies which parents and practitioners can employ to introduce vegetables to young children to improve their food preferences. Results from our study may be published in scientific journals or presented at a conference.

Who can I contact for details or if I am interested?

If you are interested in helping us with our research, please e-mail: veggies@leeds.ac.uk, or call 0113 343 8472 and we'll be in touch as soon as possible. If you agree to take part we will require you to sign a consent form during our meeting and you will be given a copy to keep for your record. Please safeguard this information sheet for future reference and feel free to contact our research team if you have any questions or would like further details of the study.

This study is supervised by Professor Marion Hetherington (email: M.Hetherington@leeds.ac.uk) and Dr Pam Birtill (P.Birtill@leeds.ac.uk) and has been approved by the School of Psychology Ethics committee (date approved: 24/03/2017; reference number: 17-0108)

We would like to thank you for reading this information sheet.

Yours Sincerely,

Chandani Nekitsing and the Research Team

Appendix D5: Participant opt-in consent form (Study 3)

UNIVERSITY OF LEEDS

Consent to take part in: Parents' perspectives on their child's vegetable intake	Add your initials
I confirm that I have read and understood the information sheet explaining the above research project and I have had the opportunity to ask questions about the project.	
I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason and without there being any negative consequences. In addition, I am free to decline to answer any questions. Please contact Chandani Nekitsing (veggies@leeds.ac.uk) by 31/07/2017 if you wish to withdraw information you have provided. After this date your interview will be transcribed and all identifying information replaced with a random ID. After this process of analysis we will no longer be able to remove your individual data.	
I give permission for members of the research team to have access to my anonymised responses. I understand that my name will not be linked with the research materials, and I will not be identified or identifiable in the report or reports that result from the research. I understand that my responses will be kept strictly confidential	
I agree for the data collected from me to be stored and used in relevant future research in an anonymised form.	
I understand that relevant sections of the data collected during the study, may be looked at by individuals from the University of Leeds or from regulatory authorities where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records.	
I give permission to audio record the interview. I understand that this will be transcribed anonymously and I cannot be identified. The records will be retained for up to 10 years.	
I agree to take part in the above research project and will inform the lead researcher should my contact details change.	

Name of participant	
Participant's signature	
Date (dd/mm/yyyy)	
Name of researcher	
Signature	
Date (dd/mm/yyyy)	

* Please keep this document safe for future reference. If you have any questions please contact Chandani Nekitsing, Dr Blundell-Birtill or Professor Hetherington; email: veggies@leeds.ac.uk or phone: 0113 3438472. Study approved by School of Psychology Ethics Committee, reference number: 17-0108; date approved: 24/03/2017.

Appendix D6: Semi-structured interview questions

A qualitative study of parents' perspectives on vegetable liking and intake in their food fussy children.

Thank you so much for giving me your time today. This session will last approximately 45 minutes. As I have mentioned earlier this audio recording will be only for our research purpose and the information you provide with not be shared with anyone. Talking to you will be really useful for us as we will learn more about techniques which parents use to encourage their children to eat vegetables; especially when they are going through period of food fussiness. During food fussiness phase children are more selective about what they eat; and are likely to refuse foods which are familiar and unfamiliar to them. Most children between the ages of 2 and 5 years will experience these behaviours at some point.

Just to reassure you I am a mum myself so I know how hard it can be to get your child to eat veg sometimes, please be as honest as you can be as this would really help us. Hopefully it will be nice for you too to share some of your experience. So, I am really interested in four broad areas; the first one is around your experience during the fussy eating phase and strategies you used during these time to encourage vegetable intake, followed by some general vegetable intake questions, the third area is around unfamiliar vegetable and finally how you dealt with vegetable refusals. If you do not understand a question, please feel free to ask for clarification. You will have the opportunity to ask questions at the end of the interview. So to start….

Opening questions

Please tell me little bit about yourself and what you do? *(e.g. Work)* ….

Tell me about your child *(nursery, what are they usually like)*….

