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Role-Model, Reoffer, Reward: A Thematic Analysis and TDF Mapping of Influences on Families' Use of Evidence-Based Vegetable Feeding Practices

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Abstract

Children's vegetable intake is low, despite benefits for immediate and long-term health. Repeatedly reoffering vegetables, role-modelling consumption, and offering non-food rewards effectively increase children's vegetable acceptance and intake. However, a number of barriers prevent families from reoffering previously-rejected vegetables. This study used the Theoretical Domains Framework (TDF) and the COM-B model of behaviour to explore barriers and enablers to reoffering, role-modelling and offering non-food rewards among parents of 2-4-year-old children. Twenty-five semi-structured interviews were conducted, from which eleven core inductive themes were generated: 'Child factors', 'Eating beliefs', 'Effectiveness beliefs', 'Past experience', 'Current family behaviours', 'Harms', 'Knowledge', 'Need for change', 'Parent effort', 'Parent values' and 'Practical issues'. The codes underpinning these themes were inductively mapped to 11 of the 14 TDF domains, and five of the six COM-B components. Previously-reported influences on families' vegetable feeding practices were confirmed, including concerns about child rejection of foods/meals, cost of vegetables, and food waste. Novel findings included some parents' perceptions that these practices are pressurising, and that certain beliefs/knowledge about children's eating behaviour can provide a "protective mindset" that supports families' perseverance with reoffering over time. Future interventions should be tailored to better reflect the diversity of needs and previous experiences of feeding that families have, with some families likely to find that troubleshooting and further signposting is appropriate for their needs while others might benefit from more persuasive and educational approaches. The mapping of codes to the TDF and COM-B will facilitate the identification of appropriate intervention functions and behaviour change techniques when designing new interventions to support families with increasing their children's vegetable intake.

Keywords

Repeated exposure; role modelling; non-food reward; vegetable feeding; barriers; enablers; COM-B; TDF; Behaviour Change Wheel

1. Background

A higher intake of fruit and vegetables across the life course is associated with reduced risks of cancer, stroke and heart disease (e.g., Bazzano et al., 2002; Joshipura et al., 2001; Liu et al., 2000). For children, associated benefits include reduced constipation (Kranz et al., 2012) and reduced adiposity (Fletcher et al., 2017). In England, national guidelines recommend eating at least five portions of fruit and vegetables per day (NHS, 2022b), and evidence suggests there are further health benefits when people consume up to seven (Oyebode et al., 2014) or even ten portions a day (Aune et al., 2017). In practice, few people consume the recommended five-a-day including less than 25% of children (NHS Digital, 2021). This is a significant public health concern given that childhood eating behaviours tend to endure throughout life (e.g., Cusatis et al., 2000; Devine et al., 1998; Nicklaus et al., 2004; Woo et al., 2021).

Evidence suggests that vegetable consumption may be associated with greater health benefits than fruit intake (Joshipura et al., 2001; Oyebode et al., 2014). Nevertheless, vegetables are among children's least preferred foods (e.g., Cooke & Wardle, 2005; Ragelienė, 2021) and children's reluctance to eat them is a key barrier for caregivers trying to feed children a nutritious diet (Fulkerson et al., 2011; Holley, Farrow, et al., 2018). Children often start rejecting vegetables in early childhood, partially due to (i) an innate dislike of bitter or sour tastes, and (ii) a predisposition for rejecting new foods ("neophobia"), both thought to protect children from accidentally ingesting harmful substances as they grow in independence (Birch & Fisher, 1998; Cooke, 2007). Early childhood may therefore be a particularly fruitful time for interventions promoting vegetable acceptance, to ensure that vegetable rejection does not become a long-term behaviour.

Repeatedly reoffering vegetables to children over a number of occasions (or 'repeated exposure') successfully increases acceptance and liking of those vegetables (e.g., Holley et al., 2015, 2017; Wardle et al., 2003). It is important that children try these foods when they are offered (including licking, biting, chewing or consuming the food), as liking and acceptance may result from learning that these foods are safe and lead to positive consequences (e.g., fullness after eating; Cooke, 2007; Kalat & Rozin, 1973). A recent systematic review found positive effects of reoffering interventions that lasted between seven to 14 days (Holley et al., 2017a), broadly aligning with earlier evidence that five to ten exposures are required for acceptance (Birch et al., 1982, 1998).

Role-modelling is another effective feeding practice that is commonly used by families (e.g., Russell et al., 2018), whereby caregivers consume the target food in front of their child (Holley et al., 2015, 2017a; Palfreyman et al., 2015; Scaglioni et al., 2018). Modelling is thought to encourage vegetable intake through observational learning (Bandura, 1969) where behaviour is learned through observing people we identify with performing that behaviour and experiencing positive consequences (e.g., enjoyment). Using non-food rewards is another successful feeding practice that can be used alongside reoffering (Holley et al., 2015, 2017a). This promotes the development of positive associations between the disliked food and the reward via a process of conditioning (Cooke et al., 2011), with even small rewards such as stickers or games often having positive effects on children's eating behaviour (Remington et al., 2012).

Home-based interventions in which caregivers role-model, reoffer and/or offer rewards have shown some success in encouraging children to consume more vegetables (Holley et al., 2015) even when interventions are self-directed without any contact with researchers or healthcare professionals (Fildes et al., 2014). However, multiple barriers can prevent caregivers from reoffering vegetables, including limited awareness of the importance of reoffering vegetables, the financial cost of providing vegetables that might be rejected, concerns about food waste, the time and effort required to prepare vegetables, caregivers' own behaviours and preferences, concerns about children's negative emotional reactions (e.g., tantrums) and child temperament and stubbornness (Holley et al., 2017b). These barriers are significantly associated with lower reoffering (Holley, Farrow, et al., 2018). With this in mind, interventions to promote children's vegetable intake must be carefully designed to ensure that materials align with caregivers' needs and realities, to maximise intervention acceptability. Incorporating an understanding of behavioural influences into intervention design can also facilitate behaviour change, by ensuring that interventions target the appropriate factors to allow change to happen (Michie et al., 2014).

Using behaviour change frameworks such as the Theoretical Domains Framework (TDF; Atkins et al., 2017; Cane et al., 2012) and the Behaviour Change Wheel (Michie et al., 2011, 2014) can enable intervention developers to map behavioural influences to appropriate intervention functions and behaviour change techniques (BCTs; Carey et al., 2019; Michie et al., 2014) via probable mechanisms of action. The TDF synthesises 33 theories of behaviour change and 128 theoretical constructs into 14 theoretical domains that describe the mechanisms of action of behaviour change (Cane et al., 2012). In contrast, the Behaviour

Change Wheel contains a simplified, evidence-based and elegant model of behaviour (the Capability, Opportunity, Motivation model of behaviour, or COM-B) that describes the minimum number of factors needed for a behaviour to occur (Michie et al., 2011). The TDF domains can be mapped directly onto COM-B, and both can be used to categorise influences on a given behaviour to improve understanding of the contributing factors. Where COM-B provides a high-level overview of the factors influencing behaviour and whether they relate to individual capabilities and motivations or the opportunities available in the wider environment, the TDF provides more granular detail on the specific mechanism of action underpinning this. This then facilitates the mapping of influences to intervention functions and behaviour change techniques (BCTs) using the Behaviour Change Wheel and associated tools such as the Theory and Techniques Tool (Carey et al., 2019; Michie et al., 2013, 2014). This process aligns with UK Medical Research Council guidance that encourages intervention developers to consider the underlying theory driving change, and interactions between interventions and implementation contexts (Skivington et al., 2021).

