Circular Economy and Behaviour Change: Using Persuasive Communication to Encourage Pro-Circular Behaviours Towards the Purchase of Remanufactured Refrigeration Equipment

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Abstract

Refrigerated Display Cabinets (RDCs) are used in the retail sector to display chilled and frozen food, and beverages. The manufacture of RDCs is typified by the extensive use of materials and energy, meaning that the development of a Circular Economy in this sector is particularly important.

A number of behavioural barriers are preventing the development of the Circular Economy but an appropriate behaviour change intervention could help to overcome them. This paper investigates how effective the use of Persuasive Communication could be in influencing the Behavioural Attitudes, Product Perceptions and Behavioural Intentions towards the purchase of remanufactured RDCs. Participants in this study are engineers and academic experts of retail refrigeration equipment.

The study was carried out in three consecutive stages. In the first stage participants completed a questionnaire, which assessed their Behavioural Attitudes, Product Perceptions and Behavioural Intentions. In the second stage participants were exposed to the intervention, which was the Persuasive Communication in the form of an audio-visual presentation. In the third stage participants completed a second questionnaire which assessed the impact of the intervention. The results show that the Persuasive Communication had a positive impact on the participants' Behavioural Attitudes, Product Perceptions and Behavioural Intentions towards the purchase of remanufactured RDCs. This paper demonstrates how effective this type of intervention could be, if developed further to create a target market and generate demand for remanufactured RDCs.

Keywords: Circular Economy; Pro-Circular Behaviour; Behaviour Change; Persuasive Communication; Circular Business Models; Remanufacture

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Introduction

The negative environmental impacts of the long-practiced linear system have led to businesses and governments (UN, 2015; HM Government, 2018; European Commission, 2015) recognising the importance of moving to a more sustainable and circular economy. The Circular Economy is an economic and industrial system underpinned by a variety of theories including Stahel's Closed-Loop Framework (1982), McDonough and Braungart's Cradle to Cradle (2002) and Pauli's Blue Economy (2010). They all advocate the necessity of keeping resources in circulation in order to reduce waste and consumption of raw materials in industrial processes. The adoption of the Circular Economy typically involves businesses implementing a range of alternative business models, such as remanufacture.

Remanufacture is a process in which good quality reusable components in end-of-life cores are reutilised in the production of 'good-as-new' products. Products can be remanufactured depending on their technical capabilities, namely easy-disassembly and content of high quality components made with long-life materials. An example of products that have a technical capability for remanufacture are Refrigerated Display Cabinets (RDCs). Refrigerated Display Cabinets are used to stock and display chilled, frozen food and beverages in retail grocery stores (i.e. supermarkets, convenience stores). An average Refrigerated Display Cabinet weighs 500kg and contains 85% metals (steel, aluminium, brass, copper), 3% polymers and 3% glass. Due to the manufacture of new Refrigerated Display Cabinets consuming extensive volumes of materials, moving to a more resource-efficient production of Refrigerated Display Cabinets is particularly important.

Typically, Refrigerated Display Cabinets are used in retail grocery stores for 5 years on average before they are disposed. The remanufacture of Refrigerated Display Cabinet has a potential to increase their functioning by up to15-20 years (Bibalou et. al., 2011). This could reduce waste and decrease the demand for raw materials (such as steel, aluminium, brass, copper etc.) that are sourced to produce new Refrigerated Display Cabinets. Currently remanufacturing rates in the UK Retail Refrigeration Industry are low. Estimates show that the industry continues to produce large amounts of waste from the disposal of Refrigerated Display Cabinets (Walsh, 2009). This low uptake of remanufacturing is due to business-to-business consumers (the retailers who purchase refrigeration equipment to use in their stores) not showing any intention to perform pro-circular behaviours[1], which is due to them holding unfavourable attitudes and perceptions towards remanufacturing. If consumers were encouraged to buy remanufactured RDCs, there would be a greater demand for *circular* products, meaning producers would be more inclined to implement circular business models.

For consumers, generally there are several behavioural barriers that result in the low uptake of pro-circular behaviours, especially at the stage of purchase (Smol et al., 2018). The first, is having an adverse attitude and perception towards a circular product and service (Houston et al., 2018). For example, products that are remanufactured are often wrongly perceived by the consumer as being of lower quality (APPSRG and APPMG, 2014). Therefore, promoting circular products, particularly appeasing concerns about their performance, in addition to educating consumers about the merits of the Circular Economy is essential in attempting to change behaviours (Smol et al., 2018; Suárez-Eiroa et al., 2019). This is particularly important, as the implementation of pro-circular behaviours by consumers is often disregarded due the benefits (e.g. resource security, waste reduction) not being immediately apparent to them (Atherton, 2015).

This study uses selected constructs of the Pro-Circular Change Model[2] to measure the impact Persuasive Communication has on influencing the Behavioural Attitudes, Product Perceptions and Behavioural Intentions towards the purchase of remanufactured RDCs.

The first construct used is Behavioural Attitude, this is defined as "a psychological tendency that is expressed by evaluating a particular entity with some degree of favour or disfavour" (Eagly and Chaiken, 1993, p.1). Behavioural Attitudes are learned and changeable evaluations that ultimately influence behaviours (Daiton, and Zelley, 2005). It is usual for a person who holds positive attitudes towards a certain behaviour to perform the behaviour and vice versa (Ajzen and Fishbein, 1977). As literature on Circular Economy suggests (Maichum et al., 2016, Houston et al., 2018; Atherton, 2015), an adverse attitude towards performing of certain pro-circular behaviours, could prevent their uptake.

[1] Pro-circular behaviour is "an action which is brought about due to prioritising resource-efficiency. This behaviour benefits or at least reduces damage to the environment, economy and society." (Muranko et al., 2017a) Behaviours such as *purchasing remanufactured products* are considered as pro-circular.

[2] The Pro-Circular Change Model (P-CCM) is a theoretical framework developed to help identify and influence behaviours that can support the development of a Circular Economy (Muranko et al., 2018).

The second construct used is Product Perceptions, these are person's beliefs about a product that is directly associated with[3] or is a consequence of[4] performing a behaviour. Product Perceptions relate to an individual's beliefs about product's characteristics, such as its appearance, performance or quality (e.g. APPSRG and APPMG, 2014; ERN, 2015; CRR, 2009). Currently consumers perceive *circular* products negatively. Products that are reused, repaired, refurbished or remanufactured are typically seen as poorer quality than brand new products, which has contributed to the low uptake of the Circular Economy so far.

The third construct used is Behavioural Intention. The performance of a behaviour relies on the Behavioural Intention to perform it (Ajzen, 1991). The more favourable Attitudes and Perceptions a consumer holds, results in a more positive Behavioural Intention which leads to the behaviour being more likely.