Fussy eating

When I say the words "fussy eating" what do you think of? *(prompt: what comes to your mind)*

So would you say that your child has been fussy or picky eater at some-point? *(if they say no: was she/he ever choosey/ picky about what she/he wanted to eat)*

Around what age would you say they started being fussy?

I know it may be hard to remember, but what did your child do during these times and what did you do in response?

Which foods were your child fussy about and what about these foods they did not like? *(Prompt: is there any other foods / Prompt:* was it the texture, colour, taste*)*

Did they refuse new foods or foods they had already tried before?

How did you encourage your child to eat vegetables during this period? *(if vegetable is not what the child is fussy about then prompt with specified food)*

From the things that you tried with her/him, what strategies worked and what didn't work? e.g. rewarding them, hiding veg etc*... (prompt: or would you offer something else)*

Are there any circumstances under which your strategies would not work?

What was most challenging during this time? *(prompt: how you felt)*

Would you say fussiness and pickiness is still ongoing? *(If stopped: when did they stop being fussy, if they say improved now: then prompt with "how"?*)

(If more than one child) Have you noticed any difference in how fussy your children are about eating veg?

Is there anyone else in the family who is fussy about veg? Please tell me a little about them…

Vegetable intake

Brief: we are going to move on from fussy eating and talk a little about general vegetable intake.

So what sorts of vegetable do you generally eat in your households? *(ask for examples)*

Which vegetables does your child likes and eats…

When you visit supermarket, what helps you to decide which vegetables to buy? (*Prompt: so do you usually have a list or may be look for what's on special offer)*

What role does your child have in this decision?

Do you keep track of how much vegetables your child eats?

Do you offer vegetables to your child that you do not eat?

When do you generally offer vegetables? With meals? Which snacks? *(prompt: do you offer them raw e.g. salad, snack or cooked in curries, roasted, boiled)*

Do you think children young as 2 to 5 should be taught about eating vegetables?

What method of teaching would you suggest for this age group? *(prompt: cooking, smelling, cutting)*

Unfamiliar vegetables

Brief: we will now focus on some vegetables that are unfamiliar to your child, so these are the vegetables that your child does not eat very much of because it is new or they do not like to eat them.

Note: if they do not eat or even try unfamiliar vegetables, some of these questions should be altered to unfamiliar foods…

What sorts of vegetables do you not eat generally in your household?

Do you offer vegetables to your child which is new to them or they do not like?

Please tell me what sorts of vegetables you offer which are new or disliked….

How do you introduce these vegetables to your child? *(prompt: so do you offer with something they like, hide it, reward them)*

So when you offer something they don't like or new to them how does your child respond to these vegetables *(or other food)*?

How often (days/ weeks) and how many times would you offer a disliked or novel vegetable to your child before you decide to stop offering?

What do you about when you decide to stop offering certain vegetables?

(Prompt: cost, waste)

Vegetable refusal

Tell me about vegetables *(or foods)* which your child refuses to eat…. *(prompt: can you tell me little more about any particular vegetables)*

What do you do usually when your child refuses to eat their veg *(of other food)*?

Is this any different from refusing other foods?

Do you offer anything else when he/she refuses to eat their veg?

Closing questions

From your experience, what advice would you give to other parents on ways to get their children to eat vegetables when they are going through food fussiness?

Is there anything that you would do different now?

Would you like to share anything else about how to encourage children to a variety of vegetables or ways to deal with food fussiness?

Do you have any questions?

