

# *The 3Is: let's INVOLVE, INFORM and INSPIRE the next generation on disposing food packaging sustainably*

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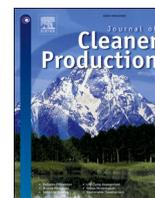
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## The 3Is: Let's INVOLVE, INFORM and INSPIRE the next generation on disposing food packaging sustainably

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### ABSTRACT

Consumers are typically confused and lack knowledge relating to disposing of food packaging sustainably; accordingly, targeted education may help to encourage more sustainable practices and subsequently modulate behaviour. In addition, children represent the next generation, and they need to be involved, informed and inspired so that they can practise correct food packaging disposal from an early age. This paper investigates: (1) children's knowledge relating to food packaging symbols and disposal; and (2) the role of education on children's sustainable food packaging behaviour. A series of workshops were undertaken at primary schools to educate children (7–11 years;  $n = 195$ ) via interactive, informative and fun activities relating to food packaging symbols and disposal. Children were also provided with an activity booklet and ten food items to be completed at-home for one-week to track appropriate food packaging disposal. Education (pre vs post) had a significant effect on improving knowledge relating to food packaging symbols (tidyman and green dot) and correct disposal practices for the juice bottle, baked bean can, jelly pot, ketchup bottle and pizza box. Importantly, children were able to incorporate sustainable food packaging practices at home; 65% of children correctly identified the right bin for most food items. Overall, there was significant impact on children's learning (84% learnt something new) and future behaviour (83% will change future food packaging disposal behaviour). Therefore, more emphasis should be placed on educating the next generation to promote a shift in everyday sustainable food packaging behaviour.

### 1. Introduction

Sustainability is a multidimensional concept utilising economic, social and environmental aspects that all generations are under pressure to adopt; yet, consumers encounter a range of associated barriers subsequently impacting adherence (Boesen et al., 2019; Ketelsen et al., 2020; Otto et al., 2021). Accordingly, there is an increasing focus on sustainable approaches, especially as to how sensory and consumer science can contribute to overcoming environmental issues as well as to help ensure sufficient resources are available for the next generation (Asche-mann-Witzel et al., 2019). More specifically, food packaging waste is widespread; therefore, promoting and incorporating sustainable food packaging practices is key (Boesen et al., 2019; Otto et al., 2021). Food packaging has functional roles, as well as creating expectations and associations which subsequently impacting purchase decisions (Marsh and Bugusu, 2007; Ares and Deliza, 2010; Ares et al., 2022). However, it is associated with disposal related challenges, such as large quantities, typically single-use items, which are discarded relatively quickly post

purchase (Geueke et al., 2018). Strategies utilising reduce, reuse, and recycle are considered viable approaches to decreasing food packaging waste and are perceived as important elements for sustainable packaging by consumers (Geueke et al., 2018; POST, 2019; Oloyede and Lignou, 2021). Consumers are typically the end-users of packaging materials (e.g., plastic, cardboard, metal, paper and glass) and make disposal related decisions, despite often not being equipped with adequate knowledge to do this correctly (Herbes et al., 2018; Boesen et al., 2019; Taufik et al., 2020; Otto et al., 2021; Norton et al., 2022, 2023). Therefore, consumers need more guidance on packaging symbols, sustainable food packaging materials and correct recycling procedures to make informed decisions (Sijtsema et al., 2016; Klaiman et al., 2017; Boesen et al., 2019; Ketelsen et al., 2020; Otto et al., 2021; Norton et al., 2022, 2023). This suggests research that incorporates consumers (regardless of age) could be key to help overcome the barriers associated with promoting sustainable food packaging behaviour.