While previous research has begun to explore the barriers experienced by caregivers when reoffering vegetables to young children, influences on caregivers' use of role-modelling and rewarding have not been confirmed. Identified barriers have also not yet been examined through the lens of the COM-B model that sits at the hub of the Behaviour Change Wheel and associated frameworks such as the TDF. Furthering our understanding of these factors is important for informing the development of effective, evidence-based public health interventions to support children's intake of vegetables. The aims of the current study were therefore to (1) explore caregivers' perspectives of the factors influencing their use of reoffering, role-modelling and rewarding as feeding practices to encourage pre-school children's vegetable consumption; and (2) to analyse these using the TDF and identify appropriate intervention functions and BCTs for targeting them.

2. Methods

2.1 Design

Semi-structured interviews with parents of children aged 2-4 years were conducted in March and April 2022. This study is reported using the 32-item checklist of the consolidated criteria for reporting qualitative research (COREQ-32; Tong et al., 2007).

2.2 Participants & Recruitment

Eligible participants were the primary caregivers (i.e., parents and guardians) of children aged 2-5 years. Eligible caregivers were (i) aged 18 years or over; (ii) able to understand the study information and materials; (iii) fluent English speakers or accompanied by a fluent English speaker as interpreter; and (iv) the caregiver primarily responsible for providing their children's meals and snacks outside of school/nursery. Only those who reported experiencing difficulties getting their children to eat vegetables in the demographic questionnaire (see below), and/or that their child consumed three portions or fewer of vegetables per day, were invited to interview.

Twenty-five participants were recruited by approaching caregivers at (eight) toddler groups[1] in Loughborough and London, UK , and online via Facebook groups for caregivers living in those areas. The number of parents declining to participate upon being approached was not recorded. As research typically over-represents white, university-educated and financially well-off groups (Henrich et al., 2010; Roberts et al., 2020), recruitment was targeted towards toddler groups and social media platforms that served areas with higher levels of socioeconomic deprivation and/or greater ethnic diversity, with an aim to recruit a representative sample of the UK, including participants from all main ethnicity categories recorded in the UK census (Race Disparity Unit, 2021) and living in postcodes across the full range of Index of Multiple Deprivation (IMD) deciles. While some have previously suggested using a sample size of 10 (plus a stopping criterion of three, based on achievement of data saturation) for qualitative research (Francis et al., 2010), Braun and Clarke have more recently emphasised the need to base sample size decisions on interpretative and pragmatic judgements that consider, among other issues, diversity of the sample, pragmatic constraints of the project and the depth of data generated from each participant (Braun & Clarke, 2021). Following this guidance, a sample size of 25 was planned and later deemed to be sufficient at analysis based on perceived data saturation and the achieved diversity of the sample.

2.3 Measures

2.3.1 Demographic Questionnaire

2.3.1.1 Demographic information. Questions captured caregiver age, gender, ethnicity, highest obtained education level, child age in months, child gender and child

[1] Toddler groups are informal programmes organised within the community (e.g., by churches, children's centres and other community venues), providing facilities for children to play, and an opportunity for parents and caregivers to socialise. They are sometimes provided free of charge but may request a small fee to cover the costs of refreshments and room hire.

ethnicity. Participants reported whether they were the caregiver who provided most of the child's meals and snacks outside of school and nursery. Home postcode was requested for calculating the Index of Multiple Deprivation (Ministry of Housing, Communities & Local Government, 2019) for the participant's home area.

2.3.1.2 Subjective Social Status. Participants were also asked to rate their Subjective Social Status (Adler et al., 2000) on a scale from one (representing people with the least in society, for example the least money, least education and least respected jobs) to 10 (representing people with the most in society, for example the most money, most education and most respected jobs). A pictorial image of a ladder with the number "1" on the bottom rung and "10" on the top rung was provided to aid comprehension. Previous work has confirmed construct validity of the scale (Cundiff et al., 2013), and a recent meta-analysis confirmed a positive association between subjective social status and health outcomes, even when controlling for objective measures of socioeconomic status (Zell et al., 2018).

2.3.1.3 Children's Eating Behaviour. Caregivers reported if they had difficulty getting their child to eat vegetables (never, occasionally, often or always), and completed the food fussiness subscale of the Children's Eating Behaviour Questionnaire (six items, e.g., *"My child decides that they don't like a food even without tasting it"*; Wardle et al., 2001). Finally, a brief Food Frequency Questionnaire assessed the number of portions children and caregivers consumed per week of (i) raw vegetables (e.g., carrot sticks, celery); (ii) cooked vegetables (including sweet potato but not potato); and (iii) salad (e.g., tomatoes, lettuce). This vegetable-specific Food Frequency Questionnaire was used by Holley, Farrow, et al., (2018); Holley, Haycraft, et al., (2018), adapted from the measure originally used by Wardle et al., (2003).

2.3.2 Interview Topic Guide

The full interview topic guide is included in Supplementary File 1, and was designed to explore influences on the three target behaviours of (i) reoffering, (ii) role-modelling, and (iii) rewarding to encourage children's vegetable consumption. Questions explored caregivers' current feeding practices (e.g., "*If your child refuses to eat vegetables, what do you do?*"), and caregivers' views about the target feeding practices (e.g., "*What do you think about reoffering children vegetables they have previously refused on a different day or at a different meal or snack time?*"). Prompts encouraged caregivers to think about the barriers or enablers that might influence their use of these practices (e.g., "*What would stop you from*

doing this?"). Additional questions explored caregivers' ideas and needs for a digital resource to support them with vegetable feeding but are not reported in this paper.

2.4 Procedure

Caregivers gave written informed consent to participate and completed the demographic questionnaire. Eligible caregivers were invited to book an interview. Interviews were offered as a video call (Skype or Teams), phone call, or in-person interview. Twenty-four participants chose to participate by phone and one via Teams audio call. The interviewer (LP) is a white female who holds a PhD in Psychology and was a post-doctoral research associate without experience of parenthood at the time this study was conducted. LP has previous experience conducting qualitative research with caregivers of young children (including focus groups and interviews) for both research and public consultation purposes. Participants had been informed prior to the interviews that the goal of the study was to understand families' needs and experiences of vegetable feeding so that the research team could develop a new digital intervention. No prior relationship existed between LP and any of the participants. Children were not involved in the interviews, however some participants' children were in the room with them during interviews. Each interview lasted between 25 and 74 minutes (M = 45 minutes). Interviews began with a reminder that participants had the right to withdraw at any time or skip any questions they did not wish to answer. All interviews were audio recorded and subsequently transcribed verbatim. No repeat interviews were conducted, and no field notes were recorded.

2.5 Ethical Considerations

Ethical approval for the project was granted by the Loughborough University Ethics Review Sub-Committee (project ID: 10644). All recordings were destroyed after transcription. Any identifiable details such as the names of places or people were removed from transcripts.

