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154 Behavioural Insights into Personal Electronics Repair in Sweden

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Abstract

Sweden is actively seeking to scale up repair activities as part of its strategy to reduce waste, transition to a circular economy, and achieve zero net emissions by 2045. In the last couple of years, several new policies to promote consumer repairs have been adopted or proposed in Sweden. However, very little is known about the socio-cultural factors that shape people's decision to repair their personal electronics. This study addresses this gap by applying consumer behaviour theory to study the factors shaping and influencing people's decision to repair their personal electronics. A mixed-method research approach was used, involving 19 semi-structured interviews and an online questionnaire answered by 190 participants. The interviews and questionnaire targeted Swedish residents and were based on Triandis' theory of interpersonal behaviour. The study revealed that intention and habits determined repair behaviour and that social norms, attitudes, and feelings about repair determined participants' intention to repair. Moreover, the interviews and the questionnaire uncovered that, in general, attitudes and social norms about repair do not encourage repair behaviour and that the physical environment is filled with barriers that discourage people from repairing their broken electronics. Therefore, the study concluded that to scale up repair activities, it is essential to improve the perceived individual benefits of repair, strengthen social norms to make repair the expected solution for broken personal electronics, shape repair habits, and lower contextual barriers. Based on these findings implications and specific policy recommendations are discussed.

Keywords: Repair, Electrical and Electronic Equipment, Theory of Interpersonal Behaviour, Circular Economy, Sweden.

Introduction

There is sound evidence to assert that electronic products (e-products) are causing significant environmental impacts in our natural world (Laurenti et al., 2017; Lavers Westin et al., 2019). In fact, in Sweden alone, e-products are hot-spot products of urban consumption responsible for between 14 and 58 percent of the total urban emissions causing climate change, acidification, eutrophication, ozone formation and resource use (Lavers Westin et al., 2019). For most e-products, the most significant environmental impact happens in the extraction and manufacturing phases, therefore extending their life through repair will generally result in environmental gains (Bachér et al., 2020; Bakker & Schuit, 2017; Parajuly et al., 2019; Rudenauer & Prakash, 2020).

Beyond the environmental benefits, repair also promises to boost local economies (EC et al., 2018; King et al., 2006; Llorente-González & Vence, 2020; Mitchell & Morgan, 2015) and bring back a lifestyle centred on caring for our belongings (Bovea et al., 2017; Montalvo et al., 2016). Therefore, promoting repair and product repairability are coined as essential strategies to mitigate the environmental impacts of e-products and meet environmental goals such as the transition to a circular economy (CE) (Almen et al., 2020; Bakker & Schuit, 2017; EEB, 2019; Wieser & Tröger, 2018).

Both in policy and academia, repair is increasingly referred to as an important strategy to extend the life of electronics and achieve circularity. Especially at the European Union (EU) level, there has been a boom in repair-related policies, including introducing repairability standards for product design, and regulations to publish repairability information, make spare parts accessible, and improve legal guarantees (Svensson-Hoglund et al., 2021). In the specific case of Sweden, the Government has introduced tax deductions to promote the repair sector (Almen et al., 2020). The key EU-level legislation addressing repair include the Ecodesign Directive, the Sales of Goods Directive, the Waste Framework Directives, The Waste Electrical and Electronic Equipment Directive, the EU Ecolabel, and Green Public Procurement.

In academia, repair gained attention along with the concept of the CE, with the first publication appearing in 2010 and a boom that started in 2018 with over 50 publications (Niskanen et al., 2021). However, despite the increased interest in repair demonstrated by the surge in both policies and publications on the subject, existing research has not paid sufficient attention to how attitudes, social factors, affective appraisal, and habits influence an individual's decision to repair electronic devices (Ackermann et al., 2018; Cerulli-Harms et al., 2018; Raihanian Mashhadi et al., 2016; Scott & Weaver, 2014; Wieser & Tröger, 2018). Moreover, very little is known about the Swedish case. Instead, existing literature has overwhelmingly focused on understanding contextual barriers to repair, such as cost, access, product design, information provision, and guarantees (see Lopez Davila, 2021, for a review of the literature on electronics repair).

When analysing the existing legislation, it appears that repair policies that target consumer behaviour are reduced to information provision through manuals and eco-labels, hinting at a neoclassical economics understanding of the individual as a rational decision-maker that corrects his or her behaviour based purely on information. However, research shows that behaviour is complex and multidimensional, governed by norms, emotions, habits, attitudes, and context (Jackson, 2005; Triandis, 1977). Thus, information provision alone is unlikely to be effective, and a more comprehensive conceptualisation and understanding of the factors that shape behaviour is needed to successfully design effective behaviour-change policies that promote the repair of electronic devices.

This study addresses this research gap by applying behaviour theory to gain behavioural insights into personal electronics repair. In this study, personal electronics are defined as computers, tablets, printers, electronic watches, music equipment, calculators, mobile phones, televisions, projectors, digital cameras, electric toys, videogames, and sports machines. The use of behaviour theory is key since it provides the possibility of exploring repair behaviour more comprehensively and of testing the strength of the different factors that influence repair decisions. The findings of the study would enable policymakers to understand the factors that influence repair behaviours and identify concrete intervention points to incentivise Swedish residents to engage with this practice effectively, and promote the environmental objectives of Sweden.

The next section introduces the theoretical framework, followed by a section on methods. This is followed by an overview of the main results and a discussion section. The paper ends with policy recommendations and the conclusions.

Theoretical framework

Behaviour theories have been widely applied to explain and predict environmental behaviours such as upcycling (Sung et al., 2019; Terzioğlu, 2021), product care (Ackermann et al., 2018), sustainable food consumption (Shin & Hancer, 2016; Vermeir & Verbeke, 2008), waste recycling (Chan, 1998; Chan & Bishop, 2013), and travel mode choice (Bamberg & Schmidt, 2003; Domarchi et al., 2008). To understand the complexity of environmental behaviours, many of these researchers have proposed modifications to existing behaviour models such as Ajzen and Fishbein's theory of planned behaviour (TPB) or Schwartz's value-belief-norm. A common factor of these modified models is that they include elements that are part of the Theory of Interpersonal Behaviour (TIB), such as habit, self-concept, and affect.

TIB has been recognised for its wide applicability and explanatory power in studies investigating upcycling behaviour (Sung et al., 2019), travel mode choice (Bamberg & Schmidt, 2003; Domarchi et al., 2008), hand hygiene behaviour (Kupfer et al., 2019), and ethical decision-making (Li et al., 2020). Moreover, in a comprehensive review of consumer behaviour and behaviour change models, Jackson (2005) found that

although TPB is the most widely used model in the study of environmental behaviours, it has failed to measure actual behaviour. Similarly, Bamberg and Schmidt (2003) argue that there is increasing evidence that TPB fails to explain all kinds of social behaviours. In contrast, Jackson (2005) and Bamberg and Schmidt (2003) argue that TIP captures many of TPB's criticisms and thus is a better framework to study social behaviours. Thus, given the broad applicability and comprehensive conceptualisation of behaviour, TIB is considered as the most appropriate framework to investigate repair behaviour.

Triandis' Theory of Interpersonal Behaviour

Triandis proposes that behaviour is shaped by three overarching factors: Intentions, the strength of habits, and the facilitating conditions that enable or hinder a behaviour (Triandis, 1977). Moreover, he proposes that there are three factors that influence intention: Attitudes, social factors (such as norms, self-image, and roles), and affect (i.e. emotions) associated with the behaviour (Triandis, 1977) (see Figure 1).

