



Capabilities, opportunities and motivations that drive food waste disposal practices: A case study of young adults in England

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ABSTRACT

Data in England suggests that food waste is still being disposed into the black bin, also known as residual waste, despite continuous efforts to promote separate food waste collection and food waste reduction practices. Furthermore, it has been anecdotally reported that 18 to 30-year-olds have the highest propensity to generate large amounts of food waste and thus need to be urgently engaged in communication that helps them change their behaviour. This study aims to explore young adults' capabilities (C), opportunities (O), and motivations (M) that may lead to a certain behaviour (B) towards food waste disposal practices (FWDP) grounded on the Behaviour Change Wheel, also called the COM-B model, and could reveal barriers to action. In doing so, a case study approach is used via Harrow Council residents in England within the age group of 18–30 years old. The study took place amid the national lockdown due to the Covid-19 pandemic and targeted young residents within the 18–30 age group using a structured interview approach with a diagnostic questionnaire promoted through Harrow Council's social media account, followed by in-depth interviews with eligible participants. Out of the 30 residents who completed the diagnostic questionnaire, 35% reported no FWDP, 42% partial FWDP (i.e., some incorrect items in the black bin waste), and 23% reported engaging in FWDP. The first two groups only were invited to the online interviews. The interview results are organised using the COM-B model and reveal that: 1) due to Covid-19 there was a shift to home cooking and increased food waste generation (B); 2) there is a lack of FWDP knowledge, information on benefits, and advice on alleviating pests/health concerns from councils, whereas FWDP differences between councils and reliance on 'common sense' often create confusion around FWDP (C); 3) the council may not always provide a caddy or a drop-off/collection service, whereas economic (caddy liners purchase) and logistic concerns (e.g., the lack of a regular collection schedule, unfavourable features of the caddy, and lack of prompts/reminders) resulted to limited uptake of FWDP as the norm (O); 4) the benefits of FWDP do not outweigh costs, while feelings of disgust and a sense of inconvenience lead to lack of or partial FWDP (M). To our knowledge, this is the first study using the COM-B model within the context of FWDP and with a specific focus on young adults in England. Novel theoretical and practical insights are discussed, along with limitations and future research directions.

1. Introduction

Food waste generation has been gaining increasing attention in research, policy and practice due to the ever-increasing multidimensional impacts, which span over technical, economic, environmental, social and political domains, accrued from its management (Patel et al., 2021; Gustavsson et al., 2011; Parfit et al., 2010). The economic value loss of food waste is in the order of billions of pounds annually, and greenhouse gas (GHG) emissions, nutrient and water loss (e.g.,

estimated at around 6.2 billion cm³ of water consumed per year for producing food that is then thrown away), are amongst the key environmental impacts associated with food wastage (Russell et al., 2017; Schmidt, 2016; Kummur et al., 2012; Chapagain and James, 2011).

Several studies concluded that in developed countries the food waste produced at the household level constitutes the majority of waste generated in the entire food value chain (Qvested et al., 2013; Graham-Rowe et al., 2015; Prizzeau et al., 2015; Priefer et al., 2016; Stenmarck et al., 2016; Reynolds et al., 2019; Soma et al., 2020). In the UK,

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household food waste constitutes 70% of the total amount of food waste generated in the UK post-farm gate which is around 9.5 million tonnes (Mt) (Facchini et al., 2018; WRAP, 2020a). A fraction of this wastage costs the average UK family an estimated £720 a year in terms of food thrown away that could have been eaten (i.e. £60 per month; WRAP, 2021a). Additionally, food waste is largely mismanaged in the UK, with large amounts being disposed to landfills contributing to negative environmental impacts (Themelis and Ulloa, 2007). In England, there are efforts to divert food waste from landfills through its separate collection and management in composting and anaerobic digestion facilities so that nutrients and other valuable by-products (e.g. biogas in anaerobic digestion systems) can be better recovered. In spite of these efforts, food waste is still being disposed into the black bin, also known as the residual waste stream (Johnson, 2020), largely due to human behaviour.

In Harrow Council, one of the most diverse boroughs in London in terms of ethnicities and religions (Harrow Council, 2018), even though there is a separate collection of food waste that is managed in anaerobic digestion facilities (Manika et al., 2021a), the vast majority of people still dispose of their food waste in the residual waste stream (Johnson, 2020) causing multiple negative multi-dimensional (i.e., environmental, economic, social and technical). Furthermore, the cost of digesting food waste is notably lower than the cost of managing residual waste via incineration with energy recovery (Johnson, 2020). Diverting food waste from the residual waste stream has the potential to contribute to less GHG emissions, generate value from food waste in the form of a nutrient-rich fertiliser, and biogas that can be used for electricity and heat production, and save the council money that could be used for other purposes, e.g., benefiting the residents of the council (social value); while also contributing to nationwide efforts towards the UN's Sustainable Development Goal 12 of "halving food waste by 2030" (United Nations, 2015). Therefore, there is an urgent need to understand the factors associated with food waste production and disposal to reduce wastage and improve its disposal practices in order to allow its better management.

Given the importance of positive behaviour change within households, there is an obvious need for research to identify the main factors that motivate and enable, or prevent, household food waste minimisation behaviour, and its proper disposal. To date, there is little research that has directly addressed factors that influence food waste and its disposal at household level. For example, the theory of planned behaviour has been employed to investigate consumer behaviour towards food waste, with several authors arguing that situational factors and cultural and social norms can explain to some extent the intention, and hence, participation to separate food waste collection (Parfit et al., 2010; Graham-Rowe et al., 2015; Roodhuyzen et al., 2017; Soma et al., 2020; Knussen and Yule, 2008). This research aims to contribute to this knowledge gap, by using Harrow Council as a case study to understand why food waste is still being produced at large and most importantly why food waste it still being disposed into the residual waste stream despite the existence of a separate food waste collection scheme in Harrow Council (Johnson, 2020) and to suggest solutions for positive change in Food Waste Disposal Practices (FWDP).

In addition, this study focuses on 18-30 year-old Harrow Council residents only. Food waste studies show that this age group has a higher tendency to generate food waste (WRAP, 2020b; Pincipato et al., 2015). To provide a context, "a national supermarket study of the food waste patterns of 5050 UK consumers ... revealed that nearly two-fifths of those aged over 65 said that they never waste food, compared with just 17% of those under 35" (Smithers, 2017). Harrow Council also considers the 18-30 year-old age group to require the most attention, as they tend to live in shared accommodation and flats (Johnson, 2020); and the average resident age in Harrow Council is 38.3 years old (Manika et al., 2021a). Also, compared to other London boroughs, Harrow Council does not collect some food waste items (e.g., meat, fish, milk, juice; see Manika et al., 2021a for a comparison of Harrow Council and other

London boroughs in terms of food waste items collected and demographics), which may create confusion or lead to incorrect FWDP for young residents who often move across London boroughs. The literature also concurred that this demographic is an appropriate target group for interventions due to their lifestyle and potential receptivity to behaviour change, but research on FWDP of 18–30 year old residents is scant.

Hence, the novelty of this study is three-fold: 1) We used a case study approach of a London borough, focused on a unique target audience, that being 18–30 year old residents who require the most attention in terms of changing FWDP; as discussed above. 2) We tried to understand FWDP during the Covid-19 pandemic, which changed daily routines with people working largely from home and in turn, affecting household food waste and related behaviours (Babbitt et al., 2021; Principato et al., 2020; Roe et al., 2021). This is particularly relevant for the scope of this study, as the household is a point where an important fraction of food is wasted, and a point where waste reduction can create the greatest economic benefit (ReFED, 2016). 3) We theoretically advance literature and contribute to practice on food waste disposal by grounding our approach on the Behaviour Change Wheel (Michie et al., 2011). This theory (also called the COM-B model) was utilised in this study to explore 18-30 year old residents' capabilities (C), opportunities (O), and motivations (M) that may lead to FWDP [i.e., the behaviour (B)], and related barriers to action; in Harrow Council during the Covid-19 pandemic. Pro-environmental literature grounded on the COM-B model has been scarce (Manika et al., 2021c). The COM-B model is one of the most recent behaviour change theories developed, with many advantages, such as its parsimonious nature, ease of use for behaviour change initiatives, applicability and efficacy across a range of contexts (Michie et al., 2011). To our knowledge, this is the first study using this theory within the context of FWDP and with a specific focus on young adults in England; providing evidence of its theoretical applicability within the scarce pro-environmental behaviour change literature to date and offering valuable practical insights.

Section 2 summarises the current theoretical underpinnings on FWDP in UK households, followed by an overview of the COM-B model and our research questions. Section 3 presents the methodology employed, followed by the presentation and discussion of key findings in Section 4 and Section 5, respectively. Section 6 elaborates on key theoretical and practical implications, limitations and future research directions.

2. Literature review

2.1. Food waste disposal practices in UK households

Household food waste has been the focal topic of every food waste reduction campaign in the UK as it represents the largest fraction of food waste generated annually (Facchini et al., 2018). Food waste collection and reduction initiatives across the UK have been increasingly promoted to instigate change, including financial incentives, regulatory policies and raising awareness campaigns, with varying levels of success (Schanes et al., 2018). For example in 2018, the UK reduced 17% of household food waste compared to the levels produced in 2007 (WRAP, 2021a) as a result of the government funded campaign "Love Food, Hate Waste", which gained increased traction across the UK, and was described as "the most successful food waste awareness campaign in Europe" (Schanes et al., 2018). Nonetheless, there is still progress needed to bring the current 4.5 Mt of edible food that is wasted annually in the UK households to zero (WRAP, 2021a).