2.6 Data Analysis

Demographic questionnaire responses were summarised using descriptive statistics. Responses to the Food Frequency Questionnaire were converted into daily vegetable portion scores by summing all categories and dividing weekly scores by seven. A thematic analysis was conducted in NVivo (version released March 2020) using an inductive, realist approach, with codes and themes generated at the semantic (or surface) level (Braun & Clarke, 2006). LP coded interviews for influences on caregivers' use of the three target behaviours

(reoffering, role-modelling, rewarding). While no particular theoretical framework was used at this stage of the analysis, LP has previous experience of using the Theoretical Domains Framework to analyse interview data, and it is likely that this prior knowledge will have influenced the analytical process. Codes were organised separately for each target behaviour. The themes developed for the first behaviour analysed (reoffering) were perceived to align well with the codes for the other behaviours, and so the same themes were used to group codes for all three behaviours. LP and CH met to discuss codes and themes, and collaboratively developed subthemes. An external researcher (CM) second coded 10% of the transcripts by assigning highlighted text excerpts to the theme list generated by the research team. Any discrepancies were resolved through discussion, and LP updated the theme list and theme descriptions to reflect the changes.

2.6.1 Behaviour Change Wheel mapping

LP mapped all codes on to the Theoretical Domains Framework version 2 (Cane et al., 2012), limiting each code to one domain only. AMC reviewed and confirmed all code-domain mappings, and provided feedback on possible alternative code-domain mappings where relevant. These possible alternatives were discussed and finalised between both authors, and LP updated the mapping record accordingly. As the thematic analysis was completed prior to and separately from the Behaviour Change Wheel mapping, it was possible for themes to be associated with multiple TDF domains (i.e., because they contained codes mapped to different domains). Domains were mapped to potentially appropriate intervention functions using Table 2.2 from the Behaviour Change Wheel guidebook, which presents the links between the TDF domains and intervention functions, as determined by expert consensus (Michie et al., 2014) and to BCTs using the Theory and Techniques Tool, which presents the links between the TDF domains and BCTs (Johnston et al., 2021; Carey et al., 2019). As the TDF mapping is a prescriptive process whereby the TDF is mapped directly onto COM-B, the intervention functions listed in the Behaviour Change Wheel, and the BCTs listed in the Theory and Techniques Tool, only one researcher (LP) undertook these mapping exercises. An overview of the analytic process is represented in Figure 1 below.

[INSERT FIGURE 1]

Figure 1: Graphic representation of distinction between thematic analysis and Behaviour Change Wheel mapping.

LP and CH then collaboratively assessed each of the potentially appropriate intervention functions against the APEASE criteria (Acceptability, Practicability, Effectiveness, Affordability, Side Effects and Equity; Michie et al., 2014). These assessments were reviewed separately by AMC. Note that decisions regarding Practicability and Affordability were made in the context of the current research programme, and different intervention development teams may come to different conclusions regarding these criteria depending on available resources. Next, BCTs identified as potentially appropriate in the mapping exercise were linked to their relevant intervention functions using Worksheet 7 in the Behaviour Change Wheel guide (Michie et al., 2014; again, this is a prescriptive process with BCTs mapping directly onto intervention functions, and so this was conducted by LP only). Only those BCTs that were linked to APEASE-approved intervention functions were retained. In order to ensure their suitability for implementation, and to attenuate the potential disconnect between data and BCT mapping, these were mapped to interview quotes by LP and CH, with AMC reviewing all BCT-quote mappings. BCTs with no perceived match to interview data were not included in recommendations. Both the full list (all intervention functions/BCTs identified in the initial stages of the mapping exercise) and the reduced recommendations list (those matched to APEASE-approved intervention functions and interview data) are included in Supplementary File 4.

3. Results

3.1 Participants

Twenty-five caregivers (all parents; one male) aged 25-42 years (M = 33.36, SD = 4.72) were interviewed (two parents did not report their age). All of the main ethnicity categories in the UK were represented in the sample (see Table 1). The total proportion of White participants (60%) was slightly lower than the proportion in the general population (86%; Office for National Statistics, 2018). The proportion of all other ethnicity categories either matched or exceeded the proportion in the general population. Just over half of parents reported that they had been educated to Bachelors degree or Masters degree level (n = 14; 52%; Table 1). Both subjective social status and home postcode IMD ranged between 2 and 9 (see Table 1). Fifteen parents (60%) discussed their first child in interviews. Children's ages ranged between 22 and 62 months (M = 35.96, SD = 11.79) and children were predominantly male (n = 17; 68%). Seven parents (28%) reported that they "always" had difficulty getting their child to eat vegetables, 13 (52%) reported this occurred "often" and five (20%) reported this

294 occurred “occasionally”. Parents reported that their children ate between 0.00 and 2.71
295 portions of vegetables per day (*M* =0.94, *SD* = 0.91), and that they themselves consumed
296 between 0.21 and 12 portions per day (*M* = 2.79, *SD* = 2.52). Supplementary File 2 provides
297 full details on sample characteristics.

Table 1: Frequencies (n, %) of sample characteristics

Ethnicity			Parent Education		Subjective Social Status		IMD decile from home postcode	
	Parent	Child						
Asian/Asian British	2 (8%)	2 (8%)	None of these	1 (4%)	9-10	1 (4%)	9-10	4 (16%)
Black British/ Black African/ Black Caribbean	3 (12%)	3 (12%)	GCSEs or equivalent	3 (12%)	7-8	8 (32%)	7-8	1 (4%)
White British	11 (44%)	12 (48%)	A Levels or equivalent	4 (16%)	5-6	11 (44%)	5-6	8 (32%)
Another White Background	4 (16%)	2 (8%)	Foundation degree or equivalent	3 (12%)	3-4	2 (8%)	3-4	5 (20%)
Mixed/ Multiple Ethnicity	3 (12%)	5 (20%)	Bachelors degree or equivalent	9 (36%)	1-2	1 (4%)	1-2	6 (24%)
Another Ethnic Group	2 (8%)	1 (4%)	Masters degree or equivalent	5 (20%)	Not given	2 (8%)	Not given	1 (4%)

Note: Subjective Social Status ranges from 1 (low subjective status) to 10 (high). IMD = Index of Multiple Deprivation, with deciles ranging from 1 (most deprived) to 10 (least deprived).

3.2 Influences on the Target Behaviours

In total, 11 themes were generated: *'Child factors', 'Eating beliefs', 'Effectiveness beliefs', 'Past experience', 'Current family behaviours', 'Harms', 'Knowledge', 'Need for change', 'Parent effort', 'Parent values' and 'Practical issues'* (see Figure 2). Themes and subthemes are discussed for all three target behaviours combined, with any differences between feeding

practices highlighted. Supplementary File 3 provides a full breakdown of which themes and subthemes linked to which behaviours, alongside example codes.