Children represent the next generation and research utilising sustainable behaviour is becoming increasingly relevant, especially since

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environmental behaviour can be developed from childhood (Otto et al., 2019; Barrera-Hernandez et al., 2020). Otto et al. (2019) noted key developmental ages for environmental attitudes and behaviour were 7–10 years old; additionally, this age group are considered able to execute most consumer tests well (Laureati et al., 2015). Moreover, in the food packaging context, children are often provided food products either by an older user or they choose products themselves (Ares et al., 2022). Therefore, regardless of the situation, children like adults, need sufficient knowledge to be able to dispose of food packaging correctly; thus, it is considered a key step in promoting sustainable behaviour which should be learnt from an early age (Castellano et al., 2021). Schools provide an ideal environment to develop such behaviours with the potential for greater independence (as children are away from parents/guardians) in terms of decision-making (Wilkie et al., 2015; Ares et al., 2022). It is likely children will be familiar with (in some cases), as well as interested in, recycling practices; in addition, having a level of concern and lack of knowledge in appropriate disposal practices (Prestin and Pearce, 2010; Schill et al., 2020). Moreover, increasing children's awareness of sustainable food packaging behaviour could translate into a positive impact at-home (such as pester power: children pestering parents/guardians to make a change) and on the whole household (Istead and Shapiro, 2014; O'Neill and Buckley, 2019). This is particularly relevant since in the United Kingdom (UK) 70% of food waste is household-based and households with children are often key contributors (WRAP, 2021); accordingly, this provides an opportunity for improvement and children may have a key role in promoting such behaviour.

Targeted education is considered a suitable approach to enhance consumer knowledge and awareness relating to sustainable food packaging (Otto et al., 2021; Patra et al., 2022; Norton et al., 2023; Vasquez et al., 2023). In addition, education can help drive change as well as being a cost effective and 'green' solution to reducing packaging waste (Trubetskaya et al., 2022). More specifically, environmental education provides a promising approach to modulate children's behaviour (Otto and Pensini, 2017). For example, workshops provide a useful way to disseminate such information and can be conducted as a classroom activity as well as being shown to have a positive impact on children's recycling knowledge, awareness and intention in Spain (Buil et al., 2017). In addition, it is important to provide children with opportunities to practise and implement learnings (often developed in a classroom setting) in different settings (such as at-home) (Schill et al., 2020). Children's food packaging behaviour may differ between at-home and school settings depending on an individual's household infrastructure and subsequent accessibility to relevant bins (Schill et al., 2020). Therefore, is important to implement research that captures children's behaviour in both settings, and via a range of different activities, to maximise education and subsequent impact.

It is evident consumers typically lack knowledge and awareness of food packaging symbols, as well as correct disposal practices (Norton et al., 2023). Therefore, more emphasis needs to be placed on educating the next generation, so that they are suitably equipped to make decisions (e.g., tomorrow and in the future) relating to food packaging in a sustainable way. Hence, to address such a research gap; "The 3Is" a proof-of-concept project (funded by the European Institute of Innovation and Technology, EIT Food) was created to encourage a shift towards

sustainable food packaging behaviour in the next generation at ages (e.g., 7–11 years) considered fundamental in developing sustainable behaviours and attitudes. This project focused on INVOLVING, INFORMING and INSPIRING ("The 3Is") Reading based primary school children via interactive activities (such as worksheets, activity booklets, discussions, presentations and competitions) that can be utilised in the classroom and at home. "The 3Is" uses a four-stage approach (stage 1: gain initial insights – workshop one; stage 2: track at home disposal using an activity booklet; stage 3: role of education on subsequent knowledge – workshop two; and stage 4: promote engagement and creativity via a bin-design competition) as briefly summarised in Fig. 1. More specifically, this paper aims to investigate: (1) children's knowledge relating to food packaging symbols and disposal; and (2) the role of education (pre vs post) on children's sustainable food packaging behaviour.