The fourth construct used is Persuasive Communication which is defined as a behaviour change intervention "that is designed to influence others by modifying their beliefs, values, or attitudes" (Simons, 1976, p. 21). Attitudes and Perceptions can be influenced through the appropriate behaviour change interventions and encourage the uptake of pro-circular behaviours. As shown in previous studies, methods of communication can positively influence consumers' attitudes and intentions towards resource-efficient (Warren et al., 2016) and sustainable behaviours (Pelletier and Sharp, 2008), including a purchase of 'green' (Kong and Zhang, 2014) and remanufactured products (Michaud and Llerena, 2011).

Literature on the Circular Economy frequently discusses human behaviour being the important driver in the development of the Circular Economy. However, to date matters related to behaviour change, particularly in the consumer domain, remain underrepresented in Circular Economy research (Chamberlin and Boks, 2018). This paper provides an insight into the effects of Persuasive Communication in changing consumer behaviours. It demonstrates how effective this type of intervention could be, if developed further to generate consumer demand for remanufactured products, specifically remanufactured RDCs.

2. Research Methodology

The data investigated in this study were collected from questions embedded in structured surveys. The questions were designed to evaluate the impact the behaviour change intervention had on the Behavioural Attitudes, Product Perceptions and Behavioural Intentions of the population sample to perform a pro-circular behaviour - defined as *'buying remanufactured RDCs'*. The study was carried out in three consecutive stages in which participants' Behavioural Attitudes, Product Perceptions and Behavioural Intentions were assessed both, before and after the behaviour change intervention.

2.1. Population Sample

The population sample of the study included a range of industry and academic experts from both the Food and Retail Refrigeration Sectors. The reason for choosing this population sample being that they have similar characteristics to retail grocery retailers, namely those individuals who purchase Refrigerated Display Cabinets. This is evidenced by both, the sample population and the individuals who purchase RDCs possessing knowledge of Refrigerated Display Cabinets in terms of the products' use and function. The study was conducted in April 2017 at an industry meeting. The population sample contained 26 individuals including industry professionals (N=4) and academic experts (N=22) with working connections to food and retail refrigeration sector.

2.2. Research Procedure

The study was carried out in three consecutive stages, as illustrated in Figure 1. In the first stage, the study was introduced to all participants to ensure they understood what type of pro-circular behaviour was being investigated. Following the introduction, participants completed a Part 1 Questionnaire (described in section2.3.1.a), which (in addition to demographic data) recorded their Behavioural Attitudes *(1)* Product Perceptions *(1)* and Behavioural Intentions *(1)* towards purchasing remanufactured Refrigerated Display Cabinets. In the second stage, participants were exposed to the behaviour change intervention (described in section 2.3.2.), which was the Persuasive Communication in the form of an oral/slide presentation, lasting approximately 8 minutes. In the third stage, participants completed Part 2 Questionnaire (described in section 2.3.1.b) which assessed the impact of the behaviour change intervention on their Behavioural Attitudes *(2)* Product Perceptions *(2)* and Behavioural Intentions *(2)* towards the pro-circular behaviour.

[3] An example is purchase (the behaviour) of a remanufactured product
[4] An example is producing (the behaviour) a remanufactured product

Part 1 Questionnaire	>	**Behaviour change intervention**	>	**Part 2 Questionnaire**
Behavioural Attitudes (1)		Persuasive Messages		Behavioural Attitudes (2)
Product Perceptions (1)		Visual Persuasion		Product Perceptions (2)
Behavioural Intention (1)				Behavioural Intention (2)

Figure 1. Study procedure.

2.3. Study Design

The behaviour change intervention was designed using the Persuasive Communication methods. The influence of the Intervention on the participants' responses was assessed using a structured survey. The survey aimed to record the participants' current Behavioural Attitudes, Product Perceptions and Behavioural Intentions towards performing the pro-circular behaviour and to evaluate the influence of the behaviour change intervention thereafter. Both, the survey and the intervention items were developed with the support of two industry experts (with expertise in refrigeration engineering that is similar to that of the sample population and of the grocery retailers).

2.3.1. Survey Development

The questionnaire items for both parts of the survey - pre-intervention (*Part 1 Questionnaire*) and post-intervention (*Part 2 Questionnaire*), together with the scales are summarised in Table 2. and are explained further in the sections *a* and *b.*

Table 2. Questionnaire Items and Scales: Part 1 and Part 2 Questionnaire.

Variable	Q.	Questionnaire Item	Scales Items	Scale Type
Questionnaire Part 1				
Demographic	1	*Which of the following best describes you?*	*I buy RDCs/produce /sell RDCs/other refrigeration equipment, I work with RDCs/ in retail refrigeration industry/in research/in food industry/on product development, Other (please specify)*	Multiple selection
Behavioural Intention	2	*In your opinion, if a retailer needed to buy 50 fridges to furnish their supermarket, which type of RDCs would be better to buy?*	*New, Remanufactured, I Don't know*	Single-choice
Product Perceptions	3	*In your opinion, and based on the following characteristics, please compare [quality, performance, appearance, longevity and warranty] factory-remanufactured RDCs with new RDCs.*	*Better than new, The same as new, Worse than new,*	3-point Likert
Behavioural Attitudes	4	*In your opinion, buying factory-remanufactured RDCs could be... [good - bad, convenient - inconvenient, necessary - unnecessary, profitable - expensive]*	*Extremely, Moderately, Slightly, Neither*	7-point Likert
Questionnaire Part 2				
Behavioural Awareness	5	*Prior to this presentation, were you aware that RDCs can be factory-remanufactured?*	*Yes, No*	Single-choice
Behavioural Intention	6	*If a retailer needed to buy a number of fridges to furnish their supermarket, which type of RDCs would be better to buy?*	*New, Remanufactured, I Don't know*	Single-choice
Product Perceptions	7	*Based on the following characteristics, please compare [quality, performance, appearance, longevity and warranty] factory-remanufactured RDCs with new RDCs.*	*Better than new, The same as new, Worse than new*	3-point Likert
Behavioural Attitudes	8	*Buying factory-remanufactured RDCs is... [good - bad, convenient - inconvenient, necessary - unnecessary, profitable – expensive]*	*Extremely, Moderately, Slightly, Neither*	7-point Likert

a) Part 1 Questionnaire

The Part 1 Questionnaire begins with an introduction to the study followed by a *demographic* measure (question 1., Table 2.). Multiple-choice items are combined with an open-ended answer, giving each participant the opportunity to specify their role within the industry. Next, in question 2. a direct measure of Behavioural Intention was developed [based on Ajzen's recommendations (Ajzen, 2006)] to investigate participants' beliefs about performing the pro-circular behaviour. This measure was assessed using single-choice responses, enabling participants to specify their Behavioural Intentions. Measures of Product Perceptions followed in question 3. The question was accompanied by a 3-point Likert (1932) scale, which enabled participants to express their perceptions towards the *quality, performance, appearance, longevity* and *warranty* of remanufactured Refrigerated Display Cabinets by comparing them with new RDCs. A reliability analysis was carried out on the Product Perceptions comprising the above 5 items – Cronbach's alpha[5] showed the measures reached a good reliability *(α=0.85).*The final question in Part 1 Questionnaire (question 4.) measured participants' Behavioural Attitudes [developed as per Ajzen's recommendations (Ajzen, 2006)] towards performing the pro-circular behaviour. The question was accompanied by a 7-point Likert scale, which enabled participants to indicate their attitudinal beliefs about how *good-bad*, *convenient-inconvenient*, *necessary-unnecessary* and *profitable-expensive* it is to buy remanufactured RDCs. Cronbach's alpha showed the measures of Behavioural Attitudes also reached an acceptable reliability *(α =0.76).*

b) Part 2 Questionnaire

Part 2 Questionnaire began by asking participants to indicate their *awareness* of remanufacturing RDCs prior to the intervention (question 5). This question was accompanied by a *yes-no* dichotomous option, which were provided to clearly distinguish the participants' answers. This question was followed by the repeated measures (equivalent to those included in the Part 1 Questionnaire*)* of Behavioural Intentions in question 6., Product Perceptions *(α= 0.82)* in question 7. and Behavioural Attitudes *(α=0.93)* in question 8.