3.2.1 Theme 1: Child factors

Parents reported a number of factors attributable to their children that influenced their vegetable feeding practices. The subtheme ***"Child temperament"*** affected all three target behaviours (reoffering, role-modelling and rewarding). Children's growing autonomy and independence left some parents feeling that efforts to reoffer or role-model would be ineffective: *"I mean I have an incredibly strong-willed three-year-old! […] if she's refusing, there's not that much I can do"*. Parents also reported poor attention and behaviour at mealtimes as barriers to role-modelling, and some children's lack of responsiveness to rewards in general was a barrier to rewarding. As well as fixed temperament, the three feeding practices were also influenced by parents' ongoing judgements of children's moods ***"In the moment"***, with some taking "*every meal as it comes*".

The subtheme "***Children's food preferences***" positively and negatively affected reoffering and rewarding only. Believing that children didn't actively dislike a vegetable (e.g., because the child had only left it on the plate but not spat it out), encouraged reoffering and rewarding. However, perceiving that children "*visibly*" disliked a vegetable discouraged reoffering. Relatedly, expectations of "***Children's emotional reactions***" towards disliked vegetables prevented reoffering or role-modelling to avoid child distress, fights, or negative reactions in public. One participant said of reoffering: "*Persistently saying, no, you've got to try it, you've got to eat it […] I don't like doing that, because I don't want him to be too upset*", indicating that reoffering may be conflated with pressuring children. Conversely, one parent reported that negative emotional reactions were not an issue: "*It doesn't matter if she's sad for a bit, it's OK, just get over it!*".

"***Concerns about children not eating***" prevented reoffering only, including beliefs that children would reject whole meals or leave the table when vegetables were served. "***Safety concerns***" influenced judgements about which vegetables to reoffer, with parents saying they would not reoffer a vegetable their child had previously had an allergic reaction to or choked on. Finally, "***Child age***" was predominantly discussed as a barrier to rewarding, with younger children perceived as unable to delay gratification, or recognise links between eating a vegetable and receiving a reward: "*I don't see [her] you know even understanding that concept that if she ate something she could then get a sticker, I don't think she would be*

fussed by that, she'd just want the stickers and then it would all end up in chaos". One parent suggested that child age could be a barrier to role-modelling, due to it being "*much easier to kind of get that kind of dialogue with a five-year-old than it is with a two-year-old really*".

3.2.2 Theme 2: Eating beliefs

Wider beliefs about the development of children's eating behaviour influenced reoffering only. Beliefs that "***Food preferences are developmental***" and that children's preferences change over time independently of parental action could sometimes encourage reoffering: "*Tastes change […] so I still expect them to try it every now and then to see if they would enjoy it again*". However, participants often believed that these changes only happened over the long-term, which prevented reoffering repeatedly within short windows, with parents instead waiting until children were older. Beliefs about the child-friendliness of different vegetables also influenced reoffering decisions: "*If he will eat the sweeter vegetables, the ones that are more common for kids, I think that maybe I will introduce the ones that are not so common".* On the other hand, "***Protective beliefs and attitudes***" encouraged reoffering and alleviated concerns about children's vegetable intake. These included the attitude that even very gradual progress towards trying a vegetable is important, and the knowledge that it is normal for children to suddenly start rejecting vegetables.

3.2.3 Theme 3: Effectiveness beliefs

"***Positive effectiveness beliefs***" were reported for all three feeding practices, including general beliefs that they would encourage vegetable intake as well as specific anticipated benefits, such as reoffering helping vegetables to become familiar and normalised, role-modelling helping children to learn positive messages about vegetables, and rewarding helping to increase children's motivation to try vegetables. Positive effectiveness beliefs were not always tied to current behaviour, for example: "*I don't persevere to the length of keep doing it, going yummy, yummy, yummy. But yeah, if I tried harder on my part, he would be more influenced to do it.*"

"***Negative effectiveness beliefs***" were not reported for reoffering. Some parents believed that role-modelling would not influence their children: "*It would just be like, oh right, cool, good for you!*". A couple of parents believed that role-modelling would only be effective with peer (not parental) role-models. For rewarding, some participants believed that children were only responsive to high fat/salt/sugar food rewards (not the recommended non-food rewards), that rewards would not persuade their child to try disliked vegetables, that rewards would lose

their appeal over time, and that vegetable intake would not continue once reward systems were removed: "*You're going to have to phase it out at some point because it's not … it's not … you can't do that until your child's eighteen*".

3.2.4 Theme 4: Past experience

Whereas "effectiveness beliefs" reflected more hypothetical beliefs about the feeding practices, this theme captures concrete reports of past experiences. Some participants reported past successes with the three feeding practices. These successes most often related to children accepting the offered vegetable, but sometimes referred to parents' own behaviour having been influenced by reoffering or role-modelling in their lifetime: "*I don't know if it was Jamie Oliver or something, the way he was just eating them on the show, I was like, gosh, these mangetout must be really good, I have to try it again!*". Parents also reported positive spill-over effects, such as siblings being influenced by role-modelling. However other participants reported having tried the practices to no avail, for example: "*…if you offered this food fifteen, twenty times then the child should … would be more likely to have it […] why is that not working for me? I don't know why or what, or, is it, what am I doing wrong?*". For rewarding, some participants reported that their child would suddenly change their mind and say that they didn't want that particular reward if they learned that it was contingent on them trying a vegetable.

3.2.5 Theme 5: Current family behaviours

Pre-existing family behaviours and routines affected reoffering and role-modelling only. When these went "***Against the grain***" this was mostly due to participants not eating (certain) vegetables themselves, which affected reoffering intentions due to it being "*a bit hypocritical if you're trying to make your child eat something that you won't eat*", and preventing role-modelling. Some parents reported simply being out of the habit of buying certain vegetables: "*I don't mind [asparagus] and I definitely would eat it, but I think it's just your habits of what you usually buy*". For role-modelling only, different mealtimes was reported as a barrier, with children tending to eat earlier in the day. "***Aligning well***" referred to families already regularly eating vegetables (meaning they were available for reoffering) or eating together and talking about the food they eat (meaning that role-modelling was already happening naturally at mealtimes).

3.2.6 Theme 6: Potential Harms

Some participants believed that unintended negative consequences could arise from reoffering or rewarding, for example that reoffering a rejected vegetable too soon and in a pressurised manner could cement children's dislike: "*If someone forces you to keep having something that you don't like at the same age, you'll always think you don't like it before you really have a chance to decide if you like it!*". For rewarding, some participants reported concerns that children would come to rely on rewards and have "*the expectation that he would have that every time"*. A few participants also reported a concern that rewards would *"create a bad relationship with food later on in life*".

3.2.7 Theme 7: Lack of Knowledge

A few participants reported not having been aware of the practices or not having thought to try them before; this was mainly the case for role-modelling and rewarding, however one parent reported not having been aware of reoffering as an effective practice until they spoke to a fellow parent after noticing that their child was less willing to eat vegetables than other children. One parent specifically highlighted low awareness of the evidence that rewarding is effective: "*Maybe if I see like more reports, like more evidence of it actually working… I haven't seen any evidence or any reports*".