## 2. Materials and methods

### 2.1. Project overview

One hundred and ninety-five children (7–11 years,  $8.3 \pm 1.1$  years; 47% male and 53% female) from Reading (Berkshire, UK) primary schools partook in the project. This population are perceived to have sufficient literacy skills to perform most consumer tests well (Laureati et al., 2015). Power calculations demonstrated minimum of 100 children would be sufficient based on Yamane's formula  $= \frac{N}{1+Ne^2}$ , where  $n$  = sample size;  $N$  = population, and  $e$  = precision (Yamane, 1973). In brief, recruitment adhered to the following process: (1) primary schools in Reading were informed about the project; (2) interested primary schools contacted the project team and primary schools subsequently circulated the participant information sheet and consent form to parents and/or guardians; (3) parents and/or guardians that agreed to let their child take part in the project signed the consent form and returned it to their child's teacher; and (4) children were informed about the project orally and confirmed they were happy to take part. The exclusion criteria were minimal (such as outside age-range, no written consent from parents and/or guardians and food allergies or intolerances) to be as inclusive as possible. The University of Reading School of Chemistry, Food and Pharmacy ethics committee (study number: 44/2022) provided a favourable opinion for conduct.

A series of school visits were undertaken at primary schools during school hours in Reading to educate children via insightful workshops and fun activities relating to food packaging. In addition, all stages were developed to ensure suitability for primary school children, as well as to promote learning in order to help children incorporate such changes into their everyday lives.

### 2.2. Stage one: workshop one

This initial stage (workshop one) focused on understanding children's knowledge of food packaging symbols (tidyman, green dot and three arrows; all common food packaging symbols in the UK) and disposal of different food items (juice bottle (clean), baked bean can (clean), glass milk bottle (clean), jelly pot (clean), sponge cake wrapper/tray (clean), ketchup bottle (used) and pizza box (used); representing different material types). Children ( $n = 195$ ) answered ten short and



Fig. 1. Overview of "The 3Is" four-stage approach utilised in primary schools.

simple questions relating to food packaging symbols (i) have you seen this symbol before? and (ii) do you know what it means? via a YES or NO question) and appropriate disposal (multiple choice question with different bin types: general waste, recycling, food waste or bottle bank) independently in class on printed worksheets. The worksheet was supplemented by an interactive presentation and each question was discussed in turn to educate children on packaging symbols and correct disposal practices (including cleaning prior to disposal and mixed materials). In addition, children were provided the opportunity to ask questions, as well as being introduced to the different bin types that exist in the Reading Borough (UK) and how this might vary between houses and flats (Fig. 2).

### 2.3. Stage two: at-home activity booklet

Children were provided with an activity booklet and ten food items (water bottle, cheese snack, apple, yoghurt, cereal, carrot/houmous snack, crackers, orange juice, pineapple slices and jam; Fig. 3) to be completed at-home for one-week in order to track subsequent appropriate food packaging disposal. The rationale for selecting the ten food items was twofold to: (1) enable consistency between children and reduce any potential extraneous variables; and (2) represent different packaging materials (such as plastic, cardboard, mixed materials, metal, and glass). The activity booklet involved three steps where children were asked to: (1) pick one food item from the food bag; (2) consume the food (if they wish); and (3) circle the bin (general waste, recycling, food waste, bottle bank; appropriate bins images were provided for both houses and flats) selected by them to dispose of the packaging, this process was repeated for all food items. It is important children were able to understand the process and had the opportunity to ask questions; therefore, during workshop one (e.g., prior to children receiving the items) an example on how to dispose of one food item in the booklet was discussed.

The images utilised in the activity booklet were specifically designed with children in mind to maximise engagement and ensure suitability. There were also some fun activities (such as word search, colouring, and maze game) that the children could complete if they wished. The children ( $n = 166$ ) that completed the activity booklets were asked a series of follow up questions: (i) activity booklet easiness (five-point category scale; very difficult to very easy); (ii) describe the experience of completing the activity booklet (using a few words); and (iii) asked if they needed any help from parents/guardians to complete the booklet (via a YES or NO question).