2.3.2. Behaviour Change Intervention Design

The behaviour change intervention was delivered by the lead researcher through a presentation which included Persuasive Communication. The presentation began with an introduction to RDCs with emphasis on their design, material content and size. Next, the process of remanufacturing RDCs was explained (to minimise any confusion about the process, remanufacture was compared and distinguished from refurbishment, as both processes are often mistaken to be the same). The Persuasive Communication items are summarised in Table 3. and are explained further in sections a) and b) below.

Table 3. Persuasive Communication items.

Targeted Variables	Type	Content
Behavioural Attitudes [a]	Environmental messages	Message with intrinsic value; emphasis on the behaviour contributing to reduction of waste from the disposal of refrigerated display cabinets Message with extrinsic value; emphasis on the reduction of the company's carbon footprint
	Economic messages	Message with intrinsic value; emphasis on the behaviour helping local manufacturing businesses grow Message with extrinsic value; emphasis on profits associated with the purchase of remanufactured refrigerated display cabinets
	Social messages	Message with intrinsic value; emphasis on performing of the behaviour contributing to skilled jobs and training opportunities in manufacturing sector Message with extrinsic value; emphasis on the behaviour contributing to company's Corporate Social Responsibility[6] goals

[5] Cronbach's alpha (Cronbach, 1951) is a measure of the internal consistency of a scale. Cronbach's alpha describes the extent to which all the items in a test (e.g. items of Behavioural Attitude) measure the same construct (e.g. the Behavioural Attitude). It is expressed as a number between 0 and 1, with an acceptable value of alpha typically ranging from 0.70 to 0.95.

[6] Corporate Social Responsibility reports describe retailers' business approach that contributes to sustainable development by delivering social (as well as economic and environmental) benefits for all stakeholders.

Product Perceptions [b]	Graphics	Illustration: emphasis on the effects of remanufacture on an example of a graphic illustration a 'before and after' refrigerated display cabinet Photographs: emphasis on the effects of remanufacture on an example of a images (x2) containing a factual representation of a 'before and after fridge'; images (x2) of components used in remanufacture of an RDCs; images (x2) of fridges – comparison one of a remanufactured RDC, and one of a new RDC

[a] Behavioural Attitudes were targeted by delivering persuasive messages verbally and visually by the lead researcher.
[b] Product Perceptions were targeted by delivering visual persuasion, in the form of graphics in the presentation.

a) Targeting Behavioural Attitudes

The Persuasive Communication has been shown to be a successful method in changing people's attitudes. Persuasive messages used in this study, were designed to positively influence the participants' Behavioural Attitudes and ultimately change their Behavioural Intentions towards the purchase of remanufactured RDCs. The presentation included six messages (as described in Table 3.), that were developed to comprise both, extrinsic and intrinsic values associated with the environmental, economic and social benefits of remanufacturing RDCs.

As per Ajzen's (1992) recommendations, the Persuasive Communication messages used in the presentation were designed to hold three key components: (I) an advocated position - which outlines a particular problem or recommends specific behaviour, (II) an argument - which provides reasoning for adoption of the advocated position and (III) factual evidence - which reinforces the argument. For example, a Persuasive Communication message comprising intrinsic value and potential environmental benefits attributed to buying remanufactured RDCs, was defined as:

'*Did you know that if you purchased 50 remanufactured RDCs, you could save 25 tonnes of reusable parts and material from entering the waste-stream?' (*I*); 'FACT#3 In 2015 there were 69,000 RDCs in the UK at their end-of-life available to be remanufactured. Due to a low demand for remanufactured RDCs, they were disposed of and generated 34,000 tonnes of waste. A greater demand for remanufactured RDC's could help to reduce waste.'* (II*); '(source: Centre for Remanufacture and Reuse)'*(III)

A typographical representation was also considered in the design of messages. As per the recommendations of Husband and Hellier (2011), the colours of fonts were manipulated to enhance the key parts of messages i.e. red font was used to highlight the negative parts of the messages, whereas green and blue fonts were used to highlight the positive parts of the messages. An enlarged font size was used to draw the participants' attention to the important parts of the message.

b) Targeting Product Perceptions

Visual persuasion involves the use of graphics such as illustrations and photos to influence people's beliefs and behaviours. Visual persuasion was implemented to influence the participants' perceptions about remanufactured RDCs. The presentation included one graphical illustration and six photographs. The illustration was a RDC split into two – one half illustrating the condition of an end-of-life RDC and the other half illustrating a remanufactured RDC. Participants were exposed to the illustration for at least two minutes during the presentation (the illustration appeared on several occasions during the presentation).

The photographs showed pre-and post-remanufactured RDCs. This first pair of images showed an eleven-year-old RDC before remanufacture and after remanufacture. To emphasize the high standard of the remanufacture, the second pair of images showed the new coil and energy efficient fans that were installed. The final pair of photographs showed two models of RDCs. Despite both RDCs looking like brand new products, one was remanufactured. The aim of this visual persuasion was to influence the perception of the participant to consider remanufactured RDCs to be like brand new products.

The graphical illustration and photographs were displayed during the presentation alongside keywords (such as *before* or *after remanufacture* or *new components*). The lead researcher also verbally emphasised the quality, performance and longevity of RDCs.

3. Results

This section presents a descriptive and inferential statistical analysis of the participants' Behavioural Attitudes, Product Perceptions and Behavioural Intentions towards the purchase of remanufactured RDCs before and after the influence of the behaviour change intervention. First, sample means were calculated to estimate the central tendency of data. Secondly, standard deviations were calculated to indicate dispersion of data from the sample mean. Lastly, standard errors were calculated to indicate the precision of the study, and how well the sample truly represents the population of experts working within the sector at large. Frequency histograms are also provided

to illustrate the distribution of data. The participants' awareness of remanufacturing RDCs prior to the intervention is also provided.