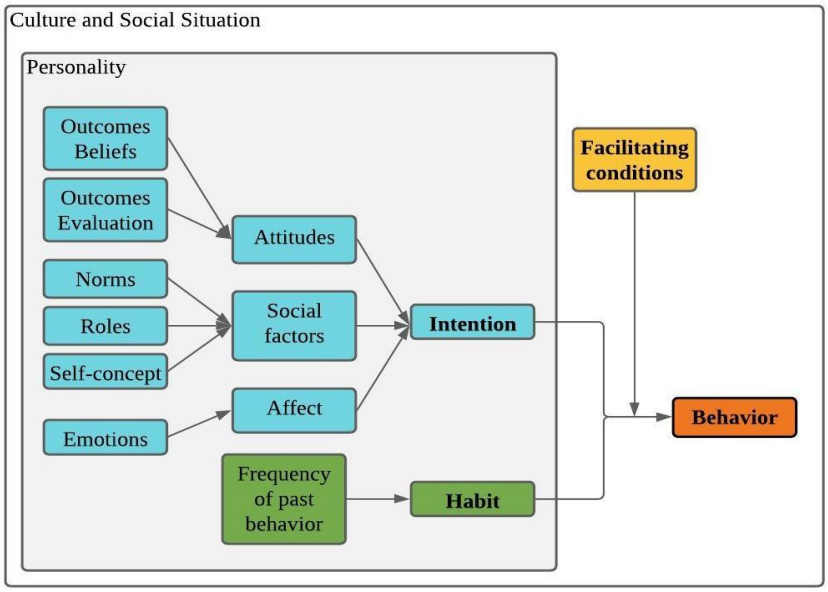

Figure 1. Triandis' Theory of Interpersonal Behaviour
(Source: adapted from Jackson, 2005 and Page & Sherif, 1980)

Triandis theorises that depending on the type of behaviour, situation, or person, the weights of the components of his model shift (Triandis, 1977). For example, for new, unlearned social behaviours, intentions determine a behaviour. However, once the behaviour has been repeated multiple times and has been rewarded or punished, the behaviour becomes automatic and is determined by habits (Triandis, 1977). Moreover, the influence of habits and intention on behaviour is moderated by the presence or absence of facilitating conditions (Triandis, 1977).

Methods

This study used a mixed-methods exploratory sequential research design. Guided by Triandis' TIB this study commenced with a qualitative data collection and analysis phase, which informed the second phase of quantitative data collection and analysis. The qualitative data collection consisted of 19 semi-structured interviews with Swedish residents. The purpose of the interviews was to understand the residents' past experiences, intentions, habits, and the facilitating conditions that influence their decisions to repair personal electronics. The interviewees were selected using non-probability quota sampling to provide a wide range of perspectives and opinions. NVivo10 software was used to conduct thematic analysis on the qualitative interviews.

Also based on TIB and guided by the findings of the interviews, quantitative data collection consisted of an online questionnaire answered by 190 Swedish residents (see Lopez Davila, 2021, for an overview of the demographic characteristics of the questionnaire sample and the list of the interviewees). The questionnaire gathered individuals' opinions and experiences repairing personal electronics. Participants were selected through non-probability convenience sampling based on the author's network. The software IBM SPSS 27 was used to conduct descriptive statistics, Spearman's rank-order correlation analysis and binomial logistic regression on the questionnaire data.

To adequately test Triandis' TIB model, correlation and regression analyses were conducted in two steps: Step 1 examined intentions to repair, and Step 2 frequency of repair behaviour. See logic in Figure 2.

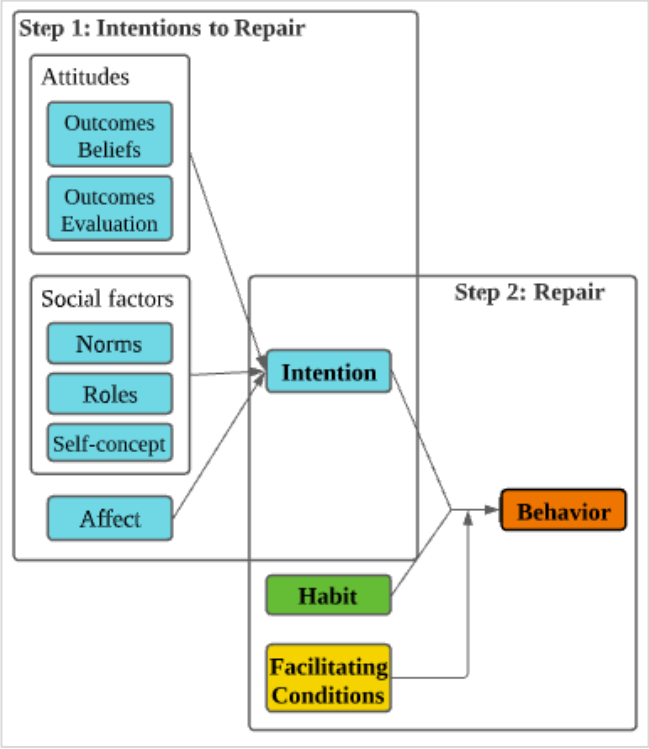

Figure 2. Correlation and regression analysis steps

Results and Discussion

This section presents the findings in the following way: 1) factors that shape repair behaviour revealed by qualitative analysis and descriptive statistics, and 2) factors that explain repair behaviour uncovered by correlation analysis and logistic regression.

Factors that shape electronics repair behaviour

The decision to repair a broken personal electronic device is shaped by intricate individual, social, and contextual factors. The following findings are presented following Triandis' TIB, starting with intention and its related factors, then with habits, and finishing with facilitating conditions (see Figure 1).

Attitudes towards repairing e-products

Repair has a tainted image. Although people think repair is beneficial for the environment, the economy, and society, they think it is complicated, time-consuming, and expensive.

The most mentioned benefits of repairing personal electronics where environmental (19 out of 19 interviewees) and economic (8/19): *"Repair is necessary for sustainable development. We are overconsuming and repair helps to slow consumption, and also the environmental and social aspects of mining"* (P7), and "*We save some money because [repairing] is not really exactly as expensive as buying a new one"* (P3). Moreover, building emotional connections and encouraging a lifestyle of caring were also mentioned as benefits of repair by some interviewees (5/19).

However, more than half of the interviewees perceived repair as an inconvenient, complicated, lengthy, and hard thing to do (13/19): *"It's the opposite of easy but I don't mean just difficult but more like a lengthy process that feels a little bit overwhelming and expensive. I don't really know if it's worth it"* (P3).

When it came to the cost of repair, twelve participants expressed that repair services were generally expensive in Sweden but that the real problem was that they felt they did not get their money's worth when repairing their personal electronics: *"Will it be more economic in the long term to buy a new phone? if I repair, would it last? because repair may be a bit cheaper but then it may not last long. You cannot guarantee a reparation in the same way you can guarantee a new phone"* (P16).

The majority of interviewees (11/19) also described repair services as time-consuming in two ways. On the one hand, it takes time to investigate where to go and what is a fair price. On the other hand, the wait time to get a device repaired can be long, which is especially problematic with devices such as computers and phones: *"There is downtime when you have a phone and you have to replace something which is not available immediately and you have to ship it from wherever then you have to wait for three days and three days without a phone in Sweden is really problematic"* (P19).