### 2.4. Stage three: workshop two

Workshop two focused on follow-up questions on food packaging symbols and disposal to understand the effect of education on subsequent knowledge. Accordingly, this workshop followed a similar structure to workshop one (worksheet, presentation, and discussion); however, there were a few modifications to the worksheet. For example, children ( $n = 195$ ) were no longer asked if they could recognise the food packaging symbols (as all children had seen these symbols at the previous workshop) instead they were asked if they could identify the meaning of the different food packaging symbols (using a multiple-

choice question). Again, the workshop was supported by an interactive presentation and discussion; all questions (from the worksheet) were discussed individually, and children were encouraged to ask questions to maximise their learning. There was also additional education provided on any relevant perceived knowledge gaps. In addition, children were asked three learning related questions (via YES or NO question): (1) is it necessary to clean the food packaging before you dispose of it? (2) did you learn something new about disposing food packaging in a sustainable way? and (3) do you think you will now change your food packaging disposal behaviour in the future? to understand whether taking part in the workshops had modulated children's behaviour.

### 2.5. Stage four: competition

The competition aimed to promote creativity and engagement with appropriate disposal behaviour. Primary schools that participated in the workshops were invited to take part in a bin design related competition. Children ( $n = 212$ ) were asked to draw a bin (such as bins that can take all food packages, encourage them/others to recycle more or maybe a superhero bin?). All drawings were collated, and the individual class teacher selected the best design at each primary school.

### 2.6. Statistical analysis

All analyses were carried out in XLSTAT (version 2022.3.2.1348, New York, USA) as follows: (1) two-alternative forced choice test to determine differences between variables (such as yes vs no or correct vs incorrect) via the Guessing model; and (2) tests for two proportions to identify changes pre and post education for packaging symbols (tidyman, green dot and three arrow) and disposal (juice bottle, baked bean can, glass milk bottle, jelly pot, sponge cake wrapper, ketchup bottle and pizza box);  $p < 0.05$  was utilised for significance level. Perceived activity booklet easiness (five-point category scale) was reported as difficult: very difficult + difficult, neutral and easy: very easy + easy in a percentage format.

## 3. Results

### 3.1. Food packaging symbols

Children were significantly familiar with the tidyman (95%) and three arrows (99%) symbols; however, they were less familiar with the green dot (60%) symbol (Table 1). Education on food packaging symbols (such as tidyman and green dot) was significantly effective at improving knowledge (Table 1). In addition, significantly more children ( $p < 0.0001$ ) were able to correctly identify the meaning of the tidyman, green dot and three arrows symbols post education as outlined in Table 2.

### 3.2. Food packaging disposal knowledge

Education was significantly influential at improving children's disposal related knowledge for juice bottle, baked bean can, jelly pot, ketchup bottle and pizza box ( $p < 0.0001$ ; Table 3). There was also a

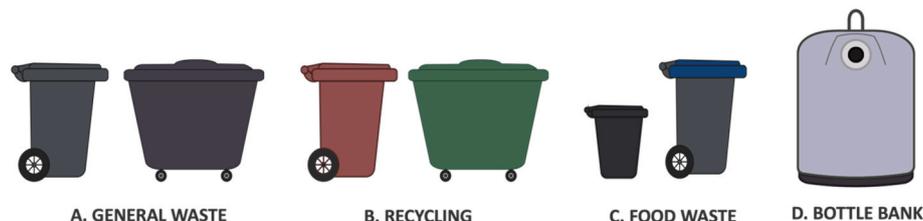


Fig. 2. Summary of bin types (general waste, recycling, food waste and bottle bank) typically used in Reading.



Fig. 3. Summary of food items utilised in the at-home activity booklet.

**Table 1**  
Children’s (n = 195) ability to recognise and knowledge (pre vs post education) towards food packaging symbols.

Symbol	Recognise symbol <sup>1</sup>		p-value*	Education <sup>2</sup>		p-value*
	Yes	No		Pre	Post	
Tidyman	94.9	5.1	< 0.0001	70.8	83.1	0.005
Green dot	60.0	40.0	0.003	16.4	65.6	< 0.0001
Three arrows	98.5	1.5	< 0.0001	86.7	86.2	0.88

<sup>1</sup>Have you seen this symbol before? <sup>2</sup>Do you know what this symbol means? This question was asked both at pre (workshop one) and post (workshop two) education. \*p-values reflect two-alternative forced choice test (recognise symbols) and tests for two proportion (correct responses for symbol meaning pre and post education) respectively and data reported as percentages.