Food waste collection and reduction campaigns seek to encourage and motivate people to engage in responsible behaviour. Prior research has shown that busy lifestyles, lack of planning, lack of skills, impulse purchases, over-purchasing, poor storage management, confusion about expiry/use by dates, as well as cooking too much food and lack of creativity in using perfectly edible food leftover (Fabian Society, 2012; Priefer et al., 2016; Makov et al., 2020; Patel et al., 2021) affect food

waste generation rates. Notably, the major factors that could contribute to behaviour change and positively influence people to reduce their food waste are those linked to economic and institutional dimensions, such as seeing food waste as a waste of money and thus making an effort to consume food rather than dispose of it, or feeling guilty of generating and throwing away food (Quested et al., 2013; Schmidt, 2016; Russell et al., 2017). Surprisingly, environmental concerns, or most commonly referred to as ‘pro-environmental behaviour’, is not amongst the strongest factors that influence behaviour change in the kitchen and food handling and wastage in particular (Quested et al., 2013). This could be due to the general lack of knowledge about the social and environmental consequences of food waste (Schanes et al., 2018) and its improper management and their responsibility towards it (Quested et al., 2011, 2013; Reynolds et al., 2019; Patel et al., 2021).

Therefore, researchers have suggested that a broad communication campaign for every household, coupled with educational programmes, can encourage householders to practice food waste reduction and separation (Refsgaard and Magnussen, 2009; Limon and Villarino, 2020). Awareness campaigns targeting households concentrate on reducing the discarding of food items that some households consider inedible by some people (Moreno et al., 2020). Those that engage in food waste reduction schemes seemed to be driven by financial benefits, such as saving money from unused food and the pay-as-you-throw scheme, instead of driven by environmental concerns (WRAP, 2014; Neff et al., 2015; Blichfeldt et al., 2015; Tucker and Farrelly, 2015). Another key factor seems to be convenience, where facilities play a vital role in motivating people to change their practices (Schanes et al., 2018). People are often willing to change their routines if they do not require too many resources and have sufficient information and opportunities (van Geffen et al., 2020; Refsgaard and Magnussen, 2009; Limon and Villarino, 2020). Furthermore, people who feel agreeable to reducing household food waste feel the pressure others imposed on their food waste reduction behaviour and feel confident in believing their ability to reduce household food waste were more likely to increase household food waste reduction intention (Lin and Guan, 2021).

The outbreak of the Covid-19 pandemic in 2020, has brought changes in food purchases and consumption, and consequently on food waste generation rates. Recent studies suggests that there was an increase in the quantities of food purchased, but not necessarily on the food waste generated. This could be due to the fact that increase in food purchases was in non-perishable food items fuelled by fears of disruptions in the food supply chain due to lockdown restrictions (Pappalardo et al., 2020; WRAP, 2021b; Burlea-Schiopoiu et al., 2021). Additionally, the reduction in food waste could also be due to the introduction of good planning and management measures (Principato et al., 2020), as people ate more at home, had more time to plan cooking and were more aware of their purchases and impact on their income, which many UK households was severely affected. The Waste and Resources Action Programme (WRAP) carried out a comprehensive series of four UK-wide surveys – in April, May, September and November 2020 – to understand how it had affected citizens’ food habits, behaviours and attitudes towards food. The 4000+ independent samples revealed that there was a 59% increase in food purchases across the samples, and a decrease in the reported levels of food being wasted to an average of 22% below pre-lockdown levels (WRAP, 2021b). However, much still remains to be done to meet the UN’s Sustainable Development Goal 12, Target 12.3 (United Nations, 2015).

2.2. The Behaviour Change Wheel and research questions

To explore how we could motivate 18-30 year-old Harrow residents to engage in FWDP, we used the Behaviour Change Wheel (the COM-B model; Michie et al., 2011). The COM-B model was originally conceptualised to study behavioural change in the healthcare context and later applied within the pro-environmental behaviour change arena (Manika et al., 2021c). It has yet to be applied within a waste

management context. In the ‘COM-B system’ i.e., Capability (C), Opportunity (O) and Motivation (M) form the core of the Behaviour Change Wheel, which then interacts to generate behaviour change and then behaviour (B) alters C, O, and M elements in a bi-directional relationship; while C and O elements influence M (Michie et al., 2011). “The COM-B system includes Capability, both physical and psychological (i.e. the capability to engage in the required cognitive processes); physical and social Opportunity (i.e., reflecting environmental or contextual rather than individual attributes such as opportunities/barriers of the physical environment and cultural norms/values, respectively); and reflective and automatic Motivation (i.e., conscious reasoning and decision making and habitual and emotional responses, respectively)” (Manika et al., 2021c). Capability needs knowledge and skills, opportunity lies outside the individual with a focus on external factors, and motivation entails all brain processes that lead to behaviour (Michie et al., 2011).

Based on the COM-B model, barriers to a behaviour are mapped against capabilities (“Do they know what the desired behaviour is? Are they physically capable of doing it? Do they have the mental or physical skills required? Do they understand why it is important for them to do it and how to do it? Do they have the self-control required to do it and keep doing it if necessary?”), opportunities (“Do they have the time, financial or material resources to engage in the desired behaviour? Do they have the social support required? Is it seen as normal in their social environment?”) or motivations (“Do they find it genuinely more attractive than competing behaviours? Is it an established part of their routine?”) elements that can usefully be targeted to achieve the desired behaviour (UCL’s Centre for Behaviour Change, 2019). Prior research and application of the COM-B system has evidenced its usefulness for understanding perceived barriers related to C, O, and M elements (Brannan et al., 2019), while also helping to develop integrated marketing campaigns that promote behavioural change (Manika et al., 2021c). Thus, a behavioural diagnosis through this theoretical lens identifies COM-B elements for design intervention.

Pro-environmental literature grounded on the COM-B model has focused on household water conservation initiatives (Addo et al., 2018) and recycling behaviours (Gainforth et al., 2016). More recently, Mattson (2020) proposed to design and evaluate a food waste reduction prototype for workplace kitchens based on the COM-B model. The use of the COM-B model within the scope of behaviour change for food waste in the literature remains extremely scarce (Manika et al., 2021c). Our work will contribute to extending both research and practice by using the COM-B model to better understand capabilities, opportunities and motivations that lead to FWDP amongst 18-30 year-old Harrow residents; and associated barriers to change. Hence, based on the aforementioned FWDP literature and the COM-B model, the following research questions (RQs) were identified in this exploratory research project, focused on the target age range of 18–30 year-old Harrow Council residents who at the time of the data collection were engaging in partial (i.e., did not place all food waste items in appropriate bins) or no household food waste collection and reduction practices:

RQ1. What are the perceived capabilities needed, and associated barriers, for engaging in (correct) household FWDP, amongst the 18–30 year old Harrow Council residents?

RQ2. What are the perceived opportunities, and associated barriers, to engaging in (correct) household FWDP, amongst the 18–30 year old Harrow Council residents?

RQ3. What are the perceived motivations, and associated barriers, for engaging in (correct) household FWDP, amongst the 18–30 year old Harrow Council residents?

The B element of the COM-B model, given its bi-directional relationship with C, O, and M elements is linked across RQs. The sequencing of the RQs reflect the COM-B model, and guide the development of our data collection methodology (although data collection starts with B as discussed in the next section).

3. Methodology

To develop insights about FWDP among 18–30 years old, we adopted an exploratory case-study approach based on an a priori framework, as outlined in Patton (1990), where the unit of analysis was the FWDP of 18–30 year olds, and the context, as noted in the introduction, is Harrow Council. Exploratory case studies are recommended for researching poorly understood phenomena (Edmondson and McManus, 2007) because they account for the context in which the research takes place, and they enable researchers to develop rich accounts of the subjective experiences of research participants (Silverman, 2001). While case studies have been used to research waste management practices at national (Gusheva et al., 2022), city (Deng et al., 2022) and at a municipal level (Hu and DongXu, 2022), they focused on the institutional actors that deal with waste (e.g., waste treatment facilities) rather than the residents who produce the waste.

The data collection took place in two stages, with the COM-B theory providing the guiding framework to design and execute the empirical study, as per Yin (1994). First, a diagnostic questionnaire gauged the residents' FDWP behaviour, and identified those who, at the time of data collection, did not fully engage in FWDP. In the second stage, we conducted in-depth interviews with those residents to understand the enablers and barriers to correct FWDP among the studied group.