The survey findings mirrored the interview findings. The questionnaire showed that there was overall agreement among participants that repairing electronic devices was good (90%), beneficial (86%), and worthwhile (73%) but also hard (68%), time-consuming (65%), and expensive (50%). Opinions about whether repair was frustrating or satisfying were divided (see Figure 3)

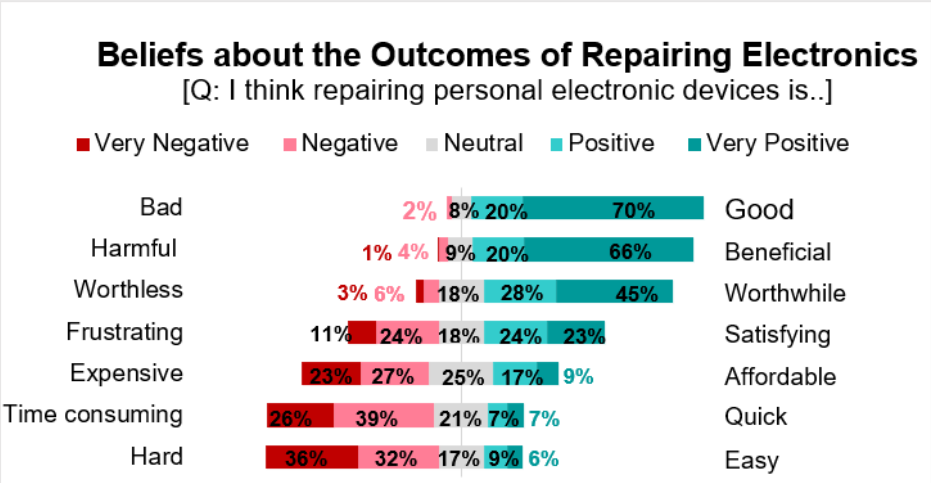

Figure 3. Respondents' beliefs about the outcomes of repairing electronics

Moreover, most participants strongly agreed or agreed that repairing electronic devices when they break helps protect the environment (87%), makes them feel proud (83%), is *not* a waste of time (71%) or money (63%), is a good deal (60%), and will result in their device working as well as when it was new (58%). On the other hand, the slight majority of participants strongly disagreed or disagreed that repairing electronics makes them uncomfortable (48%) and that repairing a device signals it will continue to break (42%) (see Figure 4).

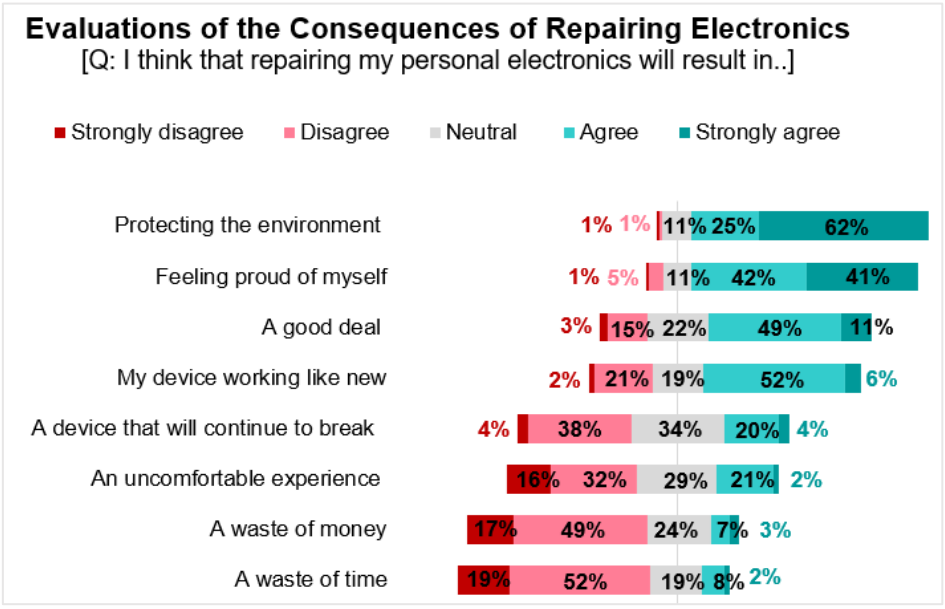

Figure 4. Respondents' evaluations of the outcomes of repairing electronics

Social Factors

Repairing broken personal electronics is seen as something people "should" but not as something they "must" do. Most participants (17/19) perceived that the normal thing to do when an electronic device breaks or malfunctions is to replace it. There were some discussions (6/19) about how there is a growing expectation to donate or recycle old devices and consensus that repair is more common for high-quality, expensive electronics. The interviews revealed two plausible explanations for this finding.

First, some participants mentioned that the current paradigm of consumption favours replacing over repairing personal electronics. The popular Swedish say "slit och släng" ("use it and throw it away") was brought up to describe the current norms around e-products. Interviewees explained that repairing things, including electronics, was the norm in Sweden for a long time, but it began disappearing at the turn of this century. This change was in part attributed to the Government, who back in the 1970s believed consumption needed to be accelerated *"for the health of the country"* (P17).

During this time Sweden experienced a few key incidents. First, there were nationwide efforts to mainstream "slit och släng" through actions such as the televised discussions. At the same time, globalization generated the well-known "race to the bottom" effect, which resulted in increasingly cheaper electronics becoming available in Sweden. Meanwhile, the cost of labour in Sweden kept on rising. All these factors contributed to repair becoming increasingly unpopular and expensive.

In this new paradigm of consumption, the norm became one where *"you should replace your whole living room every year*" (P10), as eloquently said by one interviewee: *"That's the era we are living in now [slit och släng], it's a lot cheaper to buy new than to repair and it is actually quite cheap to buy new electronics […]. It's the cultural norm and expectation so then it really feels like you're swimming upstream if you want to do something different"* (P18).

Another reason mentioned by most participants (15/19) to explain why repair culture is not the norm in Sweden, was that contrary to buying new, the process and outcome of repair is uncertain, and Swedes prefer certainty over uncertainty: *"Swedes, they say we like safety, we have insurance, security, bells in the cars. We are very much about control and security you know. We really want to know what we're getting so maybe that's part of it as well, you want to be sure. If you go 'there' maybe they won't repair it and it feels really bad not getting what I want or not being sure of what I'm getting"* (P8). Some participants (9/19) highlighted that some Swedes can be conflict-averse, which could explain a preference for replacing over repairing: *"I think people in general in Sweden avoid conflict. So that means that when we buy a product, we don't want to go back and say: 'hey, this is not what I expected I want you to fix it' we don't want that conflict, I think."* (P3).

When it comes to societal roles, being a working professional or a parent was consistently described as being *"time poor"* (P11) hence not having time to repair. In contrast, students identified themselves as perfect candidates for repair as well as for the second-hand market: *"We tend to repair things. But also buy second hand. At least in the student world it works like that a lot. Those two things before buying new"* (P14).

Regarding self-concept, the majority of participants (12/19) described themselves as environmentally aware and talked about making intentional choices to live their lives sustainably such as buying second hand, taking bags into the supermarket, and eating less meat-based products. However, during the interview, many (5/19) reflected that repair was not something they had thought about too much: *"I mean when it comes to other aspects of living sustainably, I feel that I go much longer in order to live right, or do the right thing"* (P1).