**Table 2**  
Summary of children’s (n = 195) food packaging symbol knowledge.

Symbol	Response <sup>a</sup>	Answer	%
Tidyman 	<b>Remember not to litter</b>	Correct	81.5
	Package can be recycled if clean	Incorrect	10.8
	Package should be disposed as general waste	Incorrect	6.2
	Package is not recyclable	Incorrect	1.5
Green dot 	<b>Company provided money to a packaging recovery organisation</b>	Correct	73.3
	Package can be recycled	Incorrect	11.8
	Package is made from recycled materials	Incorrect	10.8
	Depends on the Recycling Centre in Reading	Incorrect	4.1
Three arrows 	<b>Package can be recycled</b>	Correct	82.1
	Package is made from recycled materials	Incorrect	11.8
	Package not yet recycled	Incorrect	3.6
	Relates to material type	Incorrect	2.6

<sup>a</sup> All responses were simplified to ensure suitably for children; therefore, wording may not reflect the full definition. Data reported in a percentage format from a multiple choice-based question.

significant positive change (nearly 70% of children) in selecting the correct bin combinations for mixed materials (jelly and sponge cake) post education ( $p < 0.0001$ ). In addition, education on cleaning prior to disposal was significantly effective ( $p < 0.0001$ ), where most children (87%) deemed it was necessary to clean food packaging prior to disposal.

### 3.3. At-home activity booklet

Overall, performance in the at-home activity booklet was encouraging as significantly more children correctly identified appropriate disposal for water bottle, cheese snack, apple, pineapple slices, jam jar, yoghurt (pot/film), cereal (lining/box) crackers wrapper and carrot/houmous snack (tray/film) ( $p < 0.05$ ; Fig. 4). However, there was no significant effect ( $p = 0.95$ ) for orange juice (three component packaging: juice carton, paper straw and plastic wrapper) (Fig. 4). In

addition, children’s individual performance was measured (e.g., correct responses across the different food items), where 81% of children correctly selected the right bin for five or more food items. The activity booklet was perceived predominately as easy (68%). Moreover, there was a significant effect ( $p = 0.005$ ) where 60% of the children did not receive any help from parents or guardians when completing the activity booklet. Children found the experience of completing the activity booklet very positive and key words to describe the experience included: cool, nice, good, easy, interesting, exciting and fun, as outlined in Fig. 5.

### 3.4. “The 3Is” learnings

There was a significant effect ( $p < 0.0001$ ) on learning where 84% of children learnt something new about disposing of food packaging in a sustainable way. In addition, there was a significant impact ( $p < 0.0001$ ) on children’s behaviour where 83% would now change their food packaging disposal behaviour in the future.

### 3.5. Bin design competition

Children enjoyed taking part in the bin design related competition and created a range of different bins that could inspire others, incorporate all food packaging or even have superpowers (Fig. 6).

## 4. Discussion

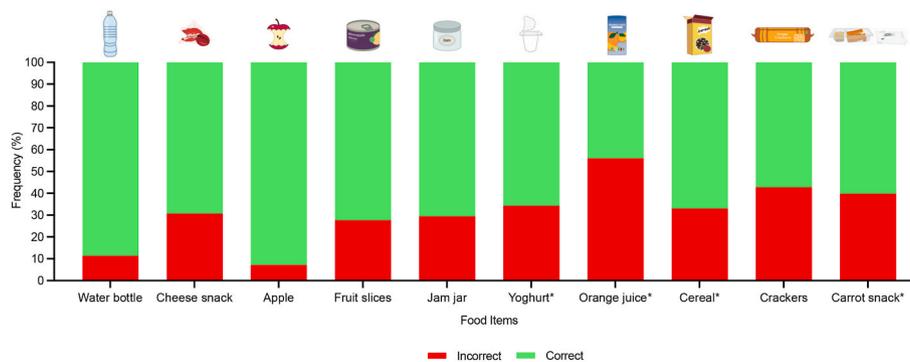
### 4.1. Food packaging symbols and disposal