Inferential statistics were used to further-analyse the impact of the behaviour change intervention. A paired sample t-test was used to determine whether the means of Behavioural Attitudes and Product Perceptions influenced by the presence of the behaviour change interventions, differed significantly from the means of Behavioural Attitudes, Product Perceptions and Behavioural Intentions held by the participants prior to the intervention. Pearson's chi-square statistic was used to examine the significance of differences in distribution of data, particularly for the Behavioural Intentions before and after the behaviour change intervention.

3.1. Behavioural awareness

The majority of participants were familiar with the remanufacture of RDCs and accounted for 58% (N= 15) of the sample. Whereas, less than half of the participants were not familiar with the remanufacture of RDCs before the study and accounted for 42% (N=11) of the sample.

3.2. Behavioural Attitudes

The analysis of results presented in Table 5. suggests that before the behaviour change intervention the overall Behavioural Attitudes of participants towards the purchase of remanufactured RDCs were relatively positive. Participants reported that they perceived the purchase of remanufactured RDCs to be *good, convenient* and *profitable*. More neutral responses were given to their Behavioural Attitudes towards the *necessity* of performing the pro-circular behaviour. The Behavioural Attitudes recorded after the behaviour change intervention scored slightly higher.

Table 5. Behavioural Attitudes (BA) before and after behaviour change intervention (BCI).

	N	$\bar{x}$	SD	*SE*	minimum	maximum
BA good - bad						
Before BCI	23	**5.52**	1.50	*0.31*	1.00	7.00
After BCI	24	**5.92**	1.56	*0.32*	1.00	7.00
BA convenient - inconvenient						
Before BCI	23	**5.26**	1.42	*0.30*	1.00	7.00
After BCI	24	**5.46**	1.96	*0.40*	1.00	7.00
BA necessary - unnecessary						
Before BCI	23	**4.91**	1.65	*0.34*	2.00	7.00
After BCI	23	**5.74**	1.54	*0.32*	2.00	7.00
BA profitable - expensive						
Before BCI	23	**5.87**	.87	*0.18*	2.00	7.00
After BCI	24	**5.96**	1.57	*0.32*	1.00	7.00
BA mean						
Before BCI	-	**5.39**	1.36	*0.28*	-	-
After BCI	-	**5.77**	1.66	*0.34*	-	-

The frequency distributions of scores for participants' Behavioural Attitudes recorded before and after the behaviour change intervention (Appendix A) were also examined. The results recorded before the intervention show various levels of skewness and kurtosis in the distribution of scores for all Behavioural Attitudes. The results recorded after the behaviour change intervention, show skewness in distribution of scores directed to the left of the scales, indicating a consistent increase in positive Behavioural Attitudes for all four items.

However, the results of the t-test on Behavioural Attitudes recorded before and after intervention presented in Table 6. show the substantial and statistically significant [$t(21)=3.38$, $p=0.001$] differences were only recorded between the Behavioural Attitudes towards the purchase of remanufactured RDCs being *necessary*. There were no statistically significant differences between the means of Behavioural Attitudes towards the pro-circular behaviour being *good, convenient* and *profitable*.

Table 6. Summary of paired sample t-test on Behavioural Attitudes (BA) before and after behaviour change intervention (BCI).

	t	df	*p*
BA good before BCI - BA good after BCI	**1.433**	21	*0.083*
BA convenient BCI - BA convenient after BCI	**1.064**	21	*0.150*
BA necessary BCI – BA necessary after BCI	**3.382**	21	*0.001**
BA profitable BCI - BA profitable after BCI	**0.508**	21	*0.309*

Hypothesis: BA before < BA after
* Significance: p<0.05*
Note: Student t-test

3.3. Product Perceptions

The analysis of results presented in Table 7. suggests that before the behaviour change intervention the overall Product Perceptions of participants towards remanufactured RDCs were relatively neutral (means ≥ *2* were considered positive). The majority of participants perceived the remanufactured RDCs to be of the same *quality* and *performance* as new RDCs. However, for other items of Product Perceptions, namely the *appearance, longevity* and *warranty*, a large proportion of participants indicated that remanufactured RDCs are worse than new RDCs. The Product Perceptions recorded after the behaviour change intervention scored higher.

Table 7. Product Perceptions (PP) before and after behaviour change intervention (BCI).

	N	$\bar{x}$	SD	*SE*	minimum	maximum
PP quality						
Before BCI	24	**2.08**	.65	*0.13*	1.00	3.00
After BCI	24	**2.17**	.70	*0.14*	1.00	3.00
PP performance						
Before BCI	24	**2.13**	.68	*0.14*	1.00	3.00
After BCI	24	**2.13**	.74	*0.15*	1.00	3.00
PP appearance						
Before BCI	24	**1.71**	.69	*0.14*	1.00	3.00
After BCI	25	**2.12**	.53	*0.11*	1.00	3.00
PP longevity						
Before BCI	24	**1.71**	.69	*0.14*	1.00	3.00
After BCI	24	**1.96**	.75	*0.15*	1.00	3.00
PP warranty						
Before BCI	24	**1.71**	.81	*0.16*	1.00	3.00
After BCI	23	**1.74**	.69	*0.14*	1.00	3.00
PP mean						
Before BCI	-	**1.87**	0.70	*0.14*	-	-
After BCI	-	**2.02**	0.68	*0.14*	-	-

The frequency distributions of scores for participants' Product Perceptions before and after the behaviour change intervention (Appendix B) were also examined. The results recorded before the intervention show various levels of skewness and kurtosis in distribution of scores (for the *quality, performance* showing mesokurtic distribution with majority of scores on the positive side of scales*; for the appearance, longevity and warranty* - mixed distributions with majority of scores falling on the negative side of scales). The results recorded after the behaviour change intervention, indicated the distribution changed for perceptions towards the *appearance, longevity and warranty* of remanufactured RDS, showing a decrease in negative answers. There was little or no change in the distribution of scores for the *quality* and *performance* of remanufactured RDCs, with scores remaining on the positive side of scales.

However, the results of the t-test on Product Perception recorded before and after intervention presented in Table 8., show the substantial and statistically significant differences were only recorded between the Product Perceptions towards the *appearance* [*t(23)=2.46, p=0.011*] of remanufactured RDCs. There were no statistically significant differences between the means of Product Perceptions towards the *quality, performance, longevity* and *warranty* of remanufactured RDCs.

Table 8. Summary of paired sample t-test on Product Perceptions (PP) before and after behaviour change intervention (BCI).

	t	df	*p*
PP quality before BCI – PP quality after BCI	**0.526**	23	*0.302*
PP performance before BCI – PP performance after BCI	**0.000**	23	*0.500*
PP appearance before BCI – PP appearance after BCI	**2.460**	23	*0.011**
PP longevity before BCI – PP longevity after BCI	**1.661**	23	*0.055*
PP warranty before BCI – PP warranty after BCI	**0.272**	22	*0.394*

Hypothesis: PP before < PP after
* Significance: p<0.05*
Note: Student t-test

3.4. Behavioural Intentions

The analysis of results presented in Table 9. suggest that the participants' Behavioural Intentions towards the purchase of remanufactured RDCs before the behaviour change interventions were neutral. However, following the intervention Behavioural Intentions towards performing the pro-circular behaviour scored considerably higher.