The questionnaire findings were consistent with the interviews and revealed that most participants (49%) do not see personal electronics repair as something they are expected to do. Interestingly, the opinion on whether people think they should repair broken personal electronics was somewhat divided with a slight inclination towards thinking that repair is something others think they should do (39% strongly agreed/agreed versus 33% strongly disagreed/disagreed). Also aligned with the interview findings, most participants think it is acceptable to replace a device that still works if it is recycled/donated (54%) or replaced with a second hand device (51%) (see Figure 5).

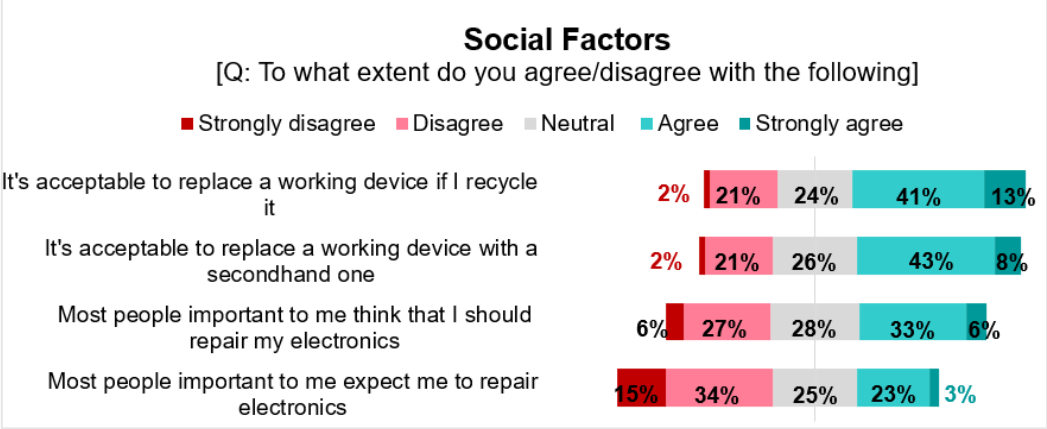

Figure 5. Perceived norms around what to do when personal electronic devices break or malfunction

Affect

Professional repairs are associated with negative emotions such frustration (4/19): *"There are so many steps that you just get angry"* (P13); discomfort (5/19): *"I know that I always get a little bit apprehensive in situations that I'm not really comfortable with and since I don't really know much about electronics I feel like I could be fooled"* (P5); and uncertainty (4/19):"*I feel a bit insecure. In Sweden we have this say: 'you buy a pig in a sack' you pay for something but it's not transparent, you don't really know what*

you get" (P8). Conversely, emotions for those who self-repair are more optimistic, including excitement, fun, and satisfaction.

Unlike in the interviews, the reported feelings about repairing electronics in the questionnaire were mixed between positive and negative emotions, with no clear trend. Participants reported feeling pleased (50%), unsure (45%), nervous (43%), comfortable (38%), confident (35%), relaxed (29%), annoyed (29%), and uncomfortable (27%) (see Figure 6).

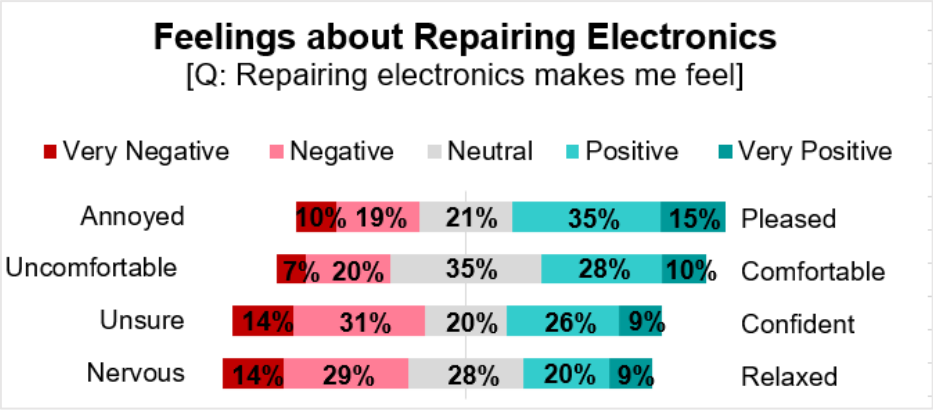

Figure 6. Respondents' feelings about repairing electronics

Habits

Most interviewees (11/19) said they usually don't repair broken electronics. In contrast, more than half of the questionnaire participants (57%) claimed to try to repair their personal electronics when they break. Most participants (7/19 and 58%) said they remember growing up in households that repaired electronics when they broke.

The most frequently cited reasons for replacing a device instead of repairing it were that the device was at the end of its useful life and hence not worth repairing (4/19): *"When those phones reached three years and started malfunctioning, you don't even consider repair, you just go for replacing"* (P12); that the device couldn't be repaired (3/19): *"Actually it has been so broken that it can't be repaired. The repairer told me that its more costly to repair than to buy new"* (P15); or simply that they did not think about repair (8/19): *"We ended up buying a new one. There wasn't even a question of trying to repair it"* (P6).

Of those who repaired their electronics (8/19), only a minority talked about using guarantees to pay for repairs (3/19); the rest repaired their devices outside of the guarantee period. The participants that reported "doing nothing" usually cited doing so because their device was functioning well enough (5/19): *"I recently dropped it so the screen crashed a little, but it works still so I can continue to use it for a while"* (P1).

Facilitating conditions

To create the optimal conditions to repair personal electronics, interview participants would like the following facilitating conditions in place:

Contextual. Repair should be as easy and convenient as buying new. Repair shops should be more visible (5/19), the entire repair process should happen online (8/19), and repair technicians should be more encouraging (5/19). The cost should be transparent, lower than the cost of replacing (11/19), and the guarantees should be as good as those of new devices (5/19). Consumers should know what to expect upfront and have access to information about repairability and maintenance (7/19).

Cultural. To increase their engagement with repairing personal electronics, participants want others to be doing it (5/19). They want society to tell them it is important to repair and encourage them in the same way they have been encouraged to buy second hand (e.g. clothes), eat less meat-based products, bring their bags to the supermarket, and take the train instead of the plane (8/19). They want to know their friends and colleagues are more engaged in repairing and to hear about their experiences and get their recommendations about reliable repair shops.

> *" I just think it has to get the attention and become commonly known. A great example is with plastic bags, like it's incredible that you would skip-go to ICA if you don't have your plastic bag rather than just buy a new one for 6 SEK. Like 6 SEK is nothing compared to what you're getting at the store but you still, sometimes I say, 'oh I didn't bring my plastic bag, I'll just go shopping some other time'"* (P6).

When it comes to the questionnaire, participants were asked to report their perceived barriers to repair. The majority reported that the following factors have impeded them from repairing their broken electronics to a considerable or a great extent: the cost of repair being higher than the cost of buying a new item (72%), not having a way to easily compare repair prices (66%), not knowing the cost of repair up-front (56%), not having access to instructions on how to maintain and repair electronics (55%), not having a device covered by a guarantee (55%), and not knowing where to go to repair their electronic devices (54%). Slightly less than half of the participants (43%) reported that not having the time to figure it out was a factor that prevented them from repairing their devices either to a considerable or great extent. In addition, about one-third of the respondents reported not trusting the repair service will do the job right (37%) and not trusting that the repair service is being transparent (31%) as considerable or great barriers (see Figure 7).