Children need both sufficient familiarity and knowledge to enable sustainable food packaging practices. Positively, children were familiar (e.g., have you seen this symbol before?) with all three food packaging symbols to some extent. For example, there was very high recognition of the tidyman and three arrows (over 90%) whereas only 60% children were familiar with the green dot symbol. This finding supports literature mentioning that children are likely to be well-informed but also lack knowledge in some cases on disposal (Prestin and Pearce, 2010; Schill et al., 2020). Moreover, children need exposure to such labels to overcome any potential lack of understanding to inform subsequent decisions (de Brabandere et al., 2022). Accordingly, it is important labels are clearly defined and appeal to children to simulate interest and maximise impact in this age group (de Brabandere et al., 2022). In addition, visual cues (such as labels) may help to guide children to make more sustainable choices; however, the effectiveness of this might vary depending on children’s environmental concern (e.g., low vs high) (de Brabandere et al., 2022). More broadly, it has been noted consumers typically lack understanding or have limited knowledge associated with food packaging symbols/labels (Boesen et al., 2019; Norton et al., 2023). Therefore, more emphasis should be placed on companies designing food packaging to cater for children’s disposal needs, which in turn could help to increase households’ interest in sustainable food packaging practices (Schill et al., 2020). In addition, it is important to

**Table 3**  
Summary of children’s (n = 195) food packaging disposal responses pre and post education by bin types (general waste, recycling, food waste and bottle bank).

Food items	General waste		Recycling		Food waste		Bottle bank	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
	Juice bottle (clean) <sup>1</sup>	11.8	12.8	59.0 <sup>a</sup>	80.0 <sup>b</sup>	1.5	0.0	27.7
Baked bean can (clean) <sup>2</sup>	40.5	30.8	30.3 <sup>a</sup>	62.6 <sup>b</sup>	26.2	2.6	3.1	4.1
Glass milk bottle (clean) <sup>3</sup>	3.6	0.5	3.6	4.6	1.0	0.0	91.8	94.9
Jelly pot (clean) <sup>4*</sup>	41.5	19.0	52.8 <sup>a</sup>	78.5 <sup>b</sup>	5.6	1.5	0.0	1.0
Sponge cake wrapper (clean) <sup>5*</sup>	70.3	76.4	16.4	22.6	13.3	1.0	0.0	0.0
Ketchup bottle (used) <sup>6</sup>	19.5 <sup>a</sup>	78.5 <sup>b</sup>	58.5	7.2	15.4	12.3	6.7	2.1
Pizza box (used) <sup>7</sup>	43.6 <sup>a</sup>	84.1 <sup>b</sup>	44.6	11.8	11.3	4.1	0.5	0.0

Green shading denotes correct answer from multiple choice-based question and data reported as percentages. Differing significant letters denote significant result from the two proportions test and corresponding analysis was only completed on correct answers pre and post education. Food packaging materials as follows: (1) juice bottle: plastic bottle; (2) baked bean can: metal can; (3) glass milk bottle: glass bottle; (4) jelly pot: plastic pot; (5) sponge cake wrapper: plastic wrapper; (6) ketchup bottle: plastic bottle; and (7) pizza box: cardboard. \* denotes children received additional education on mixed materials separation.



**Fig. 4.** Overview of children’s (n = 166) appropriate food packaging disposal from the at-home activity booklet. Data reported as percentages and \* denotes mixed materials (yoghurt: plastic pot and plastic film; orange juice: juice carton, paper straw and plastic wrapper; cereal: cereal box and plastic lining; and carrot/homous snack: plastic tray & plastic film). (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)



**Fig. 5.** Children’s (n = 166) perceived experience of completing the at-home activity booklet.

understand whether familiarity translates into knowledge and subsequent sustainable behaviour.