3.2.8 Theme 8: Need for Change

Participants reported various motivations for encouraging their children to eat more vegetables, primarily related to reoffering. Parents' "***Eating goals***" for their children included desires for children to eat a healthy diet, develop a good relationship with food and avoid the same fussy eating habits as their parents/carers: "*My children's dad, he's always … he's been a fussy eater forever, and that was a real battle for me, like when we were raising them together, I was like, what approaches … what approach works, you know?*". "***Health needs***" that motivated parents to reoffer vegetables included concerns about both the long-term and immediate impacts of not eating enough vegetables (e.g., constipation). One parent described not wanting their child to have the same weight issues that they had experienced growing up, and that they wanted their child to "*learn to appreciate that sometimes we don't eat for taste, we eat for our health*". Alternatively, some participants described a lack of urgency due to feeling that their children's nutritional needs were met through other foods in their diet. Interestingly, one parent specifically described how lower urgency allowed them to encourage vegetable intake through reoffering (which was seen as a slower process) whereas

immediate nutritional needs, such as anaemia, would have led to other practices such as hiding vegetables in meals.

Finally, "***Social needs***" referred primarily to desires for children to eat vegetables in different social environments such as school lunches, birthday parties and family mealtimes. For family mealtimes, this was mostly to facilitate mealtime preparation for parents, however for out-of-home environments, the wellbeing and social functioning of the children was of concern: "*He's going to be in environments where he'll have to navigate that himself […] as he grows older, he's going to find it quite limiting*". One parent mentioned that their desire for their child to be a good role model in front of their siblings was a motivating factor in their decision to use rewards. Finally, one parent described how social comparisons with other children influenced their level of concern for their child's vegetable intake: "*Some children eat nothing, she does eat quite a lot. Whereas my oldest daughter doesn't eat any vegetables, like she is a complete salad dodger to be honest […] So yeah, at the moment I'm not too worried about the littlest one*".

3.2.9 Theme 9: Parent Effort

Parents' internal states could prevent reoffering, role-modelling and rewarding. Participants reported that continuing to reoffer over time "*takes a lot of patience… which is not always available*", with some reporting that the difficulty of getting their child to eat vegetables led to them feeling like giving up: "*Sometimes I kind of go, oh what's the point and just give up on all that*". Similarly for role-modelling, one parent reported that repeatedly showing enthusiasm for the target food is tiring for caregivers, with another reporting that mealtimes were a rare opportunity for them to relax. For rewarding, a couple of parents noted that implementing reward schedules over time was effortful.

3.2.10 Theme 10: Parent Values

Participants' wider values and mindsets influenced perceptions of the feeding practices. Regarding "***Compatibility with parent mindset***", some felt that reoffering was compatible with the values of avoiding force and pressure, and of giving children choice over what they eat: "*My duty is to provide her with the healthy meal, it's her choice if she chooses to eat it or not*". Others equated reoffering with forcing their children to eat: "*If I feel like he doesn't enjoy that, I don't like to force it too much on him*". For role-modelling, some participants reported that in their family, meals were for relaxing and socialising rather than focusing on encouraging children to eat vegetables. The issue of pressure arose again: "*I would feel it was*

more pressurising … look, look, you know mummy and daddy are eating it, look, look, look … kind of be a bit more focus on them, I try and take the focus away". One parent appeared to be referring specifically to the suggestion in the interview question that role-modelling could include a vocal element (e.g., saying "this is really yummy"), as although they described role-modelling as pressurising they also reported that they ate vegetables in front of their children without drawing attention to it. Others reported that they could role-model without "*push[ing] it*".

For rewarding, some participants felt that rewards were not appropriate for encouraging eating behaviour, and that they created pressure and stress for children. Participants also reported wanting their children to learn to eat vegetables for enjoyment or for health, rather than for rewards: "*I just don't feel like children need to … you know, to be rewarded for eating something that's good for them. They should kind of want to … to just enjoy you know, enjoy the food that they're eating*". Participants also described reoffering and role-modelling as part of "***The role of parents***", for example: "*You should show a good example, you know, yourself. There's absolutely no point putting vegetables on a child's plate if you've then got like fish fingers and chips*". One parent specifically referred to the duty of parents to reduce childhood obesity rates, alongside the government and schools.

3.2.11 Theme 11: Practical Issues

This theme refers to influences arising from participants' social and physical environments. Participants discussed a lack of "***Resources***" including the time to prepare and cook vegetables or fit role-modelling into mealtimes, the cost of vegetables that children wouldn't eat (and associated food waste concerns), and the cost of rewards themselves. One participant described how the facilities in their accommodation prevented them from cooking and storing vegetables: "*She would love roast vegetables, if I could make up a big tray of roast vegetables, she would eat them all, but I don't have an oven. [...]I've got a very small fridge and a cupboard for food storage, there's not really any space to store food, you know, I can't buy things in bulk*". On the flipside, the availability of vegetables in the local environment (e.g., at a restaurant salad bar or in the shops) enabled reoffering. A few parents discussed the influence of "***Support***"; one referred to the positive influence of another family member who had an interest in diet and health, whereas a couple of participants described how a lack of support prevented reoffering and role-modelling: "*[My child] was born at the beginning of the pandemic and there is … there is no one that could help me and … with how to start to*

feed him, present with food, solid food, and I didn't know what to do in that moment". "***Consistency***" affected rewarding only, with participants reporting that it would be difficult to consistently maintain a reward system over frequent eating occasions, across multiple settings, and with different members of the family. One parent reported that it would be difficult to implement a consistent reward scheme while being fair to siblings with different starting points. Finally, "***What to use***" also affected rewarding only, with some participants reporting that they couldn't identify any appropriate non-food rewards that weren't already freely given: "*So I mean I couldn't really use [stickers] as a reward because I wouldn't want to take away such a lovely pleasure that he's into at the moment, this kind of artistic, sticking them on our floor pleasure!*". Others reported having something they could easily use as a reward, such as stars on a star chart as a facilitator.

3.3 Behaviour Change Wheel mapping

Mapping the codes from the thematic analysis against the TDF resulted in 11 of the 14 TDF domains being identified as central to parents' use of the three target behaviours: (i) beliefs about consequences, (ii) social influences, (iii) knowledge, (iv) reinforcement, (v) behavioural regulation (vi) environmental context & resources, (vii) goals, (viii) memory/attention/decision processes, (ix) intentions, (x) social/professional role and identity, and (xi) beliefs about capabilities (the three TDF domains that were not identified as central were skills, optimism and emotion). The most commonly mapped domains were beliefs about consequences (46% of all codes; COM-B motivation) followed by "social influences" and "environmental context and resources" (both 8% of all codes; both COM-B opportunity). These 11 domains mapped to five out of six of the components of COM-B (all except physical capability; see Figure 2). Supplementary File 3 provides further detail on the links between codes, themes, TDF domains and COM-B components.

[INSERT FIGURE 2]

The initial stages of the mapping exercise suggested that all nine intervention functions contained in the Behaviour Change Wheel (i.e., education, persuasion, modelling, training, enablement, environmental restructuring, incentivisation, restriction and punishment) could potentially be used to target the relevant domains in interventions. Of these, four intervention functions ("education", "persuasion", "modelling", "enablement") passed the APEASE criteria for the current project, and a further two ("training", "environmental restructuring") were considered suitable on all criteria except practicability and affordability. As these

criteria were assessed against the resources available to the current research team only, they should therefore still be considered by other intervention developers, resulting in a final total of six APEASE-approved intervention functions to recommend (see Supplementary File 4).