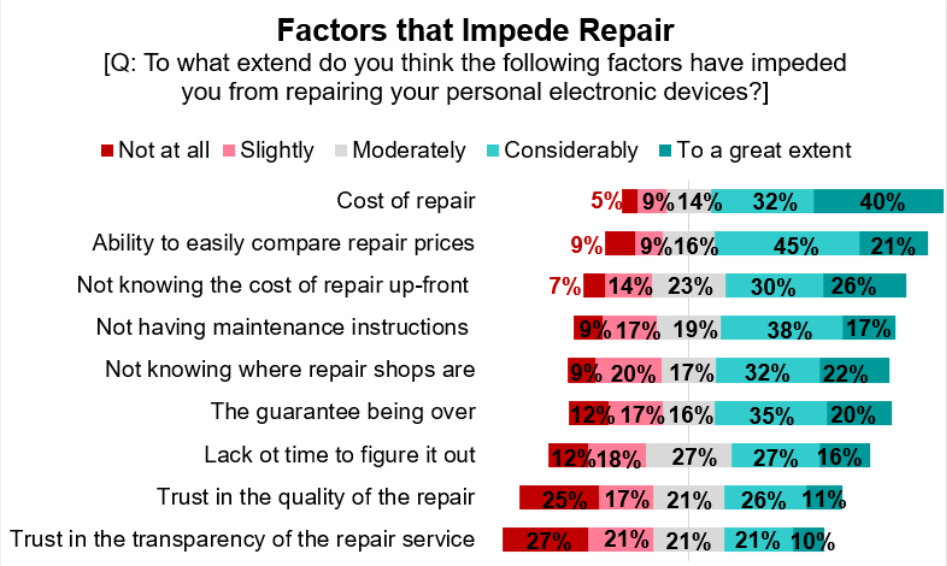

Figure 7. Factors that impede repair

Factors that explain electronics repair behaviour

Step 1: Intention to repair

Spearman's Rank Order Correlation was conducted to investigate whether the determinants of intention are correlated with intention to repair. The analysis revealed that all the determinants of intention are positively correlated with intention to repair with a moderate-size effect (r = .30 and .49). This means that on average, the more positive a participant response was on all items of the questionnaire (attitudes, affect, norms, etc.), the higher the intention to repair broken electronics they reported. The analysis also revealed that beliefs about repair outcomes helped explain 23% of the variance in respondent's reported intention to repair while roles helped explain 22% of this variance. See results in Table 1.

Table 1. Spearman's rho between determinants of intention to repair and intention

Variable	Correlation coefficient	Determination coefficient
Beliefs about outcomes	.477**	23%
Evaluations of outcomes	.374**	14%
Attitudes	.421**	18%
Norms	.300**	9%
Roles	.470**	22%
Self-Concept	.357**	13%
Affect	.345**	12%

**. Correlation is significant at the 0.01 level (2-tailed).

Moreover, binomial logistic regression was used to assess the effect of the intention factors on the likelihood that respondents intended to repair their devices next time

they break. The model to explain intention to repair had six predictors and was statistically significant $x^2(6, N=158) = 81.699$, $p < .001$, indicating that the model was able to distinguish between respondents that reported positive intention to repair and those that did not. The model explained between 40.4% (Cox & Snell R2) and 72.9% (Nagelkerke R2) of the variance in intention to repair and classified correctly 93% of the cases. Sensitivity, or true positives, was 95.6% and specificity, or true negatives, was 77.3%. Positive predictive value, or the percent of true positives predicted was 96.29%, and negative predictive value, or the percent of true negatives predicted was 73.91%.

Three predictors made a unique statistically significant contribution to the model: norms, affect, and outcomes evaluation. The strongest predictor was norms with an odds ratio of 82.48 followed by affect with an odds ratio of 0.03, and by outcomes evaluation with an odds ratio of 28.86. This means that participants who believed that they were expected to repair were 82 times more likely to report that they intended to repair their electronics. Participants who had positive beliefs about the consequences of repair were 29 times more likely to report intention to repair than those who did not. Conversely, those that reported positive emotions were 34 times less likely to report intention to repair than those that reported neutral or negative emotions (see Table 2).

Table 2. Logistic regression explaining the likelihood of reporting intention to repair electronics with beliefs about outcomes, evaluation about outcomes, norms, roles, self-concept, and affect variables

Predictor	**ß**	**SE B**	**Wald's x^2**	***Df***	***P***	**Odds ratio**
Beliefs about outcomes	20.160	3729.37	.000	1	.996	569322802.7
Evaluation of outcomes	3.363	.955	12.392	1	.000	28.862
Norms	4.413	1.423	9.620	1	.002	82.487
Roles	.941	.820	1.318	1	.251	2.563
Self-Concept	1.586	.913	3.014	1	.083	4.883
Affect	-3.530	1.096	10.364	1	.001	.029
Constant	-1.675	.675	6.157	1	.013	.187
Test			**x^2**	***Df***	***P***	
Omnibus tests of model coefficients			81.699	6	.000	
Hosmer and Lemeshow test			2.352	7	.729	
Model summary and classification						
Pseudo R square statistics		.404 (Cox & Snell R^2)			.729 (Nagelkerke R^2)	
Overall percentage correct						93.0

Step 2: Frequency of repair behaviour

The extent to which habits, intention, and facilitating conditions are correlated with frequency of repair behaviour were examined using Spearman's Rank Order Correlation. The analysis revealed that frequency of repair is positively and strongly associated with both repair habits (r= .585, p< .001) and the intention to repair (r= .501, p< .001). No significant association was found between frequency of repair and facilitating conditions. The analysis also revealed that repair habits helped explain 34% of the variance in the respondents' reported frequency of repair while intention to repair helped explain 25% of this variance. See results in Table 3.

Table 3. Spearman's rho between determinants of behaviour and behaviour frequency

Variable	Correlation coefficient	Determination coefficient
Repair habit	.585**	34%
Intention to repair	.501**	25%
Facilitating conditions	.085	-

**. Correlation is significant at the 0.01 level (2-tailed).

Furthermore, binomial logistic regression was used to assess the effect of the factors of repair behaviour on the likelihood that respondents repaired their devices when they broke. The model to explain frequency of repair included three predictors and was statistically significant $x^2(3, N=160) = 46.787$, p< .001, indicating that the model was able to predict which respondents reported repairing frequently and those who did not. The model explained between 25.4% (Cox & Snell R2) and 33.9% (Nagelkerke R2) of the variance in frequency of repair and classified correctly 73.1% of the cases. Sensitivity was 79.2%, specificity 68.8%, positive predictive value 67.06%, and negative predictive value 80%.

As shown in Table 4 below, only intention to repair and habit were statistically significant. The strongest predictor was intention with an odds ratio of 8.85 followed by habits with an odds ratio of 6.02. This means that participants that reported intent to repair electronics were almost 9 times more likely to report high frequencies of repair behaviour, while participants that reported strong habits were 6 times more likely to report high frequency of repair behaviour than those who did not.

Table 4. Logistic regression explaining the likelihood of reporting relatively more frequent electronics repair with intention, habit, and facilitating conditions variables.

Predictor	ß	SE B	Wald's x^2	*Df*	*p*	Odds ratio
Intention to repair	2.181	.789	7.633	1	.006	8.855
Habits	1.795	.395	20.619	1	.000	6.020
Facilitating conditions	.304	.501	0.368	1	.544	1.355

Constant	-3.284	.800	16.830	1	.000	0.037
Test			**X^2**	***Df***	***p***	
Omnibus tests of model coefficients			46.787	3	.000	
Hosmer and Lemeshow test			1.620	4	.805	
Model summary and classification						
Pseudo R square statistics	.254 (Cox & Snell R^2)		.339 (Nagelkerke R^2)			
Overall percentage correct	73.1					

The results from logistic regression are visualized in Figure 8 below.