Education helped to increase children’s knowledge and promote more sustainable food packaging behaviour. For example, in workshop one children were not always able to understand what each symbol

meant, nor correctly identify the most appropriate bin for disposal of the relevant food packaging. However, education (pre vs post) was successful at improving knowledge relating to food packaging symbols (tidyman and green dot) and correct disposal (juice bottle, baked bean can, jelly pot, ketchup bottle and pizza box). It should be noted for three



Fig. 6. Examples from the primary school children bin design related competition.

examples (such as three arrows symbol, glass milk bottle and sponge cake wrapper disposal) there was positive recognition (between 70–92%) prior to education hence limited room for a significant change post education. Positively, this translated into over 75% of children being able to identify the correct response in workshop two. Overall, the role of education (via two workshops) was very promising and had a positive impact in this cohort of primary school children. Therefore, it could be suggested workshops provide an ideal classroom activity to involve, inform and inspire primary school children on sustainable food packaging practices. This finding supports previous work which highlighted the positive impact of educational workshops on children's knowledge, awareness and intention in terms of aluminium packaging recycling (Buil et al., 2017). Similarly, education on food waste and recycling can help modulate subsequent behaviour in school-aged children (Wilkie et al., 2015). Moreover, it is important children are equipped with correct disposal knowledge since this has a key role in promoting sustainable behaviour and should be learnt from an early age (Castellano et al., 2021). Accordingly, it would be beneficial to understand the effect of regular education on subsequent knowledge and behaviour, as well as more emphasis should be placed on incorporating sustainable food packaging practices into the school curriculum so that children are suitably equipped.

It is important to educate children on potential barriers that they may encounter in terms of disposing of food packaging sustainably. It was clear children were uncertain about correct disposal practices for used food packaging (e.g., cleaning prior to food packaging prior to recycling) and did not always realise they needed to separate mixed materials before disposal. These two issues have also been cited in the literature as barriers to recycling, as well as associated with confusion and low awareness in terms of correct practices (Klaiman et al., 2017; Norton et al., 2023). Accordingly, children were provided with education on cleaning prior to disposal and mixed materials separation; importantly, education was successful at enhancing knowledge in most cases. This finding supports previous work which highlighted targeted education can help promote awareness on such topics (Norton et al., 2023; Vasquez et al., 2023). However, it should be noted for mixed materials packaging utilising three components (e.g., orange juice: juice carton, paper straw and plastic wrapper); education led to a positive change (but not significant) in terms of children that correctly selected bin combinations for the various components. Accordingly, future work should focus on informing and educating children on sustainable practices especially relating to mixed materials, as well as companies providing clearer instructions on packaging to help subsequent decision-making. Going forwards, more emphasis should be placed on utilising targeted education regardless of consumer age to maximise interest within households and subsequently encourage everyday

sustainable food packaging behaviour.

#### 4.2. At-home activity booklet

The activity booklet enabled an opportunity to engage children in food packaging disposal in a home setting and promote self-learning. Children's performance in the activity booklet was considered promising; therefore, children were able to put into practice learnings from workshop one and had sufficient knowledge on appropriate food packaging practices to do this at-home. In addition, children identified the experience as positive and easy to do in most cases, as well as more than half of the children completed the booklet independently. It is likely the 'sense of responsibility', intervention length (one-week) and previous experience in household disposal could have contributed to these results (Prestin and Pearce, 2010; Otto and Pensini, 2017; Schill et al., 2020). However, more frequent opportunities to partake in such activities may help to further promote, and help to successfully incorporate, positive food packaging behaviour into children's everyday lives in the future. Moreover, positive experiences in childhood are important as they can enable solid foundations for later in life (Daines et al., 2021). This is hugely relevant since environmental behaviour is often developed between 7–10 years and improving knowledge (via education) can be effective in supporting subsequent behaviour (Otto and Pensini, 2017; Otto et al., 2019). It should be noted in some cases children were less engaged in the activity booklet and this may relate to a child's household not 'fostering' recycling practices (Schill et al., 2020); accordingly, a child may not be interested or given the opportunity to get involved. Additionally, there may be differences in children's adherence to disposal practices depending on the particular setting (at-home vs school) (Schill et al., 2020). This may result from a lack of consistency and/or accessibility in infrastructure (such as different bins) or opportunities to contribute to the household disposal, resulting in limited knowledge (Prestin and Pearce, 2010; Schill et al., 2020). Hence, for some parents/guardians it would be necessary to promote awareness and encourage children involvement in household disposal of food packaging (Schill et al., 2020). Children can also pester parents/guardians to make changes (commonly referred to 'pester power') and this could be an effective approach to encourage everyday sustainable food packaging behaviour within a household (Istead and Shapiro, 2014; O'Neill and Buckley, 2019). Therefore, it could be suggested that activities that promote engagement in both school and home settings could be a feasible solution to help encourage more sustainable behaviour.