3.1. Online diagnostic questionnaire

The online diagnostic questionnaire was developed based on adapted scales from a past FWDP study (Downing et al., 2016) for the specific research purposes. The questionnaire focused on collecting data on the participants' living arrangements (namely, alone vs shared accommodation, with family members or others, in a house or flat) and the relevant services that they have access to via their councils (e.g., general waste bins, mixed recycling bins, food waste bins and garden waste bins). Instead of focusing only on food waste behaviours, we collected data on other recycling and disposal practices as well within the diagnostic questionnaire. By allowing participants to disclose other recycling practices beyond food waste, we reduced the possibility of false self-reported data on the behaviours that were the focal point of our investigation i.e., FWDP. This is grounded on prior literature's "licensing" effects (Manika et al., 2021b) i.e., people allow themselves to do/report something bad (e.g., self-reporting they do not engage in FWDP) after doing/reporting something good (e.g., self-reporting their recycle plastic waste). In relation to each recycling behaviour, we asked participants about: a) their perceptions of whether the various items mentioned could be recycled or not; b) whether the council was currently collecting and recycling such items; and c) whether, and what type of information, they may have been exposed to in the past year about FWDP from any channel. In relation to food waste behaviour as the focal point of the diagnostic questionnaire, questions focused on the frequency of food waste collection service use, perceptions of ease of use, rational for not using, frequency of leftover food and what they do with them, information received on food waste disposal practices, types of food waste collection and reduction practices, as well as specific food items and reported behaviour on what the residents did with them. The diagnostic questionnaire concluded with a series of socio-demographic questions including the participants' postcode (the latter the purpose of checking eligibility for the study).

The questionnaire took an average of 15 min to complete, and offered participants the chance to win one of the 15 Amazon Vouchers worth £10 each. It was launched on November 5, 2020 and automatically closed at 11:59pm on November 30, 2020. The data was anonymised before their analysis, including deleting the postcode. We promoted participation of the online diagnostic questionnaire via a social media advert on Harrow's social media accounts on Facebook and Instagram which were selected given that the council has a presence and followers on these social media platforms, making it easier to reach out

to all Harrow residents. Moreover, Facebook and Instagram are among the top four most popular social media platforms in the UK in 2019 (Avocado Social, 2020) and are the most popular among the project's target age group (Bland, 2020).

A total of 36 questionnaires were completed out of an approximate Harrow Council population of 38,211 residents between the ages of 18–30 years old (Tatarska, 2022). Out of the 36 participants, 6 were outside of the target age group. The total eligible participants for the Amazon Vouchers draw was 30, based on their self-reported answers. The sample size for the diagnostic questionnaire completion was small. This may be because Harrow residents in the target age group do not follow the council on social media or due to the timing of the data collection during the Covid-19 pandemic and national lockdowns. This is a limitation that future data collections should address for example by using community champions who could help to promote participation (see additional recommendations in the limitations and future research section of the paper). Nonetheless, 30 was a sufficient sample for diagnostic purposes to proceed to the next step of our structured interview approach (i.e., in-depth interviews) and to examine our RQs.

3.2. In-depth online interviews

Next, a purposeful sample of 13 eligible participants was utilised for the interviews, before reaching thematic saturation. The sampling frame for the interviews was participants who completed the online diagnostic questionnaire, living in Harrow, within the age of 18–30 years old, and self-reported to engage in no or partial FWDP (based on the questions listed in Table 1). Specifically, out of the 30 eligible participants, 10 reported no FWDP, and 13 partly engaging in FWDP. Hence, there were 23 diagnostic questionnaire participants that were eligible to participate in the online in-depth interviews. The final sample consisted of 13 interviews which had a balance of participants who reported partial or no FWDP, while other characteristics were also considered (e.g., living in a

Table 1
Criteria Used to Select Eligible Participants for the Interviews based on Diagnostic Questionnaire.

Question	Possible Answers	Criteria Used (Illustrating Eligibility of a Participant)
What did you do with each of the listed items below (e.g., tea bags, meat, raw fish, fruit, etc.) when you last needed to dispose of them? (i.e. you didn't want them or they had gone past their best before date).	<ul style="list-style-type: none"> Put in general waste bin Put in the food waste caddy Disposed of down the drain/toilet Put in the home composter Fed it to pets/animals Donating to someone else, or a food bank Doesn't apply to my household 	If respondents selected "Put in general waste bin" for <u>all</u> or <u>some</u> of the listed food waste items.
Thinking about the following situations, what would you be most likely to do in each instance? E.g., An unopened ready meal that has gone past its use by date; An unopened pack of raw fish that has gone past its use by date	<ul style="list-style-type: none"> Put the whole lot in the food waste collection Put the whole lot in the recyclables (e.g. plastic, paper, glass) bag/bin I would tip the food into the general waste bin/sink and container into recyclables Put the whole lot in the general waste bin I would tip the food into the food waste collection and the container in recyclables/general waste None of these 	If respondents selected: Put the whole lot in the food waste collection OR Put the whole lot in the general waste bin OR Put the whole lot in the recyclables (e.g. plastic, paper, glass) bag/bin OR I would tip the food into the general waste bin/sink and container into recyclables (EXCEPT for milk)

house or flat/sharing with others; age and gender – see Table 2). It should be noted that aside from these 13 completed interviews, one additional interview was terminated as there was a discrepancy between the self-reported age group in the diagnostic questionnaire and during the interview. This sample size was adequate for our study because it focused on a relatively homogeneous group of participants. Namely, all participants were in the 18–30 years old range, all lived in the same council, and all were familiar with Harrow council's food waste collection programme, as evidenced by their responses to stage 1. Furthermore, this sample size fits the type of case study used – namely, an exploratory case study to explore an under-researched but well-defined phenomenon, based on an a priori theory.

All interviews were conducted between the 2nd and December 18, 2020, lasted about 1 h each, and were conducted over Zoom with the auto-caption function enabled. The interviews were audio-recorded to allow for automatic transcription which was then checked for accuracy prior to thematic analysis. Each participant received a £30 online Amazon voucher after completing the interview as a reward for their time. During the interviews, participants answered a series of questions about their FWDP behaviour, their capabilities, opportunities, and motivation to participate in FWDP as per our research questions. The interview protocol can be seen in Appendix A. The interview transcripts were analysed following Krippendorff's (2004) systematic approach to thematic analysis (Krippendorff, 2004). As a customary of theory driven, exploratory case studies (see Sarker et al., 2018), the COM-B theory was used to set the general direction of data analysis. Accordingly, a preliminary coding book was developed based on the categories identified in the literature, and this was used to deductively code the transcripts into FWDP related a) behaviours, b) capabilities, c) opportunity and d) motivation. Subsequently, for each of the categories in the code book, the analysis of the data proceeded in an inductive fashion, with subsequent sub-categories of behaviours, capabilities, opportunity, and motivations emerging from the data. For instance, within behaviours, we created one sub-code for "limited FWDP", "no FWDP but some recycling behaviours", and "no recycling behaviours at all". In the final step, we aggregated the codes into themes, as summarised in Table 3.

The findings emerging from this analytical process are presented in the next section, following a polyphonic approach (Travers, 2001), which presents the range of perspectives offered by the research participants, and enables the development of a layered account of FWDP among the studied group.

4. Findings

4.1. Diagnostic questionnaire findings

To contextualise the results, it is important to note that Harrow council residents are provided with multiple types of bins (140L slim-line and 240L domestic waste bin, 140L slim-line and 240L recycling bin, 240L garden waste bin), including a 7L food caddy for houses, and a 140L and 240L food waste bin for those who live in flats (Harrow Council, 2021a). Food waste and recycling is normally collected every other week, and bio bags are sold in a roll of 50 for £2.90. The council provides information on what goes in the food waste bin (Harrow Council, 2021b) and according to estimates in 2013/14, the council produced 18,300 food waste tonnage (Manika et al., 2021a).

Based on the reported FWDP within the diagnostic questionnaire which was its focus to identify eligible participants for the interviews which correspond to our RQs, 10 (33.33%) participants reported no FWDP, 13 (43.33%) participants reported partial-incorrect FWDP, and 7 (23.34%) participants reported full compliance with FWDP; out of 30 participants within the 18–30 years old Harrow residents' segment. Only 13 participants out of 30 (43.33%) reported having access to food waste bins in their homes. On the contrary, all 30 participants had a mixed recycling bins at home. In terms of FWDP, we also found that 11 residents out of 30 (36.67%) were not disposing of food waste,

appropriately, indicating a potential lack of knowledge in terms of FWDP, even if they were self-reporting engagement with FWDP [13 (43.33%) participants in total reported partial/incorrect FWDP].

The diagnostic questionnaire also collected additional information and even though due to the low number of respondents and the nature and purpose of the questionnaire – being for diagnostic purposes only, we are unable to draw conclusions. However, some of the results are interesting to provide context for our interviews. Most of the participants lived in a shared accommodation with family members. Only 7 out of 30 participants (23.33%) said that food waste could be recycled and that the council collected food waste. Of the remaining participants, some thought that the council did not collect food waste for recycling; others that it is not possible to recycle food waste; or they were unsure, unwilling or unable to recycle food waste. Awareness about recycling and waste reduction practices was somehow limited in terms of food waste. Specifically, only 5 (16.67%) people reported receiving information about how to use food waste collection, and 3 (10%) on how to reduce food waste; out of 30 participants. Other interesting findings include: 7 (23.33%) participants reported never using the collection service, 3 (10%) claimed that this service is not available to them, and 11 (36.67%) said that the council does not provide food waste caddies and liners (out of 30). Moreover, 12 people (40%) found it difficult to dispose of food waste separately (out of 30).