Table 9. Behavioural Intentions before and after BCI.

	N	$\bar{x}$	SD	*SE*	minimum	maximum
BI before BCI	26	**2.08**	.80	*0.16*	1.00	3.00
BI after BCI	26	**2.58**	.76	*0.15*	1.00	3.00

As illustrated in Figure 10., the number of participants who decided to purchase new RDCs decreased from 27% to 15% (by N=3). The number of participants who were undecided about their decisions decreased from 38% to 12% (by N=7). Whereas, the number of participants whose Behaviour Intentions were to purchase remanufactured RDCs have considerably increased from 35% to 73% (by N=10).

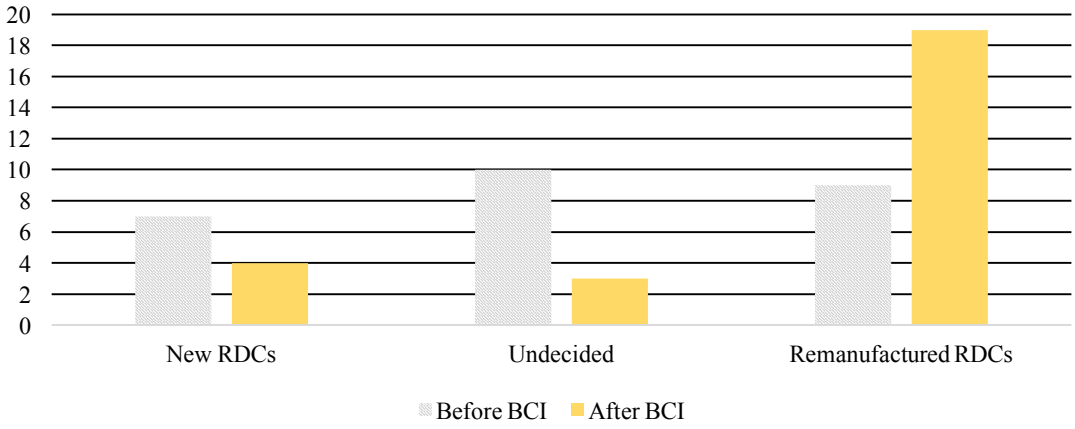

Figure 10. Frequency distribution of Behavioural Intentions before and after behaviour change intervention.

The distribution of scores, based on the participants' awareness of remanufactured RDCs prior to their participation in the study were also examined. The majority of participants' who were not familiar with the remanufacture of RDCs, were uncertain about their Behavioural Intentions towards performing of the pro-circular behaviour. This trend changed following the behaviour change intervention, mainly due to reduction of neutral (uncertain) responses and an increase in positive intentions to purchase remanufactured RDCs. A substantial number of participants' who were familiar with the remanufacture of RDCs, were uncertain or held negative Behavioural Intentions towards performing the pro-circular behaviour. This trend also changed considerably following the behaviour change intervention, with the reduction of neutral (uncertain) and negative responses, and an increase in positive intentions to purchase remanufactured RDCs (Appendix C).

Additional frequencies of scores were examined based on the participants' awareness of remanufactured RDCs prior to their participation in the study (Appendix C). The majority of participants who were not familiar with the remanufacture of RDCs, were uncertain about their Behavioural Intentions towards performing of the pro-circular behaviour (as shown in section 3.1.). This trend changed following the behaviour change intervention, mainly due to reduction of neutral (uncertain) responses and an increase in positive intentions to purchase remanufactured RDCs. A substantial number of participants' who were familiar with the remanufacture of RDCs, were uncertain or held negative Behavioural Intentions towards performing the pro-circular behaviour. This trend also changed following the behaviour change intervention, with the reduction of neutral (uncertain) and negative responses, and an increase in positive intentions to purchase remanufactured RDCs.

Pearson's chi-square statistic was used to evaluate the statistical significance of difference in data distribution between Behavioural Intentions before and after the behaviour change intervention. The analysis of results presented in Table 11. shows this difference in distribution ($x^2=8.16$, $p=0.017$) to be statistically significant. This suggests that the behaviour change intervention had a substantial effect on the participants' Behavioural Intentions to purchase remanufactured RDCs.

Table 11. Summary of chi-square statistic on Behavioural Intentions (BI) before and after behaviour change intervention (BCI).

	N	'new'	'uncertain'	**'remanufactured'**
BI before BCI	26	7	10	**9**
BI after BCI	26	4	3	**19**

x2=8.16; *p<0.05, p=0.017*

4. Discussion

4.1. Influencing Behavioural Attitudes towards the purchase of remanufactured RDCs

The literature on Circular Economy suggests there is a strong association between an Attitude towards a behaviour (i.e. purchase of 'green' products) and the Behavioural Intention towards it (e.g. Maichum et al., 2016). A Persuasive Communication aiming at changing consumers Behavioural Attitudes, could influence their Behavioural Intentions and ultimately result in its uptake (Ajzen, 1992). Therefore, this paper explored the influence of the Persuasive Communication on the Behavioural Attitudes towards the purchase of remanufactured RDCs.

The results presented in section 3.2. show that following the behaviour change intervention there was a slight increase of the overall mean for Behavioural Attitudes (*from $\bar{x}$=5.39 to $\bar{x}$=5.77).* The standard deviations also increased *(from SD=1.36 to SD=1.66)* and remained large, which indicated that the given ratings were far from the mean, falling on both the negative and positive sides of the scale. However, the frequency distribution plots indicated that the majority of ratings for all of the Behavioural Attitudes (towards the performance of the behaviour being *good, convenient, necessary* and *profitable*) recorded after the intervention fell on the positive side of the scales, with a highly-skewed distribution of scores. The standard error slightly increased *(from 0.28 to 0.34*) but remained low, which indicated that the investigated sample could be representative of a larger population of individuals i.e. refrigeration engineers from the food and retail refrigeration sector who work directly and indirectly with Refrigerated Display Cabinets.

However, the only statistically significant influence of the intervention was observed in the change of Behavioural Attitudes towards the *necessity* of performing of the behaviour (*before intervention: $\bar{x}$=4.91; after intervention: $\bar{x}$=5.74),* as illustrated by the results of the paired-sample t-test [*t(21)=3.38, p=0.001*]. This suggests that the behaviour change intervention used in this study can have a similar influence, particularly on Behavioural Attitudes towards the *necessity* of purchasing remanufactured RDCs of individuals working in the industry. Interestingly, the Persuasive Communication did not emphasise the *necessity* of purchasing the remanufactured RDCs as none of the written and verbal messages used any phrases (such as 'necessary', 'essential' or 'important') that could imply this. This suggests that the intervention has led participants to draw their own conclusions and influenced them to believe that the performing of the behaviour is important.