Thank you this is the end of the interview session

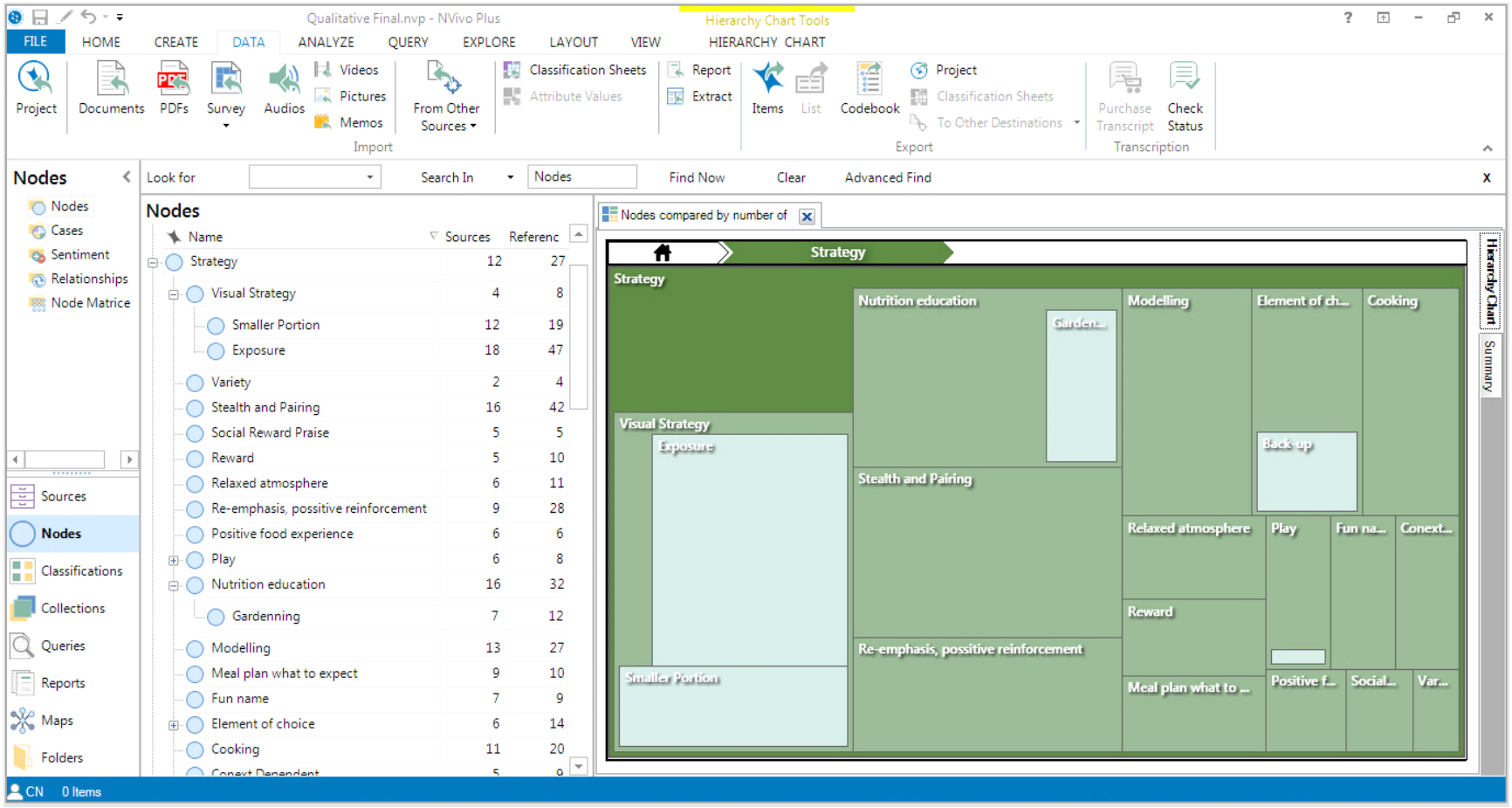
Prompts and probes will be used to encourage respondents to share more details or clarify what they have said (next page).

Probes

You may already feel that you have answered this….

Detailed oriented probes	Elaboration probes
When did this happen? How did you feel? What did you do? What else did you experience? Where were you? What was most challenging? How easy or difficult was that?	Please tell me more about that… Please give more details…. Give me another example… Please elaborate…. Please say more about this… What happened after that?
Clarification probes	**Silent probes**
What do you mean by….? Please give me an example… Repetition – so you said …..	Uh huh, silent nod, gentle smile or waiting with pause - to encourage participant to continue.

Appendix D7: Example of coding in the NVivo software



Research image (winner) presented at the Faculty of Medicine and Health Conference, Leeds, UK, 2018