The diagnostic questionnaire hinted towards evidence that there may be significant gaps in awareness and knowledge in terms of council provisions and how to engage in FWDP among 18–30 year old Harrow Council residents. Not all residents who completed the diagnostic questionnaire were aware of what the council offered in terms of food waste bins, bio bags and what type of food waste can be disposed into the caddy. These were further explored via in-depth interviews as the purpose of the diagnostic questionnaire was to identify eligible participants for the in-depth interviews rather than the method to draw conclusions on.

4.2. In-depth interviews findings

Barriers to FWDP for 18–30 year old Harrow residents who do not engage or have limited/incorrect engagement with FWDP were identified through thematic analysis and the findings organised below with respect to behaviour, capabilities, opportunities, and motivation elements of the COM-B theory. A summary of the themes that emerged is provided in Table 3 based on the UCL's Centre for Behaviour Change National Guide v.04 (UCL's Centre for Behaviour Change, 2019) as discussed in the literature review of this paper.

4.2.1. Behaviour

First, of all we found that due to Covid-19 there was a shift to home cooking and increased food waste generation amongst 18–30 year old residents (theme B1). All residents that participated in the interviews reported that their households generated food waste, either from cooking at home or from ordering takeaways. The Covid-19 pandemic resulted in many office and school closures to limit the spread of the disease and as a consequence, most residents ate more meals at home. For most interviewees, the pandemic encouraged a shift towards home cooking, be it because they had more time to plan and prepare meals, or because their income had decreased, as illustrated by these quotes:

"I haven't been working in the office since the pandemic and yeah I think everything's changed ... I am cooking a lot more now being at

Table 2
Summary of characteristics of the 13 interviewees.

Participant no.	FWDP Behaviour	Accommodation type	Age	Gender	FWCR Information
1	Partial FWDP - 6/37 food items disposed of incorrectly. Items incorrectly disposed of: Conserved food (e.g. pickles, marmalades, sauces) opened for more than 5 days/past its best before date; Unopened ready meal that has gone past its use by date; Open jar of cooking sauce/marmalade that has gone mouldy; Open tub of honey that has crystallised.	House – Sharing with family members	30	Male	Received leaflets from council regarding how to use different bins and recycling tips.
2	Partial FWDP - 3/37 food items disposed of incorrectly. Items incorrectly disposed of: Dairy products no longer wanted (cheese, yogurts, etc.) and are still edible; Conserved food (e.g. pickles, marmalades, sauces) opened for more than 5 days/past its best before date.	House – Sharing with family members	20	Female	Has information about the recycling facilities available, how to reduce food waste BUT not about food waste recycling. Got the information through YouTube and Instagram.
3	Partial FWDP - 8/37 food items disposed of incorrectly. Items incorrectly disposed of: Unopened ready meal; Unopened pack of raw fish; Unopened jar of pickles that has gone past its use by date; Open jar of marmalade that has gone mouldy; Open tub of honey that has crystallised; Half of packet of bread that gone stale; Bag of salad that has gone off; Net of oranges that have one or two oranges rotten.	Flat - Alone	26	Female	Not received information about how the separate food waste collection works and the importance of recycling food waste.
4	Partial FWDP - 6/37 food items disposed of incorrectly. Items incorrectly disposed of: Unopened ready meal/ Unopened pack of raw fish; Unopened jar of pickles that has gone past its use by date; Open jar of cooking sauce; Open jar of pickles; Open jar of marmalade that has gone mouldy.	Flat – Sharing with family members	30	Female	Received a lot of information about recycling from the council on billboards and pamphlets.
5	Partial FWDP - 18/37 food items disposed of incorrectly. Items incorrectly disposed of: Cooked starchy food (e.g., potatoes, pasta, rice) leftovers; Tea bags; Dairy products no longer wanted (cheese, yogurts, etc.) and are still edible/ past their best before date; Bread past its best before date; Conserved food (e.g. pickles, marmalades, sauces) opened for more than 5 days/past its best before date; Biscuits and other dry goods (i.e. items that are stored in cardboard) past its best before date/that has gone bad; Unopened ready meal that has gone past its use by date; Open jar of cooking sauce that has gone mouldy; Unopened jar of pickles that has gone past its best before date/has gone mouldy; Open jar of marmalade that has gone mouldy; Open tub of honey that has crystallised; Half of packet of bread that gone stale; Bag of salad that has gone off; Net of oranges that have one or two oranges rotten.	House – Sharing with family members	24	Female	Received information about food waste collection and recycling system through letters. But then, she said she did not receive information about food waste collection.
6	Partial FWDP - 7/37 food items disposed of incorrectly. Items incorrectly disposed of: Unopened ready meal that has gone past its use by date; Open jar of marmalade that has gone mouldy; Open tub of honey that has crystallised; Half of packet of bread that gone stale; Bag of salad that has gone off; Net of oranges that have one or two oranges rotten; Milk that has gone bad.	House - Sharing with family members	21	Male	Not received any information about food waste recycling.
7	No FWDP	Flat – Sharing with family members	26	Female	Has heard about recycling facilities available in her area. But then, she said has not received any information about how the food waste collection works.
8	No FWDP	Flat – Sharing with family members	30	Female	Food waste could be recycled but council does not collect. She has not received any information about recycling, including food waste.
9	No FWDP – put both food and containers/packages in the food waste caddy	House – Sharing with family members	30	Female	Food waste can be recycled but council does not collect. She has not received any information about recycling.
10	No FWDP	Flat – Sharing with family members	29	Female	Food waste could be recycled but council does not collect. She has not received any information about recycling, including food waste.
11	No FWDP	House – Sharing with family members	27	Female	She has been exposed to a lot of information about separate food waste collection and recycling tips through leaflets. She agrees that the council has provided information about food waste recycling.
12	No FWDP	Flat - Alone	28	Male	He has not received information about how the separate food waste collection works and the importance of recycling food waste. He does not think he generates that much food waste to care about recycling either, and think it is easier to use the general waste bin.
13	No FWDP	Flat - Alone	24	Male	He has not received any information about recycling in general.

Table 3
Summary of themes from interviews organised through the COM-B model.

COM-B element	Findings
Behaviour (B)	<i>Behaviour reported</i> <ul style="list-style-type: none"> • Shift towards home cooking and increase of food waste generation due to the pandemic (theme B1). • May be recycling other items but not engaging in FWDP (theme B2). • Those with limited engagement in FWDP, may fail to engage in correct FWDP (doing the wrong thing; theme B3). <p>Barriers to FWDP for those who do not engage or have limited/incorrect engagement with FWDP are reported below for C, O, and M elements based on findings (organised based on overarching questions from the COM-B theory).</p> <p><i>Do they know what the desired/correct FWDP is?</i></p>
Capabilities (C)	<ul style="list-style-type: none"> • Lack of knowledge and information on desired/correct FWDP from councils (e.g., which food waste items to place in the caddy, what to do with items not appropriate for the caddy, where to acquire caddy liners from) (theme C1). <p><i>Are they physically capable of doing it? Do they have the mental or physical skills required?</i></p> <ul style="list-style-type: none"> • Remembering which food waste item can and cannot go to the caddy is difficult (theme C1). <p><i>Do they understand why it is important for them to do it and how to do it?</i></p> <ul style="list-style-type: none"> • Those who engage in limited/incorrect FWDP discussed benefits to the environment but also to them as individuals (e.g., amount of money saved) (theme C2). • Lack of awareness of benefits of FWDP and knowledge of what happens to it after collection for those who do not engage in FWDP (theme C2). • Concerns over pests and public health (lack of correct disposal practices and information on this by councils) (theme C3). • Confusion/Misinformation of desired/correct behaviour resulting from differences in FWDP between councils (relying on family/friends that leave elsewhere) and relying on 'common sense' leads to incorrect FWDP or no FWDP (theme C4). <p><i>Do they have the self-control required to do it and keep doing it if necessary?</i></p>
Opportunity (O)	<ul style="list-style-type: none"> • No/limited perceptions for need for self-control (theme C across 1–4). <p><i>Do they have the time, financial or material resources to engage in FWDP?</i></p> <ul style="list-style-type: none"> • Some councils do not provide a food waste caddy or residents have to pay for it (theme O1). • Financial concerns over purchasing caddy liners needed for FWDP (theme O2). • Lack of regular collection by council (or pause in service) (theme O3). • Features of food waste caddy (e.g., unstable, unreliable, too small to fit all in, too big for space) lead to lack of FWDP (theme O4). <p><i>Do they have the social support required?</i></p> <ul style="list-style-type: none"> • Lack of council prompts/reminders (theme O5). <p><i>Is it seen as normal in their social environment?</i></p>
Motivation (M)	<ul style="list-style-type: none"> • Not the norm (theme O across 1–5). <p><i>Do they find it genuinely more attractive than competing behaviours?</i></p> <ul style="list-style-type: none"> • Benefits do not outweigh the costs (financial, health/pest concerns) (theme M1) • Feelings of disgust associated with FWDP (placing it in the black bin not considered as disgusting as placing FW items in the caddy) (theme M2). • Inconvenience (habitual) due to having to separate FW items, remember what can go in the caddy or not, or collection matters lead to lack of or limited FWDP (theme M2). <p><i>Is it an established part of their routine?</i></p> <ul style="list-style-type: none"> • No or limited/incorrect FWDP (theme M across 1–2).