The initial stages of the mapping exercise also indicated that 57 BCTs (out of the 74 listed in the Theory and Techniques Tool) could potentially be used to target the relevant domains in interventions. Of these, 23 were judged as suitable for inclusion in interventions (i.e., because they were linked to at least one APEASE-approved intervention function and considered to be a match for interview data) and are therefore recommended here. A further 24 potentially relevant BCTs were linked to APEASE-approved intervention functions but were not considered a match for interview data, and the remaining 10 BCTs were not linked to APEASE-approved intervention functions or considered a match for interview data. Supplementary file 4 contains tables of the 23 BCTs recommended for intervention (alongside information on the APEASE-approved intervention functions they link to, and illustrative interview quotes) as well as the remaining 34 BCTs that were judged not to be suitable for inclusion.

4. Discussion

This study set out to explore behavioural influences on caregivers' vegetable feeding practices and was the first to explore influences on families' use of reoffering, role-modelling and rewards and identify potential intervention strategies through the lens of behaviour change frameworks (the Theoretical Domains Framework, COM-B and Behaviour Change Wheel). Eleven themes were generated to describe the barriers and enablers to families' use of reoffering, role-modelling and rewarding, which have been shown to successfully increase children's vegetable intake when used in combination (e.g., Holley et al., 2015). These themes were: *'Child factors', 'Eating beliefs', 'Effectiveness beliefs', 'Past experience', 'Current family behaviours', 'Harms', 'Knowledge', 'Need for change', 'Parent effort', 'Parent values' and 'Practical issues'*. A list of potential intervention functions and behaviour change techniques (BCTs) was created by mapping the codes within these themes to COM-B and the Theoretical Domains Framework, and subsequently mapping these to the intervention functions of the Behaviour Change Wheel (Michie et al., 2014) and the BCTs in the Theory and Techniques Tool (Carey et al., 2019; see Supplementary File 4). Such mapping exercises are important as designing interventions to include theoretically relevant intervention functions and BCTs can increase the potential for interventions to target the

relevant drivers of behaviour (Michie et al., 2014). While the initial mapping exercise suggested that all nine intervention functions contained within the Behaviour Change Wheel, and 57 BCTs from the Theory and Techniques Tool could be considered for inclusion in interventions, assessing these against the APEASE criteria (Michie et al., 2014) and parents' interview data resulted in a reduced list of six intervention functions ("education", "persuasion", "training", "enablement", "modelling" and "environmental restructuring") and 23 BCTs being considered appropriate for implementation. The full list of intervention functions and BCTs is presented in supplementary materials, alongside information on the APEASE assessments.

Many of our findings support and extend previous research on influences on parents' and caregivers' feeding practices, however a number of novel barriers and enablers were also identified in this study. Firstly, whether parents perceived the feeding practices as aligning with their wider values around parenting was crucial. While some parents felt that the three practices were compatible with respecting children's choice over what to eat, others interpreted the practices as pressurising children and potentially interfering with the development of a healthy relationship with food. Such interpretations of the feeding practices may also have influenced parents' concerns around potential harms, such as the belief that reoffering could cement children's dislike of a food.

This indicates that interventions need to clearly communicate how to reoffer, role-model and reward while avoiding placing any kind of pressure on children, as well as advising families on how to flexibly adapt the practices to best suit their family. This could maximise family engagement with these feeding practices while also avoiding the negative unintended consequences that can arise from pressurising feeding practices, such as reduced acceptance of vegetables (Blissett, 2011; Fisher et al., 2002). The APEASE-approved intervention functions "education", "training" and "modelling" could be used to overcome these barriers, using BCTs such as "instruction on how to perform the behaviour" and "demonstration of the behaviour". For example, written information, instructional videos or workshops could be used to increase parents' knowledge and skills in this area, and to provide practical tips and examples of how to encourage children to eat vegetables without using pressure. Interventions could also seek to change parents' perceptions of individual vegetables using "education" and "persuasion", to overcome barriers related to perceptions that certain vegetables are more or less appropriate for children, which impacted reported intentions of

reoffering them (e.g., sweeter vegetables such as carrots and peas versus those with more bitter flavours such as cabbage and sprouts).

Next, the present findings suggest that parents' perceived level of urgency for increasing their child's vegetable intake may not always consistently predict their engagement with reoffering. While many parents reported a strong need for change as a motivation for reoffering, one parent reported that it was actually a lower sense of urgency regarding their child's nutritional needs (i.e., compared to another child with anaemia) that enabled them to engage in reoffering, which was seen to work slowly over time compared to other practices such as hiding vegetables in meals (which can increase immediate intake but is unlikely to increase vegetable acceptance in the long-term; Pescud & Pettigrew, 2014). It should be emphasised that this latter finding came from one parent only, and that lower urgency was not conducive to reoffering among those who reported lower concern about their child's vegetable intake due to social comparisons with other children who ate fewer vegetables. Indeed, other researchers have found that downward social comparisons can be used as justifications for families' provision of less healthy diets (Damen et al., 2019; Duncanson et al., 2013). However, this one parent's response can also be interpreted in light of another novel finding from the current study: that having a protective mindset can enable families' use of reoffering. In this study, families reported particular beliefs and knowledge about the development of children's eating behaviour (such as knowing that vegetable rejection is normal and accepting that progress may be gradual) that enabled them to remain calm and to continue with their reoffering efforts.

These findings align well with protection motivation theory, whereby a high level of health concern can lead to maladaptive coping responses unless self-efficacy is also high (Norman et al., 2015; Rippetoe & Rogers, 1987). Interventions targeting families' feeding practices will need to strike a careful balance between helping families recognise the importance of using reoffering, role-modelling and rewarding to increase their children's vegetable intake where appropriate, whilst avoiding causing anxiety and distress that may negatively impact parents' wellbeing and lead to the use of counterproductive feeding practices. For this, the intervention functions "education" and "enablement", and the BCT "reduce negative emotions" could be considered (e.g., supporting parents to recognise that it is normal for children to reject vegetables) as well as the BCTs of "problem solving" and "action planning" to help build self-efficacy and support parents to take action,

While the importance of effectiveness beliefs and past experiences have been reported elsewhere (Beltran et al., 2022), a distinction was made in the current analysis between parents whose beliefs were based on past experiences and those who had not yet tried the practices. Our findings suggest that interventions will need to be tailored to suit individual families' needs and experiences; while the intervention function "persuasion" (e.g., communicating evidence of effectiveness) could encourage families who have not yet tried the practices and/or are unaware of them (as in the "lack of knowledge" theme), such an approach could alienate families with past experience of trying them without success, which parents reported often resulted in frustration; a finding which has also been reported elsewhere (e.g., Duncanson et al., 2013). Instead, the intervention function of "enablement" may be more appropriate in these circumstances, through BCTs such as "social support" and "problem solving" (e.g., providing advice for troubleshooting the implementation of such feeding practices, or signposting to further feeding support).