Literature on survey research often discusses the effects of social desirability bias, specifically in reporting people's attitudes, beliefs and behaviours (Kaminska and Foulsham, 2013). The most common cause of social desirability bias is respondent lack of comfort in providing their true responses. It is possible that some participants in this study provided more socially desirable answers rather than their true answers, either before or after the intervention. This could be for example due to parts of the intervention emphasising the social and environmental impacts of the investigated behaviour. However, given that the respondents were unidentifiable and typically were not involved in purchasing of RDCs as part of their job, as well as some of their responses to questions related to their Attitudes, Product Perception and Behavioural Intentions were unfavourable (and therefore socially-undesirable), it can be assumed that the influence of social desirability bias on their answers was reduced. In addition, since the design was fully within-subject, any tendency towards a socially desirable response would have been reflected in both survey responses, therefore any differences found suggest an impact of the intervention.

4.2. Influencing Product Perceptions towards remanufactured RDCs

Product Perceptions define a person's beliefs about a product's characteristics, such as its appearance, performance or quality. Products that are remanufactured are typically seen as poorer quality than brand new products. This misconception contributes to the lack of consumers' willingness to purchase of remanufactured products (APPSRG and APPMG, 2014). Therefore, promoting remanufactured products, particularly appeasing concerns about their appearance, performance or quality could be pivotal in attempting to change behaviours. This paper also explored the influence of the behaviour change intervention on Product Perceptions towards the remanufactured RDCs.

The results in section 3.3. show that following the behaviour change intervention there was a small increase of overall means for Product Perceptions (*from $\bar{x}$=1.87 to $\bar{x}$=2.02).* The standard deviations decreased slightly *(from SD=0.70 to SD=0.68)* but remained large, which indicated that some of the given ratings were falling on the negative side of the scale. The overall standard error remained consistently low *(SE=0.14*) after the intervention, which indicated that the investigated sample could represent a larger population. Despite the increase of overall means being small, the frequency distribution plots showed there was a considerable increase of positive

responses regarding the remanufactured RDCs having the same *appearance, longevity and warranty* as new RDCs.

However, the only statistically significant influence of the intervention was observed in change of Product Perceptions towards the *appearance of* remanufactured RDCs (*before intervention: $\bar{x}$=4.91, after intervention: $\bar{x}$=5.74),* as shown in the results of the paired-sample t-test [*t(23)=2.46, p=0.011*]. These results suggest that this type of visual persuasion can have a similar influence on individuals working in the industry.

4.3. Changing Behavioural Intentions towards the purchase of remanufactured RDCs

The performance of a behaviour relies on the Behavioural Intention to perform it (Ajzen, 1991). The stronger Behavioural Intention a consumer holds, them performing the behaviour is more likely. This paper explored the influence of the behaviour change intervention on the participants' Behavioural Intentions to purchase remanufactured RDCs. The results in section 3.4. suggest that the intervention instigated a positive increase of means for Behavioural Intentions (*from $\bar{x}$=2.08 to $\bar{x}$=2.58),* which demonstrates the efficacy of the intervention in changing intentions towards the purchase of more sustainable products. The standard deviations slightly decreased *(from SD=0.80 to SD=0.76)* but remained relatively large, which indicated that some of the given ratings were falling on the negative side of the scale. However, the frequency distribution plots indicated there was a considerable increase of positive responses (which resulted in decrease of negative and neutral responses - 35% of participants before the intervention to 73% of participants after the intervention choosing the purchase of remanufactured RDCs). In addition, the standard error *(decreased from SE=0.16 to SE=15*) remained low which contributed to the assumption that the investigated sample could be representative of a larger population. Furthermore, the results of chi-square statistics showed that the differences in the distribution of data were also statistically significant (x^2*=8.16, p=0.017*). This indicates that the behaviour change intervention had a substantial effect on the participants' Behavioural Intentions to purchase remanufactured RDCs.

In addition, the Behavioural Intentions of participants who were and were not aware of the ability to remanufacture RDCs prior to the intervention were both equally influenced. This suggests that the intervention had two functions. The primary function was persuasion, shifting the intentions of participants from unfavourable to favourable. The secondary function was education, providing the participants with the relevant knowledge about the remanufacturing process and it outcomes, thereby influencing their intentions to purchase remanufactured RDCs. These results suggest that the behaviour change intervention used in this study can have a similar influence on the behaviours of individuals working in the industry, whether it is to educate them or change their existing beliefs about the purchase of remanufactured RDCs.

4.4. Using Persuasion in Marketing to change consumer behaviours

There are a number of Circular Economy business models (e.g. product-service systems, repair, refurbishment, remanufacture) the adoption of which is hindered due to the low consumer demand for *circular* products and services. It is possible, that these models are not promoted appropriately to consumers to encourage their pro-circular behaviours. Finding the means to advertise the Circular Economy in order to shift people's behaviours is now particularly important (Gould, 2016). Marketing has been a successful tool used to inform and persuade consumers to stimulate their interests, desires and action. The persuasive communication is already present in some successful marketing strategies used to change people's behaviours (O'Shaughnessy and O'Shaughnessy, 2003). Methods of communication have also been shown in previous research to have a positive influence consumers' attitudes and intentions specifically towards a purchase of 'green' (Kong and Zhang, 2014) and remanufactured products (Michaud and Llerena, 2011).

This study contributes to the research on Circular Economy and behaviour change. It demonstrates that the use of persuasive communication can be very effective in changing people's attitudes, perceptions and intentions. The strength of this study, particularly the level of influence the intervention had in a relatively short time, indicates that if developed into a sustained marketing programme, this method has a potential to influence consumers and generate the demand for *circular* products and services across the retail refrigeration industry, and potentially in other technical sectors. The increased interest of consumers in purchasing remanufactured products could have wider policy implications. It could lead to the development of product-specific remanufacturing standards, to ensure the quality of remanufactured goods. It could also result in the development of process-supporting tools for manufacturers to guide best practice and support the implementation of remanufacturing in their business models (Muranko et al., 2017b).

This study used a mix of persuasive messages and images in the intervention. The effect of the intervention shows a scope for further research to investigate what types of Persuasive Communication (i.e. messages with intrinsic or extrinsic value, messages with environmental, economic or social content, or images of products that

were remanufactured etc.) can be most effective in influencing pro-circular behaviours. Understanding what types of Persuasive Communication have most effects on the uptake of certain pro-circular behaviours, could strengthen the development of marketing strategies.

Conclusion

This study used a selection of constructs from the Pro-Circular Change Model to investigate the influence of Persuasive Communication on the Behavioural Attitudes, Product Perceptions and Behavioural Intentions towards the purchase of remanufactured Refrigerated Display Cabinets by individuals from the Food and Retail Refrigeration Industry. The results show that the Persuasive Communication had a positive and statistically significant impact on the participants' Behavioural Intentions towards the purchase of remanufactured RDCs. The intervention also proved to be effective in changing their Behavioural Attitudes and Product Perceptions. This shows there is a scope for this type of intervention to be examined further on a target population of Retailers (who purchase refrigerated display cabinets for grocery stores), and if successful to be applied by businesses to implement the model (the Pro-Circular Change Model; Muranko et al., 2018) in their marketing strategy and promote remanufacturing in the Retail Refrigeration industry.