Notes: FWDP = Food Waste Disposal Practices; Questions in italics within C, O, and M sections of the table above adapted from UCL's Centre for Behaviour Change National Guide v.04 (UCL's Centre for Behaviour Change, 2019). These should not be confused with the interview questions but are used for our organisation based on themes identified and the COM-B model.

home because I've got the time to do so. And you can actually prepare your meals and plan." (Resident 3; partial FDWP)

"I'm also on furlough.¹ The money all changed, so I have to be more wise off." (Resident 10; no FDWP)

Moreover, we found that while some did not engage in FWDP at all, they did recycle other items (theme B2) and those who did engage in partial FWDP often reported incorrect FWDP i.e., doing the wrong thing (theme B3). Typical food waste items produced by households were peelings, unused fruit, stale bread and leftovers from meals. Among the participants, a few participants did not practice any FWDP at all, choosing instead to dispose of their food waste in the general waste bin, even though they did recycle other items. In addition, various residents reported disposing of raw fish that had gone past its use by date, or opened jars of cooking sauce that had gone mouldy in the general waste, while placing the containers for these items in the recycling bin. This meant that we witnessed failures to dispose of food waste correctly even among those residents who separate food from its containers, and instead recycling the latter.

While some residents participating in this study reported disposing some food waste items correctly, others did not. Specifically, the most disposed cooked starchy food included potatoes, pasta or rice correctly; as well as unwanted fresh fruit and vegetables with the exception of bags of salad leaves, such as leftovers, peelings, and items past their best before dates. Coffee grounds and tea bags were commonly disposed of in the food waste bin. Conversely, fish and meat were rarely disposed correctly. Namely, ready meals tended to either be placed in the general waste bin while still in their containers or, sometimes, the container is placed in the recycling bin, and the food in the general waste bin. Another type of item that was rarely placed in the food waste bins were those that contained liquids, such as jams, marmalades, pickles, yoghurts and cooking sauces. By and large, unopened items tended to be entirely discarded in the general waste bin, while opened ones might be separated between the general waste (the food) and the recycling (the container) bins. Again, we witnessed failures to dispose food waste items correctly even among residents who self-reported engaging in FWDP. Moreover, our findings showed that some items are more problematic (i.e., fish and meat, ready meals, items containing liquid such as jams, marmalades, pickles, yoghurts and cooking sauces, and unopened items) than others (i.e., starchy foods such as potatoes, pasta or rice, unwanted fresh fruit and vegetables, coffee and tea bags), when it comes to FWDP.

There were also some instances where residents reported disposing of the whole item in the recycling bin with its food waste contains still inside. For instance, participant 6 reported placing stale bread which was still in its package alongside other recyclables such as plastic, paper and glass. Such practices are not only a failure of properly disposing of food items, but also make it impossible to recover the other items in the recyclables bin, due to soiling. It should be noted that not disposing of food items in the council's bins does not necessarily mean that residents are not disposing of food items incorrectly. Rather, they may be engaging in alternative FWDP, at least for some food items, as illustrated by this quote:

¹ On 20th March 2020, the UK government announced a furlough scheme to encourage employers to retain their staff. Under this scheme, instead of being made redundant, those employees were sent home, with the government paying up to 80% of their salary, up to a maximum of £2500 per month.

“We’ve got compost heaps in the garden ... (and) we have a blender in the sink, which then, you know, just blends it and gets rid of it.” (Resident 6, partial FWDP)

4.2.2. Capabilities

A big theme that emerged from the data in relation to the Capabilities element of the COM-B is the lack of knowledge with regards to: the desired/correct FWDP (theme C1), benefits information and awareness of what happens to food waste after being collected (theme C2), and how to alleviate pests/health concerns (theme C3); while FWDP differences between councils and relying on ‘common sense’ adds to confusion (theme C4). All leading to limited perceptions for need for self-control (theme C across 1–4).

In terms of information, some residents declared that they had received no information from the council about FWDP. For instance, resident 13, who reported no FWDP, declared that:

“Honestly when it comes to waste, I haven’t seen much of anything from the council.”

This was echoed by resident 8, who said:

“No one told us or explained about the food caddy systems. I know my parents have one. So, I know how they use theirs. But, yeah, I don’t know how to do that in our flat.” (Resident 8, no FWDP)

Having said that, other residents did acknowledge that there had been some communication from the council. For instance:

“If I remember correct, it comes once a year. It’s usually to tell us when the bins are going to be collected over the Christmas and New Year’s period ... If I’m correct in remembering, I think last year it said what you can put in what bin. But, again, there’s more focus, I think, on other recycling type than food waste side. There’s a lot about, you know, put your wrapping paper in the recycling bin. But not so much (about) the food waste, I don’t believe. If I remember correctly. But, again, it only comes like once a year.” (Resident 12, no FWDP)

One resident, who remembered seeing some relevant info also said:

“Might have (seen information) through, like, a magazine that we get from Harrow council. But, see, I’m not really ... into it ...” (Resident 9, no FWDP).

This could be associated with the issue of communicating the information rather than its availability, giving rise to recommendations about the council’s communication strategy around FWDP and the information and communication patterns based on the needs of this age group of residents.

In terms of the purpose of FWDP, we found that many residents were not motivated to participate in FWDP, because they were not aware of the benefits of engaging in this activity:

“I know nothing about what happens to it thereafter.” (Resident 1, partial FWDP)

“I’m assuming that it can be made for compost, and all that kind of stuff doesn’t add to the landfills and everything else. But that’s about it.” (Resident 11, no FWDP)

Residents that did engage in some FWDP felt that more residents would do it if they understood the benefits of doing so, not just for the environment, but even for themselves, for instance in terms of saving money by reducing food waste:

“Try and minimize food waste is certainly an advantage. I would encourage more people to try and minimize their waste, and use up their food.” (Resident 1, partial FWDP).

“I definitely see that (the amount of money saved) would be really interesting.” (Resident 4, partial FWDP).

For a small number of residents, resistance to FWDP arose from a perception that this activity was inefficient, from an environmental perspective:

“With the food waste one, they have an entirely separate truck that comes to collect it. Of course, it increases costs.” (Resident 4, partial FWDP)

“I think if one Council does it, another Council will look to try do it to say they’re even. I think it’s about, you know, trying to match their competitors and prove that they’re doing something about the planet.” (Resident 6, partial FWDP)

“I see some things go in the bin that I know it’s just going to go to a landfill and cause more emissions, when it could be composted and use for people’s gardens and stuff like that. I would much rather that my food scraps were to go to something more sustainable.” (Resident 7, no FWDP)

In fact, some residents even felt that it could be detrimental to the quality of life of residents, because it attracted insects, foxes, vermin and other nuisances, as illustrated by this quote:

“No one wants to see that. (This area) has quite a bad track record for vermin ...” (Resident 6, partial FWDP)

For others, still, there was a perception that the activity was pointless because their FWDP efforts would be offset by the actions of other residents:

“I know that other residents always contaminate ... like, they’re always not doing the regular recycling right. They probably wouldn’t do (food waste) right, either. So, why bother when it’s all going to get contaminated anyway?” (Resident 12, no FWDP)

There were several 18–30 year old residents who seemed to be confused or misinformed about how certain food items might be disposed of. This was particularly evident for those items that were consumed less often, or with which participants might be less familiar. For instance, people who were vegetarians or vegans, but living in a household where meat and fish might be consumed, were unsure of how to dispose of such food items:

“Meat for me, it’s meant to go the general waste bin. I might be wrong about that” (Resident 7, no FWDP)

In addition, some residents also mentioned factors relating to the consequences of processing food waste separately from other waste. For some, a couple of residents expressed a concern that putting food items out would attract pests, and generate a public health problem:

“I don’t want to generate flies. And that’s the problem we had last time. So, when you keep it inside the house, it tends to generate flies ... (and) We’ve got a lot of foxes in the area. We used (the food caddy) in the beginning, but foxes would knock it over a lot ... Also, the food caddy itself is only small, and, when it’s windy, it just flows around everywhere.” (Resident 11, no FWDP)

“Putting all the food waste there ... I think it would attract like foxes, or rats or birds. You know, vermin. So ... I just put the food in the regular bin” (Resident 12, no FWDP)

In the absence of effective communication from the council around FWDP, some residents looked at how their friends and relatives disposed of food items, replicating the mistakes that others did.

We’ve got someone that lives in a different Borough and they had the caddy in their Borough years ago. They had been doing just the fruit and veggie things in the caddy. So, when they spoke to our family we kind of assumed it was that same practice.” (Resident 5, partial FWDP)

“I used to live with my mum. So, that was what I carry on doing.” (Resident 13, no FWDP).

Alternatively, residents tried to reason about how to dispose of items based on their characteristics. For instance:

“I think probably when it’s in liquid form, I tend to think, oh, maybe it shouldn’t go to the food waste caddy.” (Resident 2, partial FWDP)

“If something’s cooked, for example, it won’t go in (the food waste caddy). Or if it’s something that was frozen previously, and being grilled and stuff, it won’t go in there. If, however, it’s just like the raw things and more natural thing like the peelings for example, then it will go in there.” (Resident 5, partial FWDP)

4.2.3. Opportunities

Related to opportunities, councils do not always provide a caddy or a drop-off/collection service (theme O1), coupled with financial concerns over caddy liners (theme O2), lack of regular collection schedules (theme O3), unfavourable features of the caddy (theme O4), and lack of prompts/reminders (theme O5) lead to lack of FWDP as the norm. Hence, adequate facilities provision is essential and this is consistent with prior literature as well as applicable potentially beyond the 18–30 year old segment.