### 4.3. Bin design related competition and overall learnings

Drawing related activities can help stimulate children's creativity, as well as building on current knowledge and promote problem solving, understanding, learning and experimenting (Durham Commission, 2019). The bin design related competition enabled this, as well as inspiring, motivating, engaging and identifying future solutions to encourage more sustainable behaviour. In addition, the competitive element inspired creative, fascinating and futuristic designs; overall, it is hoped children will go home and become interested in disposing of food packaging in a sustainable way.

It is fundamental to consider the children's perspective and evaluate learning post workshops to understand the impact of education on sustainable food packaging behaviour. There was an overriding positive response where nearly all children (over 80%) learnt something new and would change future behaviour. Therefore, "The 3Is" approach utilising interactive, informative and fun activities was successful in promoting a shift in sustainable food packaging behaviour for children aged 7–11 years. It should be noted that "The 3Is" only focused on primary schools in one area (e.g., Reading) during the Autumn term; therefore, could be considered limited in scope. Accordingly, future work should include a broader age range of children (e.g., secondary school; aged 11–18 years) and expand "The 3Is" approach to beyond primary schools in the Reading area to maximise impact. In addition, emphasis should be placed on tracking sustainable food packaging behaviour across the school year to understand the potential long-term impact on subsequent behaviour as well as investigating the role of 'pester poster' from children in their household.

## 5. Conclusion

"The 3Is" project focused on involving, informing and inspiring primary school children about how to dispose of food packaging sustainably utilising interactive, informative and fun activities. Children had some familiarity with food packaging symbols; however, there were knowledge gaps. There was a positive impact of education on improving knowledge for food packaging symbols (tidyman and green dot) and correct disposal practices (e.g., juice bottle, baked bean can, jelly pot, ketchup bottle and pizza box). Cleaning food packaging prior to recycling and mixed materials separation were two areas identified for additional education; they warrant improved awareness and clearer messaging in the future. The children enjoyed completing an activity booklet at-home to track subsequent appropriate food packaging disposal. Importantly, children were able to incorporate sustainable food packaging practices at-home, as demonstrated by the promising results (more than 65% of children correctly identified the right bin for most food items) from the activity booklets. The bin design related competition was effective at inspiring interest in sustainable food packaging. "The 3Is" approach was successful in promoting learning (84% of children learnt something new) and modulating future behaviour (83% of children will change future food packaging disposal behaviour). Therefore, this project emphasises the importance of educating (via fun, interactive and informative approaches) the next generation to promote a shift in everyday sustainable food packaging behaviour. Accordingly, next steps should focus on developing "The 3Is" approach beyond Reading based primary schools and focusing on schools across the UK and Europe, as well as expanding the age-group (e.g., secondary schools) to ensure the next generation is well equipped to deal with disposing of food packaging sustainably.

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## CRediT authorship contribution statement

**Victoria Norton:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Software, Writing – original draft, Writing – review & editing. **Niki Alexi:** Methodology, Writing – review & editing. **Ana Contente:** Investigation, Methodology, Writing – review & editing. **Stella Lignou:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Software, 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.

## Data availability

Data will be made available on request.

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