This study confirmed the influence of a number of child factors on parents' feeding decisions including temperament, mood and developmental stage (Beltran et al., 2022), as well as food preferences and dislikes (Duncanson et al., 2013; Ventura et al., 2010). Parents in the current study reported offering foods that are already liked to avoid food waste, negative emotional reactions and fights (Holley et al., 2017b; Nepper & Chai, 2016; Ventura et al., 2010) and preferred to provide previously-accepted vegetables when trying new feeding practices, rather than offering novel or disliked vegetables (Beltran et al., 2022). Focusing on increasing intake of these "quick win" vegetables may help to improve parents' confidence in the target feeding practices while reducing the likelihood of food waste and negative child reactions, especially given the importance of past experiences identified in the current study. However, interventions may also need to encourage parents to offer novel or disliked vegetables too, particularly considering some parents' beliefs that the development of children's tastes over time would lead to vegetable acceptance without parental intervention, as reported here. Such beliefs could be targeted in interventions using "education" and "persuasion" approaches.

This study also confirmed the importance of practical issues such as the affordability of vegetables, associated concerns about food waste when those foods are rejected, and lack of time to prepare healthy food (e.g., Damen et al., 2019; Holley et al., 2017b). The intervention functions "environmental restructuring" and "enablement" could be used to target some of these barriers, alongside BCTs such as "adding objects to the environment". For example, providing families with vegetables to reoffer their children (e.g., through family services and

school-based programmes) could help to alleviate financial concerns regarding the cost of vegetables and the potential waste of them. The study also confirmed that the extent that feeding practices align with families' current behaviours (e.g., daily schedules, parents' own vegetable intake) influences the likelihood of adopting them, building on previous findings that feeding practices are affected by existing routines (Beltran et al., 2022) and parents' own likes and dislikes (Duncanson et al., 2013). In these instances, further interventions may be needed to focus on a wider set of family behaviours (e.g., caregivers' own consumption of vegetables).

While separate analyses for each target behaviour were originally planned in line with Behaviour Change Wheel guidance (Michie et al., 2014), it was subsequently judged that the themes developed for the first behaviour analysed (reoffering) were a good fit for the remaining behaviours (role-modelling and rewarding). There are a number of possible reasons for this alignment; firstly, awareness of these themes may have encouraged perceptions of the same patterns in the data in the subsequent analyses. Secondly, as reoffering was discussed first in all interviews, it is possible that parents' responses to reoffering influenced their responses when discussing the remaining behaviours. However, it is also worth noting that reoffering, role-modelling and rewarding are highly interlinked behaviours (for example, a vegetable must be reoffered if it is to be rewarded) and so it is unsurprising that the factors influencing use of one of these feeding practices would also influence their use of another.

Despite the similarities, unique influences were found for each of the target behaviours. For example, only reoffering was associated with concerns around children rejecting entire meals when vegetables were provided. Unique barriers for rewarding included beliefs that rewards would lead to an unhealthy relationship with food, perceptions that younger children would not understand reward systems, and anticipated difficulties with implementing reward systems consistently and fairly over time. While reoffering and role-modelling were seen to fit in well with some families' existing habits (i.e., because there were already plenty of vegetables available, or because families already ate together), rewarding was not described as aligning with existing routines by any participants (although it is possible that rewarding could align with routines where families are already offering rewards for other behaviours such as toilet training). This suggests that for those families who are already frequently purchasing and consuming vegetables, reoffering and role-modelling could be easily

integrated into practice, but that change may be more effortful for families who are not already purchasing and consuming vegetables.

For the TDF mapping exercise, "beliefs about consequences" (COM-B motivation) was the domain with the greatest number of code mappings (46% of all codes), followed by "social influences" and "environmental context and resources" (both 8% of all codes, both COM-B opportunity). The theme map also shows that many themes and subthemes contained codes mapped to domains associated with motivation (six out of 11 identified domains). This dominance of motivation is unsurprising given that the TDF contains more motivation-related domains than opportunity or capability-related domains (Michie et al., 2014). The COM-B model also emphasises that both capability and opportunity influence motivation (Michie et al., 2011), meaning that interventions targeting motivation should also consider the influence of people's wider abilities and environments.

Furthermore, while our analysis mapped fewer codes to other domains, this does not necessarily indicate that these domains are comparatively insignificant, and overall, our findings suggest that domains across capability, opportunity and motivation are relevant for the target behaviours of role-modelling, reoffering and rewarding, This supports previous calls for behaviour change interventions to target a wider range of influences than knowledge (capability) and motivation (Marteau et al., 2012), and suggests that interventions must also enable families to use effective vegetable-feeding practices with their children either by directly tackling barriers of opportunity in their social and physical environments, or by providing families with the tools to navigate them. This is supported by the outcomes of the Behaviour Change Wheel mapping exercise, which indicated that intervention functions such as "enablement" and "environmental restructuring" may be needed alongside intervention functions such as "training", "modelling", "persuasion" and "education". Supplementary file 4 provides additional detail on the 23 BCTs that could be used to deliver these functions, to tackle the wide range of barriers discussed above.

The ethnic and socioeconomic diversity of the sample is a strength of this study, with only the White ethnicity category (which has typically been overrepresented in research; Roberts et al., 2020) being underrepresented compared to the national population. Another key strength is the use of an established behaviour change framework to explore barriers and enablers to behaviour, and to link behavioural influences to potential intervention functions and BCTs. This is important as there is currently a clear gap for interventions that support

families to reoffer, role-model and reward; at the time of writing, national guidance for weaning and feeding advises reoffering and role-modelling for introducing new foods to babies, and role-modelling for overcoming fussy eating, among other tips (NHS, 2022a). However, specific instructions for how to reoffer effectively (e.g., how to avoid pressure or persuasion) are not provided, and no consideration is made for families managing tight budgets or wishing to reduce food waste. Furthermore, families are not provided with any tools or support to enable their use of these feeding practices and using rewards is not currently mentioned in any national guidance (except in advice to avoid giving food rewards).

One limitation of this study is that parents who participated were likely to be those with greater awareness and motivation to increase their children's vegetable intake, due to the need for active engagement with the research process. While efforts were made to recruit a diverse and representative sample, it is possible that families facing the greatest barriers to vegetable feeding were not included in this research. Individual-level intervention approaches that require families to actively engage with them may widen health inequalities (Adams et al., 2016) by disproportionately benefiting those who have the required resources and who are motivated and able to respond to advice. Another limitation is that most participants were mothers, with only one father participating. While mothers still tend to take on the role of primary caregiver most often, fathers and other family members (e.g., grandparents) also increasingly take on this role, and it is possible that unique barriers may be experienced by these different caregivers.

To conclude, this is the first study to use the Theoretical Domains Framework and the Behaviour Change Wheel to assess and categorise influences on parents' use of reoffering, role-modelling and rewarding as feeding practices to encourage children's vegetable intake. These findings confirm the barriers and enablers reported in past research and, importantly, identify further novel barriers previously unreported. The intervention functions and BCTs elicited in this study can be used to build and evaluate interventions to effectively support families in using these practices, with the aim of ultimately increasing children's vegetable intake.

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Author contributions

LP: methodology, investigation, data curation, formal analysis, writing – original draft; AMC: funding acquisition, conceptualisation, methodology, formal analysis, writing – review & editing; EH: funding acquisition, conceptualisation, methodology, writing – review & editing; CF: funding acquisition, conceptualisation, methodology, writing – review & editing; CEH: funding acquisition, conceptualisation, project management, methodology, formal analysis, writing – review & editing. All authors have approved the final article.