The residents reported a lack of facilities and equipment to engage in FWDP. One key piece of enabling equipment was a separate bin to collect food waste:

“I don’t have it (a food waste caddy). It wasn’t provided. We just have one general waste bin and one recycling bin.” (Resident 10, no FWDP)

Other residents had received a small bin to collect waste at home, but reported not having nearby collection points to dispose of the food waste generated. The lack of easy access to nearby collection points is a particular barrier for those without access to a vehicle; as well as for those shielding at home during the Covid-19 pandemic. However, even those with no health concerns and who had access to a car, saw this as a significant barrier. Consequently, they felt that the only way that they could dispose of food waste was by throwing it in the general waste bin, which not only was larger than the food caddy, but was collected regularly from their homes:

“I have, like, looked into how to do it. And we would basically have to drive somewhere to drop it off. And it would take a lot of time ... And also, it would be a bit of a hassle Basically, to make it worth it to drive, I would want to bring a lot of food waste. And we don’t have the space to collect that.” (Resident 7, no FWDP)

One resident also reported experiencing problems with unreliable food waste collection, leading them to deposit their food waste alongside other waste:

“We had a lot of issues when we first moved in. Every time there was a missed collection, I reported it. I did have to report it about three or four times ... Food waste starts deteriorating very quickly. So, you want to dispose of it very quickly. You don’t want it to be hanging around your property another week” (Resident 1, partial FWDP).

Various residents also mentioned the need to use compostable plastic liners for the food caddy, as a barrier. Some residents were unsure where to find this particular type of liner:

“If they’re going to make it mandatory, they need the scheme to actually work properly. You need to have your separate outdoor bin. And you need to be clear on where to find these recyclable bags” (Resident 13, no FWDP)

For most residents, the barrier seemed to be the cost of these liners, particularly associated with the fact that the food waste caddies are relatively small and, therefore, residents would need to replace the liner more frequently. This was evident, for instance, in participant 1’s explanation for why they only disposed of some food items in the food

waste caddy:

“(I would be) taking more bags, for which I’m paying for, and separating the waste into smaller chunks so that I can actually fit it into the bin ... If the caddy and the bags are free, it will remove any potential barriers or obstacles in people’s minds” (Resident 1, partial FWDP).

Many residents did not engage in FWDP because they perceived this to be a costly activity also in itself, in what were already stretched budgets: “I just can’t really stretch to that for a food caddy bin.” (Resident 8, no FWDP).

The financial concerns were particularly relevant for those residents that had seen their income reduced, as a result of the Covid-19 pandemic:

“This year, the pandemic ... being on furlough ... money is quite tight, isn’t it? People are out of work. People need help.” (Resident 10, no FWDP).

Still others perceived that the financial cost should be absorbed by the council, either as part of the overall budget, or because the council should be able to benefit financially from collecting and processing food waste, as illustrated by these quotes.

“I don’t think we should have to ... My reason for that is we pay council tax and it goes up every year.” (Resident 10, no FWDP).

“I know they probably save some money by collecting the food waste because they can probably sell it to make compost or something.” (Resident 12, no FWDP).

In addition, the features of the caddy itself indicated a potential barrier to action. Some residents reported that the food waste bin was too small, leading them to dispose of additional food items in the general waste bin. This problem might have been exacerbated during the Covid-19 period, as many residents were spending more time at home, and thus having more meals at home, for instance as a result of places of study or working closing down.

“It’s fairly limited in size. It’s not the biggest bin ... We can only fit around three bags in that bin before you sort of reach the capacity.” (Resident 1, partial FWDP)

However, most residents reported the opposite problem. They thought that having a separate bin for food waste collection was a nuisance, because it took up too much space in their houses, specifically in the kitchen, as illustrated by this quote from resident 12:

“I don’t really have much counter space for it.” (Resident 12, no FWDP)

Irrespective of size concerns of the caddy, others reported that the bin was unfit for the purpose of disposing food items. They described the bins as being unstable, and too easy to be accidentally opened (e.g., if knocked off by the wind or an animal), creating nuisance.

“The (food fell out and attracted foxes and vermin) with our old bin, just because the lid was not locked properly.” (Resident 1, partial FWDP)

Lastly, the need for prompts and reminders was also a barrier related to generating opportunities for FWDP. Residents who were aware of some communication from the council specifically related to FWDP, they could not recall the details, stating that they had either not paid much attention at the time, or that they had forgotten about it, saying:

“Might have (seen information) through, like, a magazine that we get from Harrow council. ... I might have seen a leaflet, but haven’t seen one in a very long time. I would say a year ago or something.” (Resident 9, no FWDP).

4.2.4. Motivations

Generally, the interviews indicated that benefits of FWDP do not outweigh the costs (theme M1), while feelings of disgust and a sense of inconvenience lead to lack of or partial FWDP (theme M2); related to the Motivation element of the COM-B.

Overall, residents reported perceptions that citizens shouldn't be absorbing the financial cost of FWDP and should not have to face the cost of engaging in a behaviour that benefited society, generally; which hinted towards a lack of perception of benefits related to FWDP for the individual and the environment.

"I need to buy liners for other bins and, in general, liners aren't a concern. It's just, I'd be quite annoyed having to pay separately for another bin." (Resident 13, no FWDP)

"I don't think you should have to pay for recycling because you're doing something good. You're trying to recycle. So, I think if you're doing something good and trying to help the planet, you shouldn't have to pay extra for it. It should be free." (Respondent 6, partial FWDP)

Even though the above focus on financial costs, these quotes illustrate the relationship between C and O elements and their influence on M as per the COM-B model and respective themes identified in previous sections.

Moreover, some residents reported a sense of disgust from handling the food waste bins because of smell and residue. Others, reported a sense of disgust from actually handling certain food items, themselves. For instance, resident 4, who engaged in limited FWDP, explained why she would throw unopened jars with food in it in the general waste bin, instead of emptying them in the food caddy before disposing of the jar:

"When I was thinking of (jars of pickles and cooking sauce that have gone mouldy), because I'm a molecular biologist and the thing has mould in it, I wouldn't open it" (Resident 4, partial FWDP)

Lastly, residents also discussed the inconvenience of separating the waste into various bins:

"We have the black bins that are so convenient ... Me, working late, and not having that time or energy to do stuff. Or, you know, people with families. The whole convenience aspect. We can all do more. We're just lazy." (Resident 12, no FWDP)

For some, the inconvenience was related to the fact that the food caddies are relatively small, meaning that they need to be emptied frequently. This inconvenience was exacerbated during the pandemic, as most residents were having more meals at home and, thus, producing more food waste than usual:

"I live in a one bedroom flat on the first floor. Coming down just, you know, is an obstacle." (Resident 10, no FWDP)

"(Don't want to go outside to empty the caddy every day). It's probably laziness. It's absolutely inconvenient." (Resident 11, no FWDP)

Separating waste could also seem a daunting activity, particularly for those residents that had never done it before:

"I think if people understood, especially about how to deal with leftovers and hints and tips about how to minimize waste ... Once they realize how easy it is, it may be easier to instil that behaviour on a permanent basis." (Resident 1, partial FWDP)

5. Discussion

5.1. Theoretical implications

Unlike prior studies that focused on household food waste reduction practices across individuals with various levels of involvement, our

research focused on 18–30 year old residents who either showed no engagement in FWDP or they partially engage in FWDP (i.e., separate some food waste items and place them in the correct or incorrect caddy for collection). From a theoretical angle, we extended the FWDP literature by being one of the first to adopt the COM-B model and investigating its appropriateness as a framework in relation to developing food waste behaviour change initiatives. Specifically, our study provided evidence about the benefits of using the COM-B model within a novel FWDP context and highlighted the potential need for a segmentation approach (i.e., different age groups necessitating different interventions). In addition, our research focused on collecting data during the Covid-19 pandemic, which may have resulted in changes in relevant behaviour that may influence behaviour change endeavours in the post-pandemic era (hence, pre-pandemic FWDP studies may be outdated or have limited relevance today).

More specifically, several barriers to FWDP were identified, organised via the elements of the COM-B model in [Table 3](#). First of all, we found that due to Covid-19 there was a shift to home cooking and increased food waste generation amongst 18–30 year old residents, and often incorrect FWDP was reported; as part of the Behaviour element of the COM-B. Based on our sampling frame also some 18–30 year olds also did not engage in FWDP at all, which could be detrimental to the environment if adopted for their whole lives. In terms of the Capabilities element of the COM-B, we found that there is a lack of FWDP knowledge, benefits information, and advice on alleviating pests/health concerns from councils, while FWDP differences between councils and relying on 'common sense' adds to confusion. Information about food waste collection schemes, and particularly on how to dispose different food items, as well as the benefits of practicing food waste separation should be provided to 18–30 year old residents at regular intervals. In particular, the benefits for the individuals themselves – such as the savings that they may accrue – may be an important factor for 18–30 year olds in the post-Covid-19 era that may lead to FWDP. Related to Opportunities, councils do not always provide a caddy or a drop-off/collection service, coupled with financial concerns over caddy liners, lack of regular collection schedules, unfavourable features of the caddy, and lack of prompts/reminders lead to lack of FWDP as the norm. Hence, adequate facilities provision is essential and this is consistent with prior literature as well as applicable potentially beyond the 18–30 year old segment. Generally, benefits of FWDP do not outweigh the costs, while feelings of disgust and a sense of inconvenience lead to lack of or partial FWDP; related to the Motivation element of the COM-B.