This paper encourages further research into the application and influence of Persuasive Communication on the performing of pro-circular behaviours in other circular business models across various manufacturing and service industries.

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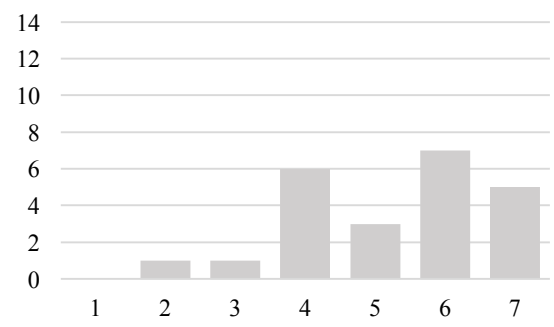
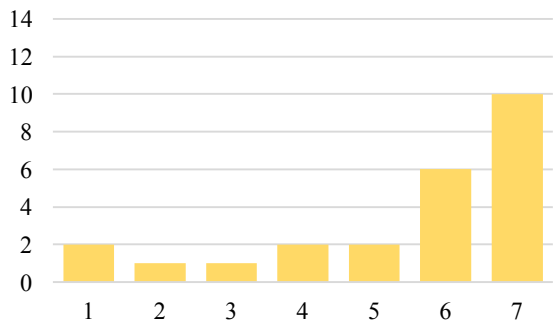
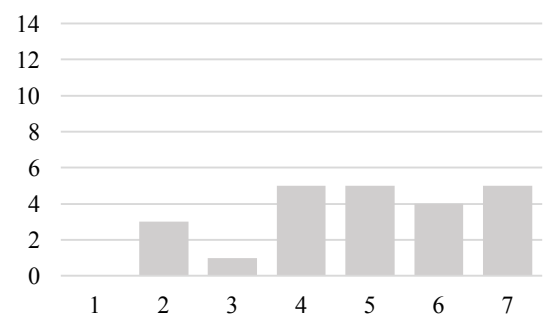
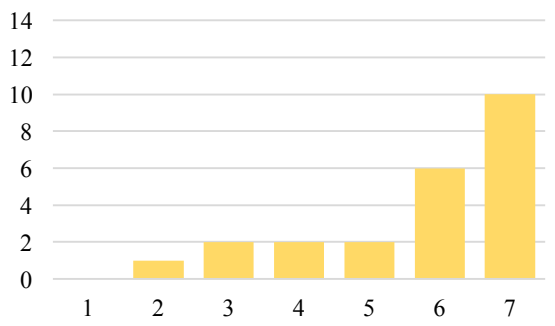
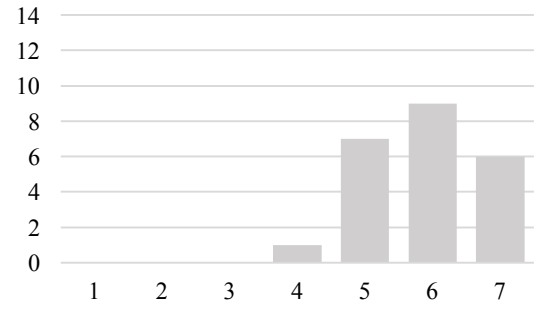
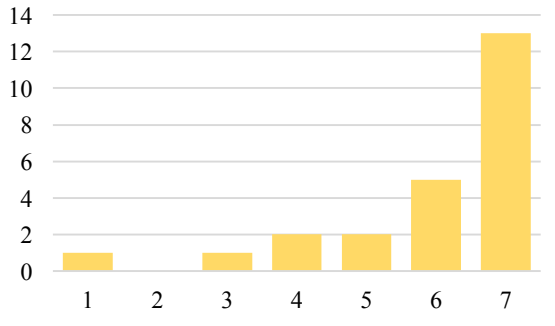
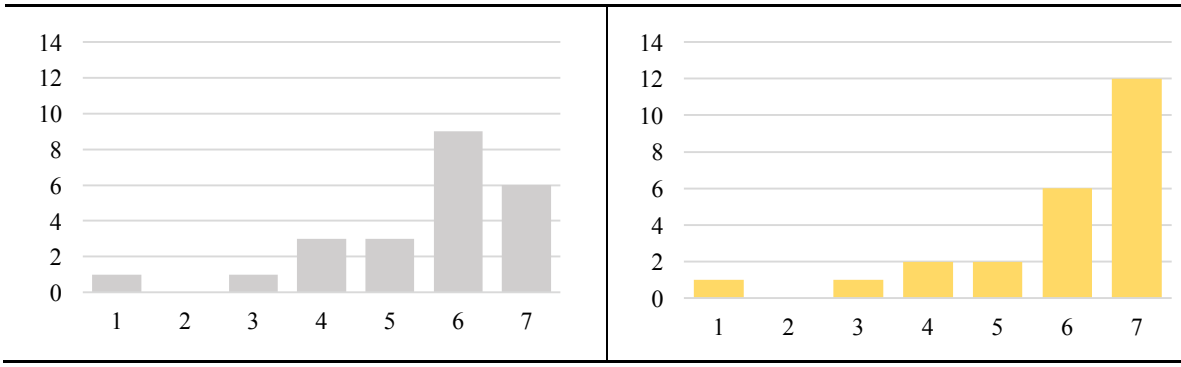
Appendices

Appendix A

Frequency Distribution of Behavioural Attitudes before (left) and after (right) the behaviour change intervention (BCI); response ratings*: 1- strongly negative, 2 - moderately negative, 3 - slightly negative, 4 – neutral, 5- slightly positive, 6 – moderately positive, 7 – strongly positive.*