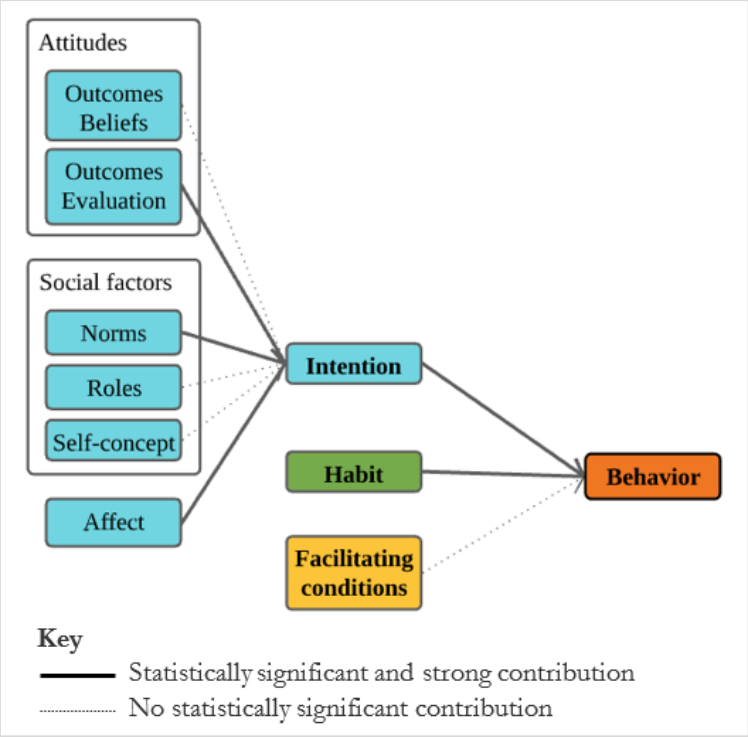

Figure 8. Logistic regression findings

Discussion

Triandis' theory of interpersonal behaviour proved to be a powerful model for understanding and explaining repair behaviour that can guide interventions for scaling up repair of personal electronic devices. Altogether the qualitative findings suggest that repair has an unfavourable image. Attitudes and feelings about repair are both positive and negative, with a slight inclination towards being negative. Most people agree that repair results in societal and environmental benefits. However, there are mixed thoughts about the personal benefits of repair, with people thinking it could be a good deal but also that it is complicated, time-consuming, and expensive. Social norms around broken electronics favour replacing devices over repairing them. Repair habits are still existing although they seem to have declined over the past decades. Lastly, the physical environment of repair is filled with barriers and disincentives.

The finding that attitudes do not favour repair behaviour suggests that for repair to be scaled up, attitudes about the personal benefits of repair need to be improved. Moreover, the fact that social norms about consumption of personal electronics may be influencing people's decision to repair their personal electronics to a greater extent than norms about repairing, indicates that strengthening norms and social expectations of repair cannot happen without addressing existing consumption norms. Repair needs to be understood not as a standalone practice but as part of electronic device consumption. Some organizations such as iFixit have understood the importance of placing electronics repair in the context of consumption and are actively working on inviting people to reflect on their consumption levels and use their community and repair resources to fix their products and 'hang on to last year's model' (Wiens, 2010). This study suggests that iFixit is on the right track, and their approach should be studied and supported by actors that wish to scale repairs.

Quantitative findings generally confirmed the qualitative analysis and suggested that norms are fundamental in the decision-making equation when a device breaks or malfunctions. The findings uncovered that intention to repair and habits shaped participants' repair behaviour, while facilitating conditions were not a determining factor. In addition, data revealed that norms, attitudes, and affective appraisal shaped participant's intentions to repair. Moreover, all the determinants of frequency of repair behaviour and intention to repair, except affect, are positively related, meaning that an increase in any of the determinants increases intention or frequency of repair behaviour. When it comes to affect, findings revealed that positive affect decreases intention to repair.

The result that intention is a direct predictor of behaviour have been corroborated by studies on upcycling (Sung et al., 2019), travel mode choice (Bamberg & Schmidt, 2003), and recycling (Chan & Bishop, 2013). However, the intention-behaviour gap in pro-environmental behaviours has been highly debated in academic literature, with studies finding no link between the two (Carrington et al., 2010; Hassan et al., 2016). This study contributes to this debate by confirming Triandis' position that behaviour is partly determined by controlled processes and suggesting that repair is partly an intention-driven behaviour. Moreover, the finding that habits are a direct predictor of behaviour has been documented in two studies on travel mode choice (Bamberg & Schmidt, 2003; Domarchi et al., 2008). Triandis' position is that for new, unlearned social behaviours, intentions determine a behaviour. However, once the behaviour has been repeated multiple times and has been rewarded or punished, the behaviour becomes automatic and is determined by habits. This position is confirmed by this study and suggests that repair is partly a habitual behaviour.

The result that affective appraisal is a direct predictor of intention to repair has also been found in travel mode choice (Domarchi et al., 2008), and ethical decision-making in the health sector (Li et al., 2020). Triandis' position is that affective response towards

a behaviour makes some behaviours more appealing than others and thus influence people's intention to behave. The correlation analysis confirmed this position but not the regression analysis, which revealed that neutral and negative emotions towards repair increase the repair odds and not the other way around.

A plausible explanation is that those who reported both frequent repair behaviour and neutral or negative emotions about the repair process may have limited means and therefore see repair as the most viable alternative to consuming personal electronics. Having the latest version of a product is strongly associated with feelings of success in life, positive self-image and social identity (Cox et al., 2013), therefore maintaining a faulty and outdated product through repair could lead to negative emotions. Moreover, negative or neutral emotions can be linked to the "let-down" or false anticipation of how long consumers expect a product would last before it breaks (Cox et al., 2013). Consumers usually rely on proxies such as brand and price to formulate judgements about how long a product will last (Cooper, 2004), therefore a broken product (either due to accident or premature obsolescence) can affect people's emotion even in the event of a minor repair. The functional reliability of a product (i.e. performing without breaking down regardless of how long it is built to last) is deemed crucial for consumers, even for products expected to be kept for a short time (Cox et al., 2013). Nevertheless, further research on the role of affective appraisal on repair would be necessary to identify complementary explanations to this phenomenon.

Finally, the finding that facilitating conditions are not a predictor of repair behaviour was documented in an upcycling study (Sung et al., 2019). This lack of association and predictive value is not surprising given that the literature review and interview findings revealed that there are more substantial barriers than drivers to electronics repair. Therefore, it could be that those who repair are not doing it because "it is easy" (or rather, "less hard"). The questionnaire revealed that 65% of the participants tried to repair the last device that broke. This suggests the study sample is overrepresented by those who choose to repair in today's barrier-ridden context and indicates that it is norms and attitudes, and not facilitating conditions, that influence the decision to repair for this group of people. However, this finding does not imply that lowering the barriers to repair would not increase the number of people who chose to repair; instead, it suggests that mainstreaming and improving the image of repair would. This last thought is supported by Triandis' TIB, which posits that "even if the intention is high, the habit well established, and the affect optimal, the behaviour might not happen if the environment renders the behaviour impossible" (Page & Sherif, 1980, p. 198).