Similar to prior research ([Blichfeldt et al., 2015](#); [Neff et al., 2015](#); [Tucker and Farrelly, 2015](#)), environmental concerns is not the main driver of engaging into FWDP, but convenience aspects are ([Metcalfe et al., 2012](#)). Hence, the success of a separate food waste collection and reduction scheme requires certain prerequisites to ensure the engagement of 18–30 year olds. For instance, [Metcalfe et al. \(2012\)](#) have focused on the utilities represented by the food waste caddy and how these are in direct relationship with the performance of FWDP. Residents' perceptions and attitude towards food waste, aesthetics and cleanliness associated with having the food waste caddy sitting on their kitchen countertops or kitchen floor, the sense of guilt over throwing food waste in the black bin, space limitations in keeping the caddy inside the household, competence, capacity and frequency of use, and mistrust of the council, come into play on the way the caddies are viewed and used ([Metcalfe et al., 2012](#); [Bulkeley and Gregson, 2009](#)). A focus on the positive impacts may outweigh the negative impacts of FWDP, and this needs to be signposted as it can affect C, O and M elements that interact to generate behaviour/FWDP; while recognising that FWDP subsequently alter residents' C, O and M. Theoretically, this bio-directional relationship of B with C, O and M has not been previously recognised explicitly within the FWDP context and as evidenced below it may contribute to practical insights improvements in communication and engagement of 18–30 year old that is aligned with their lifestyle habits, and which may differ from other age segments, especially in a

post-Covid-19 pandemic era.

5.2. Practical suggestions for engagement

We put forth practical suggestions for encouraging FWDP of 18–30 year old residents to address key barriers related to COM-B elements highlighted from our in-depth interviews (see Appendix B for a full list also of resident suggestions in empowering FWDP). The practical insights are summarised in Fig. 1 and include: 1. Frequent knowledge dissemination & advancement but remember a one-size-fits-all approach does not work (Knowledge reflects *Capability* while prompts reflect *Opportunity*); 2. Worries and costs reduction and benefits increase (benefits to outweigh costs; reflects *Motivation* which is influenced by C and O); 3. Designing the caddy and service to fit lifestyle as a way to empower change (reflects *Opportunity*); and 4. Promote normalization to empower change and sustain behaviour (reflects *Opportunity*).

Visually, the bi-directional relationship between COM elements and B, is depicted by using the bold first letters from our practical insights which spell out FWDP (i.e., also the behaviour). The practical insights are discussed in more detail next (starting with C, O, and then M elements).

5.2.1. Frequent knowledge dissemination & advancement: there’s no a one-size-fits-all approach

Lack of knowledge on the existence of FWDP and on the way these can promote to sustainable waste management is a significant barrier to action. FWDP is a relatively new practice compared to other recyclable waste materials (i.e., metal, glass, cardboard, plastic) sorted in the household. Therefore, informing consumers about the benefits of recycling food waste needs to be well-incorporated in any behaviour change strategy (Vicente and Reis, 2008; Oke and Kruijzen, 2016). Other benefits for multiple stakeholders should also be part of the disseminated content, which follows prior research that notes that pro-environmental behaviour can have benefits for multiple stakeholders (Manika et al., 2016). For example, how FWDP could save money for individual residents and the Council (and why residents should care about the latter), as well as the environment. Information of the recycling process and what happens to the food after being collected to ensure the food will not end up at the landfill, could help reinforce that residents’ efforts in this respect are worthwhile. Tips on minimising food waste and other alternatives to FWDP can be very helpful as well.

Hence, residents’ knowledge on how to engage in FWDP, i.e., collection points, days, and ways to dispose, is often limited. Therefore, to enable the FWDP become a mainstream practice it is important for residents to understand which food waste items (materials) are collected in their area (e.g., and become aware of differences across London boroughs in terms of FWDP; Manika et al., 2021a). This type of information, and way by which is communicated, needs to keep up with people’s lifestyles, behaviour and social norms - in order to address perceived concerns related to pests/health concerns and people needs – and must have a dynamic angle to it to make sure it encompasses seasonality aspects (winter vs summer) and holiday seasons (e.g., Christmas, Easter, Diwali, and fasting periods, e.g. Ramadan) to ensure good practice. On that end, a successful behaviour change strategy should acknowledge there’s a variety of diets, which requires that information on a food item basis and whether it can be recycled or not, can help to eliminate confusion and improve the willingness to participate in the food waste recycling schemes (Kymäläinen et al., 2021). Following the changes brought upon by the Covid-19 pandemic this could be a timely opportunity to enhance FWDP endeavours from the council to target residents and promote behaviour change in FWDP. Timeliness is essential in terms of what is communicated and how.

Another impact aspects to FWDP is the proper segregation and disposal at source. One incorrect item in the food waste bin can contaminate the entire food waste stream and its potential treatment (Roy et al., 2020), people need to be aware of how to dispose their waste properly; we distinguish between three types of information needed for behaviour change: *must-have*, *should-have* and *nice-to-have* (See Table 4) reflecting the urgency of this type of information based on our interviews. Lastly, given the complexity of some FWDP, it is imperative to also remind residents of FWDP facts and using prompts keep them on ‘their toes’. This insight is in line with Oke and Kruijzen (2016) who reported that discontinued information and prompts could diminish progress in changing the residents’ behaviour and that confusing information could negatively impact on participation in any waste recycling scheme. Knowledge dissemination and advancement, as well as prompts and reminders, need to also take into account that a one-size-fits-all approach does not work, which was clear from our 18–30 year old population segment.

The choice of a suitable communication channel is particularly important in promoting FWDP. The type of media (social, mass and direct media) used to promote FWDP needs to consider the lifestyle of

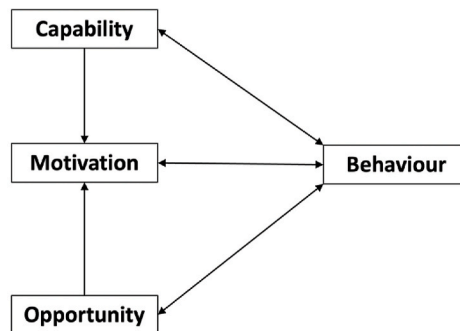
Practical Insights to empower FWDP:

Frequent knowledge (items, how, when, benefits, what happens after, etc.) dissemination & advancement (prompts also create Opportunity) but remember a one-size-fits-all approach does not work

Worries (disgust, inconvenience) & costs ↓ and benefits ↑

Design caddy and service to fit lifestyle as a way to empower change

Promote normalization to empower change and sustain desired behaviour



Food Waste Disposal Practices (FWDP)

The COM-B Model

Fig. 1. Practical insights summary.

Table 4
Recommendations on types of FWDP information for young adults in England based on urgency.

Urgency	Types of FWDP
Must-have information	<ul style="list-style-type: none"> Awareness of the council's separate food waste collection scheme is needed, in the first place, and ways to access relevant infrastructure promptly and effortlessly, such as kerbside food waste bin collection days to make sure they bring their kerbside food waste bin out on the right day. Information on what can and cannot be placed inside the food waste caddy, when the food waste is collected, and from where; as well as other ways to dispose of food waste. This type of information needs to keep up with people's lifestyles, behaviour and social norms; address concerns also related to pests/health concerns or ongoing circumstances like the Covid-19 pandemic; as well as needs by dynamically provided to encompass seasonality aspects (winter vs summer) and holidays (e.g., Christmas, Easter, Diwali, and fasting periods, e.g. Ramadan) to promote good practice; and different diets.
Should-have information	<ul style="list-style-type: none"> "Why residents should practice FWDP" can help increase personal understanding and motivation to support FWDP. Residents should be aware of the benefits to themselves, the council and the environment which can empower continuation of FWDP.
Nice-to-have information	<ul style="list-style-type: none"> Information on "how food waste is recycled" and "what happens to the food after being collected to ensure the food will not end up at the landfill?" could help make residents' feel that their efforts are worthwhile. Tips on minimising food waste and other alternatives to FWDP can be very helpful as well.

18–30 year old residents. Social media refers to computer-based technology that enables users to create and share content or to participate in social networking; it is quick, and is generally popular with the 18–30 age group. Nonetheless, social media can have the opposite than desired effect, as often the large volume of post on social media may get the message lost, downplay its importance, or create even further confusion given that social media are not location specific and due to perceptions of unreliable sources. Even if the councils were to attempt to gain residents' attention via their own webpages and social media pages, there are not many 18-30 year-old residents that follow the council's social media pages. Hence, the message would not get transmitted to this segment of the population. To overcome this, the council could use social media influencers within the target age group to promote FWDP. Alternatively, mass media which refers to technologies that reach a mass audience such as, TV, radio, newspapers/magazines and the internet could be used; but information related to FWDP can be either limited (e. g. on TV, radio, and newspapers), or overwhelming (e.g. the Internet). Information on FWDP delivered through direct media (i.e., direct mail, brochures with the waste collection schedule, information provided via the council's webpage, posters/billboards) has also limited outreach especially in the 18–30 years old target age group. Leaflets/stickers could be used to prompt residents to use the food waste caddy, but often these are disregarded by the majority of residents, or the prescribed instructions are unclear. Additionally, leaflets and stickers are associated with the use of resources (paper, printing and distribution), and some people view these means as a wasteful practice. Meanwhile, posters at public places such as bus stops could be controversial as some may consider this attractive and other consider it to be a waste of money. In short, the communication strategy should consider the audience, the information to be communicated, how it should be disseminated, and what is the best way to do it (the channel).