Before BCI	After BCI
BA inconvenient – convenient	
	
BA unnecessary – necessary	
	
BA expensive - profitable	
	

BA bad - good

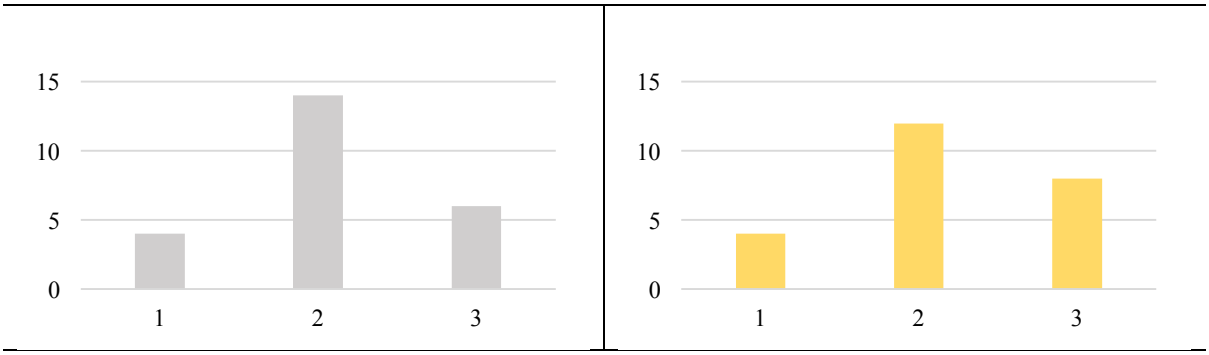


Appendix B

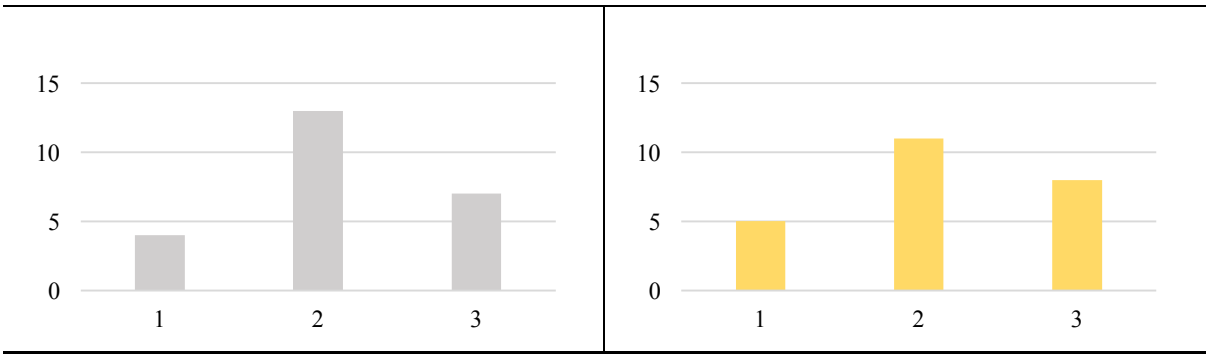
Frequency Distribution of Product Perceptions before and after the behaviour change intervention*;* response ratings: *1- 'worse than new RDCs': negative, 2 – 'the same and new RDCs': positive, 3 – 'better than new RDCs': positive.*

Before BCI | After BCI

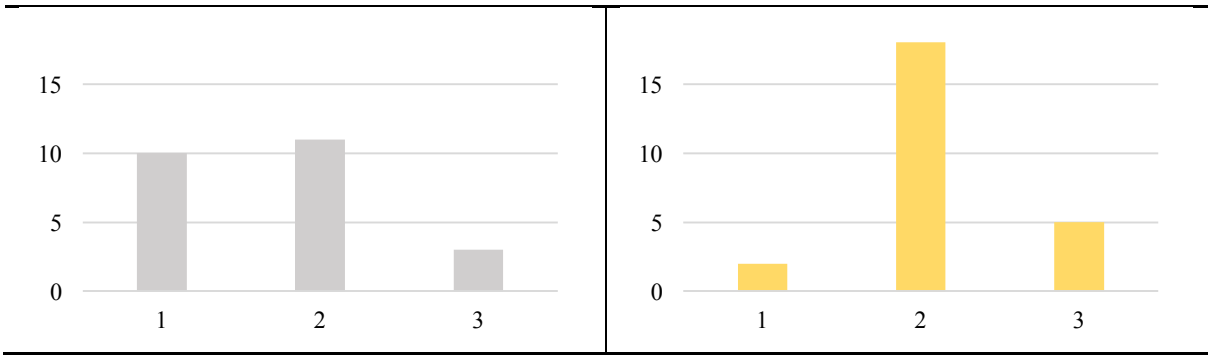
Quality

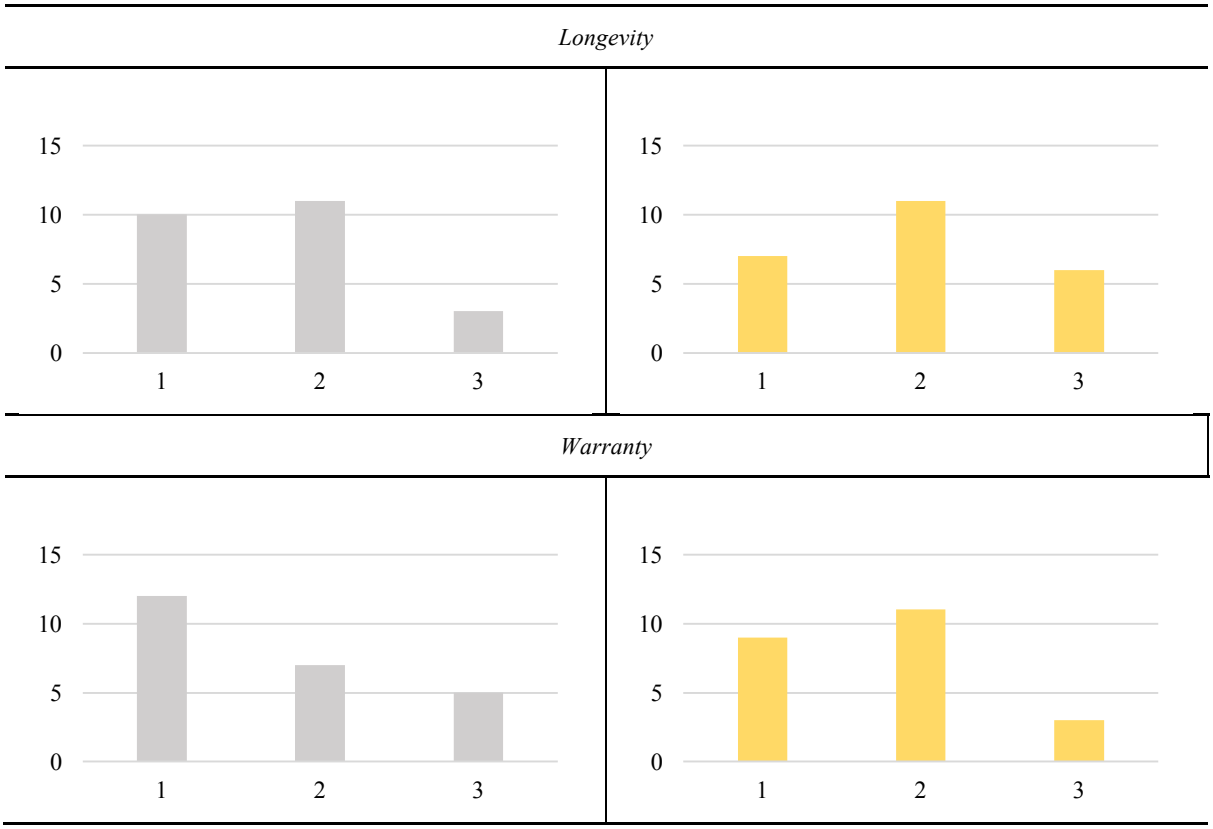


Performance



Appearance





Appendix C

Frequency Distribution of Behavioural Intentions before and after the behaviour change intervention (BCI) split by participants' awareness of remanufacturing RDCs prior to the intervention; response ratings*: 1- 'New RDCs', 2 – 'undecided', 3 – 'remanufactured RDCs'.*