Policy Recommendations

Based on these findings, policymakers should consider the following measures:

Make repair the norm for broken personal electronics. Efforts to promote repair need to focus on normalizing repair activities. Examples of interventions that could contribute to establish repair as an expected behaviour include: fund and develop media campaigns to promote repair; introduce principles of electronics repair to high school curriculums; regulate advertising to ban the promotion of early renewals and promote longer use (HOP, 2020); introduce mandatory repairability and durability labels in personal electronics (HOP, 2020); and adopt the repairability criteria proposed by the European Union green public procurement guidelines.

Adopt regulations to increase the perceived value in personal electronic repairs. Policymakers need to step in to create a conducive environment for repair services to flourish and thus change the current perception that there are not many individual benefits to repairing personal electronics. Some recommendations include: require producers to create repair funds as part of anti-waste laws (HOP, 2020) and to revise Extended Producer Responsibility contributions to take repairs into account – on top of recovering and recycling of products; push for adopting and implementing 'the right to repair' legislation; instil consumer confidence in repairs by mandating quality labelling for repairs (Gåvertsson et al., 2020); revise the taxation regime regarding repair services (Milios, 2021); and extend Ecodesign regulations to address a larger number of personal electronic devices and include criteria to limit software obsolescence (HOP, 2020).

Introduce habit-shaping interventions: These should establish: 1) context cues that trigger the desired habit, 2) incentives to encourage the desired actions, and 3) conditions that promote memory associations between the action and the environment. For example: work with repair businesses and waste management organisations to establish repair shops in recycling centres (Milios & Dalhammar, 2020); distribute repair vouchers to lower the price of repairs (Piringer & Schanda, 2020); and regulate the application of warrantees to prioritise and enable repair over replacement when products fail (Dalhammar et al., 2021).

Design tailored interventions based on consumer profiles: Conduct a market segmentation study to categorise consumers of personal electronics based on their willingness and readiness to engage with repair. Use this typology to develop public policy interventions that cater to their needs and characteristics.

Conclusions

This study aimed to gain behavioural insights into personal electronics repair in Sweden to provide recommendations for scaling this behaviour and accelerating Sweden's transition to a CE. This was achieved through a mixed-method research design involving semi-structured interviews and an online questionnaire based on Triandis' theory of interpersonal behaviour.

This study expands on our understanding of the behavioural factors shaping and explaining Swedish resident's decisions to repair personal electronics. It is the first study to explore repair behaviour using Triandis' TIB, which demonstrated that norms, affect, and evaluations of the outcomes of repair play a considerable role in shaping intentions to repair and that intention and habits shape the frequency of repair behaviour. It also highlights context-specific issues which help in developing a more nuanced understanding of repair behaviour in Sweden. In addition, this study contributes by suggesting how this new knowledge can be used to scale repair behaviour in Sweden.

The generalizability of this study is limited since the sample is not representative of the Swedish population. This is particularly important to highlight in the case of the questionnaire since the sample is primarily composed of students and young professionals. However, it can be argued that this segment of the population will be more affected by environmental degradation, and thus, increasing repair activities in this group is most important. Therefore, although not generalizable, the findings of this study are relevant and valuable in guiding the design of policies and interventions to scale up repair of personal electronics in Sweden.

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References

Ackermann, L., Mugge, R., & Schoormans, J. (2018). Consumers' Perspective on Product Care: An Exploratory Study of Motivators, Ability Factors, and Triggers. Journal of Cleaner Production, 183, 380–391. https://doi.org/10.1016/j.jclepro.2018.02.099

Almen, J., Anehagen, M., Enstrom, E., Hartman, C., Jonsson, C., Lindbladh, F., & Ohlsson, J. (2020). Promoting the Repair Sector in Sweden. 56.

Bachér, J., Dams, Y., Duhoux, T., Deng, Y., & Teittinen, T. (2020). Electronics and Obsolescence in a Circular Economy. https://www.eionet.europa.eu/etcs/etc-wmge/products/electronics-and-obsolescence-in-a-circular-economy

Bakker, C. A., & Schuit, C. S. C. (2017). The Long View: Exploring Product Lifetime Extension. United Nations Environment Programme.

Bamberg, S., & Schmidt, P. (2003). Incentives, Morality, or Habit? Predicting Students' Car Use for University Routes with the Models of Ajzen, Schwartz, and Triandis. Environment and Behavior, 35(2), 264–285. https://doi.org/10.1177/0013916502250134

Bovea, M. D., Pérez-Belis, V., & Quemades-Beltrán, P. (2017). Attitude of the Stakeholders Involved in the Repair and Second-Hand Sale of Small Household Electrical and Electronic Equipment: Case Study in Spain. Journal of Environmental Management, 196, 91–99. https://doi.org/10.1016/j.jenvman.2017.02.069

Carrington, M. J., Neville, B. A., & Whitwell, G. J. (2010). Why Ethical Consumers Don't Walk Their Talk: Towards a Framework for Understanding the Gap Between the Ethical Purchase Intentions and Actual Buying Behaviour of Ethically Minded Consumers. Journal of Business Ethics, 97(1), 139–158. https://doi.org/10.1007/s10551-010-0501-6

Cerulli-Harms, A., Suter, J., Landzaat, W., Duke, C., Rodriguez Diaz, A., Porsch, L., Peroz, T., Kettner, S., Thorun, C., Svatikova, K., Vermeulen, J., Smit, T., Dekeulenaer, F., & Lucica, E. (2018). Behavioural Study on Consumers' Engagement in the Circular Economy: Final Report. Publications Office. https://data.europa.eu/doi/10.2818/956512

Chan, K. (1998). Mass Communication and Pro-Environmental Behaviour: Waste Recycling in Hong Kong. Journal of Environmental Management, 52(4), 317–325. https://doi.org/10.1006/jema.1998.0189

Chan, L., & Bishop, B. (2013). A Moral Basis for Recycling: Extending the Theory of Planned Behaviour. Journal of Environmental Psychology, 36, 96–102. https://doi.org/10.1016/j.jenvp.2013.07.010

Cooper, T. (2004). Inadequate Life? Evidence of Consumer Attitudes to Product Obsolescence. Journal of Consumer Policy, 27(4), 421–449. https://doi.org/10.1007/s10603-004-2284-6

Cox, J., Griffith, S., Giorgi, S., & King, G. (2013). Consumer Understanding of Product Lifetimes. Resources, Conservation and Recycling, 79, 21–29. http://dx.doi.org/10.1016/j.resconrec.2013.05.003

Dalhammar, C., Wihlborg, E., Milios, L., Richter, J. L., Svensson-Höglund, S., Russell, J., & Thidell, Å. (2021). Enabling Reuse in Extended Producer Responsibility Schemes for White Goods: Legal and Organisational Conditions for Connecting Resource Flows and Actors. Circular Economy and Sustainability. https://doi.org/10.1007/s43615-021-00053-w

Domarchi, C., Tudela, A., & González, A. (2008). Effect of Attitudes, Habit and Affective Appraisal on Mode Choice: An Application to University Workers. Transportation, 35(5), 585–599. https://doi.org/10.1007/s11116-008-9168-6

EC, Cambridge Econometrics., Trinomics., & ICF. (2018). Impacts of Circular Economy Policies on The Labour Market: Final Report and Annexes. Publications Office. https://data.europa.eu/doi/10.2779/574719

EEB. (2019). Cool Products Don't Cost the Earth—Full report. www.eeb.org/coolproducts-report

Gåvertsson, I., Milios, L., & Dalhammar, C. (2020). Quality Labelling for Re-used ICT Equipment to Support Consumer Choice in the Circular Economy. Journal of Consumer Policy, 43(2), 353–377. https://doi.org/10.1007/s10603-018-9397-9

Hassan, L. M., Shiu, E., & Shaw, D. (2016). Who Says There is an Intention–Behaviour Gap? Assessing the Empirical Evidence of an Intention–Behaviour Gap in Ethical Consumption. Journal of Business Ethics, 136(2), 219–236. https://doi.org/10.1007/s10551-014-2440-0

HOP. (2020). White Paper Durable and Repairable Products 20 Steps to a Sustainable Europe.pdf.