The above analysis suggests that the past one-size-fits-all approach often used by councils to disseminate FWDP knowledge has limited impact in promoting good practice in FWDP. We therefore suggest that a semi-tailored approach should be considered, depending on the audience, the media type to be employed, and the timeliness of the

communication - a proposition also endorsed by Perrin and Barton (2001). Information channels to encourage and promote proper disposal of food waste could be supported through the use of design thinking strategies, such as recent work by Massari et al. (2021) who suggested that such digital solutions should also consider aspects of empathy and creativity (Massari et al., 2021). The use of design thinking for Social Innovation as reported by Brown and Wyatt (2010) also suggest the value of co-design and prototyping solutions (Brown and Wyatt, 2010).

5.2.2. Caddy design and service to fit lifestyle: means to empower change

The way the food waste caddies are perceived and the meaning accrued by their use are important to residents (Patrick and Hollenbeck, 2021). Its current design, i.e., a small, plastic brown box with a hinged lid, does not incentivise residents about the need for proper disposal of food waste. In fact, it is considered ugly by some, small or large by others, and is associated with pollution because it contains food that may rot and smell, and may, in turn become unpleasant to handle, attract vermin, and need frequent cleaning (Metcalf et al., 2012). For example, in Harrow Council England, England some residents leave the food waste caddy outside of their household, and when not locked properly, the bin and its contents were reportedly discarded everywhere during windy days, making a mess for not just that particular household but also its neighbours. This discouraged people from using the bin, as they have to then spend time to collect the waste and track their bins. Although the locking instruction has been engraved on the bin, it was still not clear to users as some struggled to lock it or were unaware that the bin can be locked. Discouragement was also caused by the failure of the council to provide liners (i.e., compostable bags) was seen as a reason to refuse to participation in the separate food waste collection.

Likewise, the size of the food waste caddy could be delimiting. A small size bin makes it inconvenient for large households, as it requires frequent emptying which can be especially laborious for those living in high-rise buildings or apartments, whereas the small size was regarded by others to be particularly good for food waste because its highly perishable nature demands frequent emptying. In the kerbside communal bins, the food waste bin has the capacity of 23 L while the other kerbside bins (for general waste and recycling) are 240 L. Whilst this is also seen as positive by some as food waste bins need to be emptied regularly, other users found it particularly problematic because the bins are often full and users have to press the bags down to make space for more waste. Food waste liners are not particularly strong, which meant that the bags may burst and in turn contaminate the bin, making it smell bad, and requiring cleaning for use again. On the downside, a kerbside food waste bin that reaches its full capacity frequently, could invoke the disposal of food bags into the general waste bin. Moreover, small kerbside bins can be knocked down by pests, especially in areas where bins are not secured (Residents 1 and 5).

The food waste caddy needs to be seen as an entity with its own benefits that is accepted by the residents and communicating clearly the way in which it should be handled and used. Therefore, its redesign and provision, along with a continuous provision of liners, should be the starting point to encourage residents to be environmentally friendly, by actually disposing their food waste into the bin. This can be a huge investment at the beginning for the council to provide appropriate facilities for every household in Harrow, but could be justified by the return on investment in the long run when we calculate how much the council can save from the current practice of disposing the waste in the landfill. Potentially, redesigning the food waste caddy could be a way to increase FWDP in the council based on the interviews conducted for this age group. We recommend that the locking instruction should be stuck on the bin and the engraving should be in a different colour to make it visible and to attract the attention of the users. Another suggestion would be the use of an app with a QR code on the caddy that allows users to scan and interact with the caddy on information such as what types of food waste goes in the council and when the waste in the bin is collected. Convenience is a key attribute in the design as well as the level of

knowledge/awareness of the importance of participation. A proposed redesign of the food waste caddy could offer an opportunity for design for social impact as a practice of interrogating real-world systems, in this case for social and interpersonal change. In addition, inclusive design could be used by considering the diversity of physical and psychosocial needs and capabilities of the population (Patrick and Hollenbeck, 2021) could further improve and enhance the use of the food caddy.

5.2.3. Promote normalization to empower change and sustain behaviour

As Metcalfe et al. (2012) argued the food waste caddy can instigate residents about the need to separate food waste to demonstrate they are doing the right thing when it comes to protecting the environment. This is driven by their engrained norms of 'protecting the environment', or respect towards 'authorities' and is manifested via consenting to the separate disposal of food waste in the caddy (Metcalfe et al., 2012; Vicente and Reis, 2008). This is in line with the findings of Graham-Rowe et al. (2015) who found that such norms could also help to explain intention to reduce food waste in the household (Graham-Rowe et al., 2015). In this study, it was found that Harrow council residents considered separate food waste collection to be a good practice for the environment, however the sense of respect to authorities seems to be suppressed. This could be due to the specific age group being the focus of this investigation or the supremacy of the perception, attitude and/or belief, that the food waste caddy is dirty and by disposing food waste on it, which is viewed as a pollutant, becomes a source of contamination in the household that would disrupt its cleanliness (Metcalfe et al., 2012). This is in line with the observations of Russell et al. (2017) where the behaviour towards food waste was in conflict with the norms and general attitude (intent) towards food waste reduction, due to emotions and habits of people (Russell et al., 2017). With regards to the latter, practicality aspects may also affect the norms. The effort of emptying it promptly and cleaning it regularly, the use (or not) of liners and their cost, the space the caddy occupies and where it should be placed in the kitchen or outside, appear to affect its use. For instance, Metcalfe et al. (2012) argue that bulky items such as plastic bottles, pots, tubs, card and paper, and the perceived value of glass and metal containers force residents to dispose these to the recyclable waste materials bin; whereas this is not the case with food waste. Food waste is not bulky and could be easily disposed in the black bin especially if residents perceive the amount generated as very little to make its separate disposal and collection meaningful. The presence of the caddy, however, invites certain action, even if this process appears slow. Therefore, any potential communication endeavours should build on both of the above aspects, and dissolve false beliefs over separate food waste disposal. This can, as an important strategic step, encourage everyone to change their attitude towards the food, food waste, and its handling/disposal in the household.

Lastly, as per the COM-B model, the aforementioned (5.2.1–5.2.3) can lead to motivation (*Worries and costs reduction and benefits increase*) to engage in FWDP. All recommendations can help residents of all ages based on their lifestyles to reduce their worries (e.g., disgust, inconvenience) and lead to a cost-benefit analysis that empowers and supports FWDP.

5.3. Limitations, and future research directions

As with all research, this project has its limitations that should be addressed in future work. Using an exploratory case study allowed us to understand the subjective experiences of young adults when disposing of food waste, and identify a range of enablers of, and barriers, to FWDP (namely, C, M and O). However, we are unable to quantify the absolute or relative importance of each of these factors in the observed behaviour. Further research employing quantitative approaches is needed before claims can be made about the salience of specific factors, or about the magnitude of their impact on FWDP among young adults. The focus on Harrow council may limit the transferability of our findings to other

research contexts. Namely, the interviewees' experiences of FWDP are shaped by the context in which they live (Philipps and Mrowczynski, 2019). Therefore, research into other empirical settings is needed before general claims can be made about young adults' FWDP. It should also be noted that the data were collected during the Covid-19 pandemic and national lockdowns, made data collection difficult as residents were pre-occupied with other concerns (e.g., health and family, job redundancies and furlough schemes). Hence, we should use different promotion methods to motivate 18–30 year olds to participate in such diagnostic questionnaires in the future and after the Covid-19 pandemic, although we were still able to reach thematic saturation with 13 interview-eligible participants. While the use of interviews offered in-depth insight about the participants' experiences, it is important to recognise that their answers may be shaped by phenomena such as incomplete recollection or social-desirability bias. Therefore, future research could complement interviews with other data collection methods such as observations. Council efforts should also be inclusive of all age groups and residents but further research should be conducted about different approaches needed as identified in this preliminary research among young adults and compare them with those of other age groups or segmentation methods (e.g., houses vs. flats) of residents in England and beyond. Future research should also investigate the applicability of the COM-B model across additional pro-environmental behaviour contexts since literature in this is scarce and there is still much to know about how this theory could potential help in policy implementation more specifically.

CRedit authorship contribution statement

Danae Manika: Conceptualization, Methodology, Investigation, Formal analysis, Writing – original draft, Funding acquisition, Writing – review & editing. **Eleni Iacovidou:** Conceptualization, Methodology, Investigation, Writing – original draft, Funding acquisition, Writing – review & editing. **Ana Canhoto:** Conceptualization, Methodology, Investigation, Writing – original draft, Funding acquisition, Writing – review & editing. **Eujin Pei:** Conceptualization, Methodology, Investigation, Writing – original draft, Funding acquisition, Writing – review & editing. **Khanh Mach:** Data collection, Formal analysis, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

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