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Declaration of Interests

No interests to declare.

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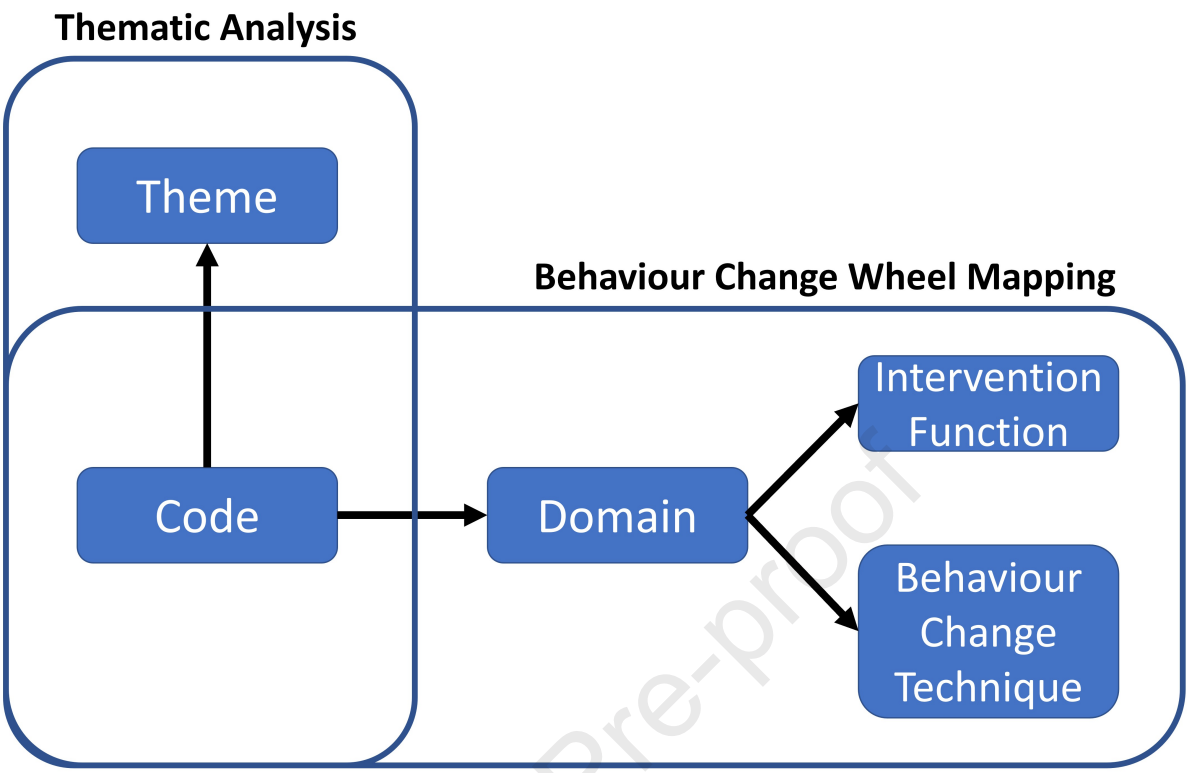

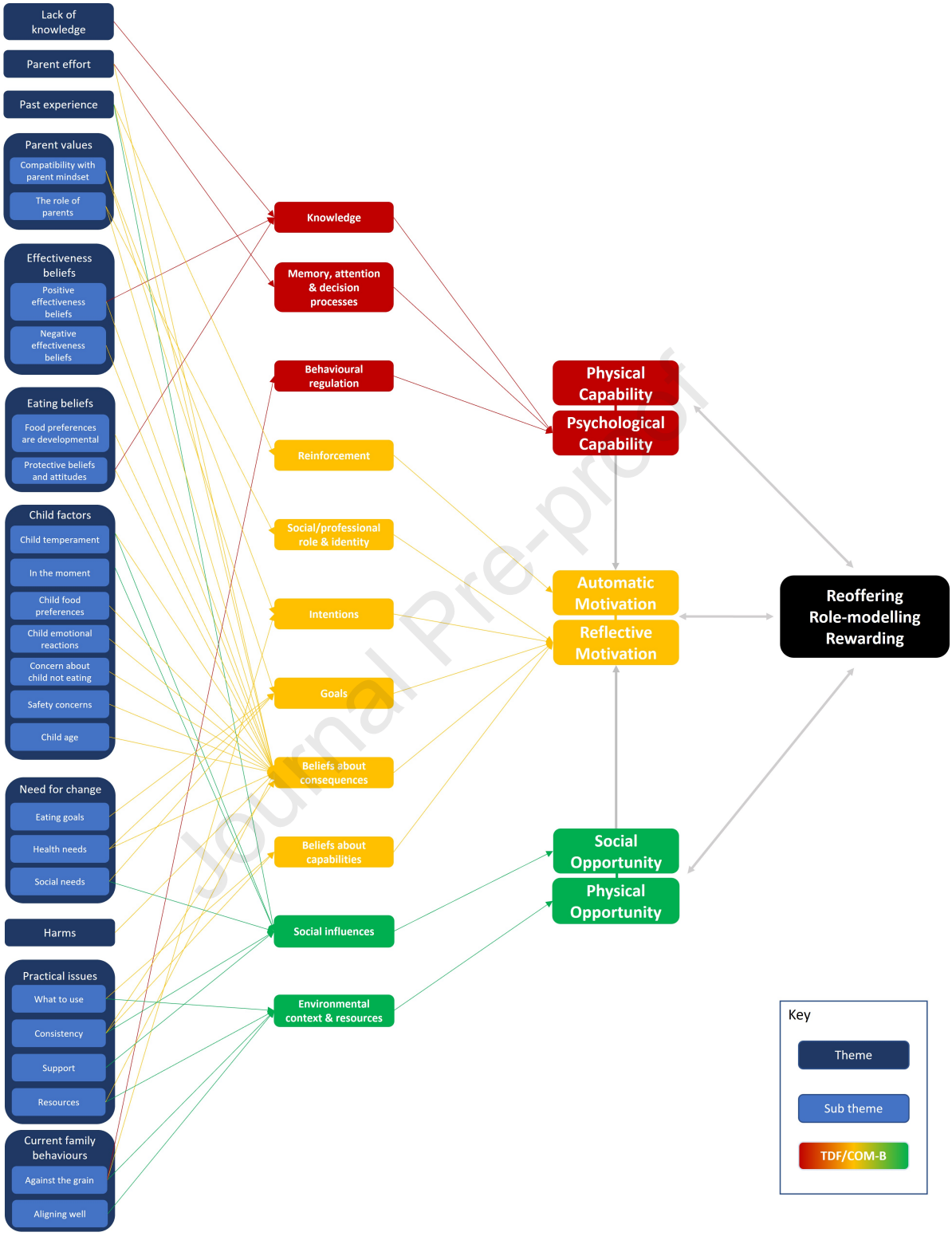

Ethical Considerations

Ethical approval for the project was granted by the Loughborough University Ethics Review Sub-Committee (project ID: 10644). Participants gave informed consent before participating. All recordings were destroyed after transcription. Any identifiable details such as the names of places or people were removed from transcripts.

Declaration of Interests

No interests to declare.