Jackson, T. (2005). Motivating Sustainable Consumption: A Review of Evidence on Consumer Behaviour and Behaviour Change. Sustainable Development Research Network.

King, A. M., Burgess, S. C., Ijomah, W., & McMahon, C. A. (2006). Reducing Waste: Repair, Recondition, Remanufacture or Recycle? Sustainable Development, 14(4), 257–267. https://doi.org/10.1002/sd.271

Kupfer, T. R., Wyles, K. J., Watson, F., La Ragione, R. M., Chambers, M. A., & Macdonald, A. S. (2019). Determinants of Hand Hygiene Behaviour Based on the Theory of Interpersonal Behaviour. Journal of Infection Prevention, 20(5), 232–237. https://doi.org/10.1177/1757177419846286

Laurenti, R., Moberg, Å., & Stenmarck, Å. (2017). Calculating the Pre-Consumer Waste Footprint: A Screening Study of 10 Selected Products. Waste Management & Research: The Journal for a Sustainable Circular Economy, 35(1), 65–78. https://doi.org/10.1177/0734242X16675686

Lavers Westin, A., Kalmykova, Y., Rosado, L., Oliveira, F., Laurenti, R., & Rydberg, T. (2019). Combining Material Flow Analysis with Life Cycle Assessment to Identify Environmental Hotspots of Urban Consumption. Journal of Cleaner Production, 226, 526–539. https://doi.org/10.1016/j.jclepro.2019.04.036

Li, H., Novack, D. H., Duke, P., Gracely, E., Cestone, C., & Davis, T. (2020). Predictors of Medical Students' Ethical Decision-Making: A Pilot Study Using the Theory of Interpersonal Behavior. Patient Education and Counseling, 103(12), 2508–2514. https://doi.org/10.1016/j.pec.2020.05.026

Llorente-González, L. J., & Vence, X. (2020). How Labour-Intensive is the Circular Economy? A Policy-Orientated Structural Analysis of the Repair, Reuse and Recycling Activities in the European Union. Resources, Conservation and Recycling, 162, 105033. https://doi.org/10.1016/j.resconrec.2020.105033

Lopez Davila, M. I. (2021). Behavioral Insights into Personal Electronics Repair: Accelerating the Swedish transition to a circular economy. The International Institute for Industrial Environmental Economics, Lund University.

Milios, L. (2021). Towards a Circular Economy Taxation Framework: Expectations and Challenges of Implementation. Circular Economy and Sustainability. https://doi.org/10.1007/s43615-020-00002-z

Milios, L., & Dalhammar, C. (2020). Ascending The Waste Hierarchy: Re-Use Potential in Swedish Recycling Centres. Detritus, 9, 27–37. https://doi.org/10.31025/2611-4135/2020.13912

Mitchell, P., & Morgan, J. (2015). Employment and the Circular Economy Job Creation in a More Resource Efficient Britain. https://doi.org/10.13140/RG.2.1.1026.5049

Montalvo, C., Peck, D., & Rietveld, E. (2016). A Longer Lifetime for Products: Benefits for Consumers and Companies: Study for the Internal Market and Consumer Protection Committee. Policy Department A: European Parliament's Directorate General for Internal Policies

Niskanen, J., McLaren, D., & Anshelm, J. (2021). Repair for a Broken Economy: Lessons for Circular Economy from an International Interview Study of Repairers. Sustainability, 13(4), 2316. https://doi.org/10.3390/su13042316

Page, M. M., & Sherif, C. W. (1980). Beliefs, Attitudes, and Values: Nebraska Symposium on Motivation, 1979. University of Nebraska Press. https://books.google.com.mx/books?id=THtKAQAAIAAJ

Parajuly, K., Kuehr, R., Awasthi, A. K., Fitzpatrick, C., Lepawsky, J., Smith, E., Wildmer, R., & Zeng, X. (2019). Future e-waste scenarios. StEP (Bonn), UNE ViE-SCYCLE (Bonn) & UNEP IETC (Osaka).

Piringer, M., & Schanda, I. (2020, September). Austria Makes Repair More Affordable. Right to Repair. https://repair.eu/news/austria-makes-repair-more-affordable/

Raihanian Mashhadi, A., Esmaeilian, B., Cade, W., Wiens, K., & Behdad, S. (2016). Mining Consumer Experiences of Repairing Electronics: Product Design Insights and Business Lessons Learned. Journal of Cleaner Production, 137, 716–727. https://doi.org/10.1016/j.jclepro.2016.07.144

Rudenauer, I., & Prakash, S. (2020). Economic and Environmental Impacts of Extending the Durability of Electrical and Electronic Equipment. https://www.oneplanetnetwork.org/sites/default/files/study_projectlifetimeextension_vzbv_oeko_englishsummary.pdf

Scott, K. A., & Weaver, T. (2014). To Repair or Not to Repair What is the Motivation? Journal of Research for Consumers, 26.

Shin, Y. H., & Hancer, M. (2016). The Role of Attitude, Subjective Norm, Perceived Behavioral Control, and Moral Norm in the Intention to Purchase Local Food Products. Journal of Foodservice Business Research, 19(4), 338–351. https://doi.org/10.1080/15378020.2016.1181506

Sung, K., Cooper, T., & Kettley, S. (2019). Factors Influencing Upcycling for UK Makers. Sustainability, 11(3), 870. https://doi.org/10.3390/su11030870

Svensson-Hoglund, S., Richter, J. L., Maitre-Ekern, E., Russell, J. D., Pihlajarinne, T., & Dalhammar, C. (2021). Barriers, Enablers and Market Governance: A Review of the Policy Landscape for Repair of Consumer Electronics in the EU and the U.S. Journal of Cleaner Production, 288, 125488. https://doi.org/10.1016/j.jclepro.2020.125488

Terzioğlu, N. (2021). Repair Motivation and Barriers Model: Investigating User Perspectives Related to Product Repair Towards a Circular Economy. Journal of Cleaner Production, 289, 125644. https://doi.org/10.1016/j.jclepro.2020.125644

Triandis, H. C. (1977). Interpersonal Behavior. Brooke/Cole.

Vermeir, I., & Verbeke, W. (2008). Sustainable Food Consumption Among Young Adults in Belgium: Theory of Planned Behaviour and the Role of Confidence and Values. Ecological Economics, 64(3), 542–553. https://doi.org/10.1016/j.ecolecon.2007.03.007

Wiens, K. (2010). Self-Repair Manifesto. IFixit. https://www.ifixit.com/News/14266/self-repair-manifesto

Wieser, H., & Tröger, N. (2018). Exploring the Inner Loops of the Circular Economy: Replacement, Repair, and Reuse of Mobile Phones in Austria. Journal of Cleaner Production, 172, 3042–3055. https://doi.org/10.1016/j.jclepro.2017.11.106