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Increasing repair of household appliances, mobile phones and clothing: Experiences from consumers and the repair industry

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ABSTRACT

Increasing product lifespans is one of the most effective environmental strategies and therefore repair is a part of the circular economy approach that aims to keep products and materials longer in use. This article explores drivers and barriers for repair from consumers' and commercial repair actors' viewpoints, in order to understand how the repair rates of household appliances, mobile phones and clothing could be increased. The study is based on a consumer survey of 1196 respondents in Norway, and 15 qualitative interviews with actors in the commercial repair industry working with repairs of household consumer goods. A surprisingly high share of repairs was conducted by consumers themselves. The main barrier is the consistently low price of new products, and often of poor quality, which contributes to low profitability in repair work for businesses and low motivation from consumers. Furthermore, access to competent personnel is a major challenge for the repair industry, a need which is expected to increase in the coming years. Both the industry and consumers agree that better quality of products is a starting point for increased product lifespans, and this will also increase the motivation and the number of profitable repairs. These results have political implications on how to promote longer product lifespans through repair such as increased utilization and knowledge of consumers' complaint and warranty rights.

1. Introduction

Circular Economy (CE) Action Plans are initiated and enforced to mitigate global environmental problems while aiming for sustainable growth (European Commission, 2020; Standing Committee of the National People's Congress, 2018). Increasing the number of products repaired is part of the circular economy strategy and therefore gains momentum in the political, scientific, and economic debate. Repair makes it possible to increase product lifespans as well as value creation and thus fits well with the CE concepts of closed loop strategies and green growth (Cooper and Salvia, 2018; Ellen MacArthur Foundation, 2020).

A more precise term for what can be achieved through repair is an increase in the length of service lifespan. This term denotes the time a product functions and can be put to use, including the duration of use by the initial user and reuse by subsequent users. The term includes both the physical lifespan in a technical sense related to the durability (strength) and the social lifespan that denotes the time the product is deemed socially acceptable (Klepp et al., 2020). The social lifespan is linked to the flexibility of the products concerning social changes, changes in life situations, and changes in personal taste, while technical lifespan refers to the products' technical capacity. Both aspects are part of the quality of the product.

A recent Eurobarometer survey showed that the most common reason for purchasing a new digital device was the breakdown of the old product (38%) (Kantar, 2020b) indicating that repair could prolong the service lifespans of a large share of these products. According to Ertz et al. (2019), there are two fundamental strategies towards creating closed loops (1) the slowing loop: prolonging the useful life of products through design for long-life as well as life-extending measures such as repair, remanufacturing, refurbishment, reconditioning and 2) closing of the loop: reutilization of materials through recycling. The latter is given more attention although the well-established waste hierarchy prioritizes

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prevention through prolonged use over material recycling (European Parliament and the Council, 2008).

Increasing product service lifespans is one of the most effective environmental strategies, as it has the potential to slow down the production and consumption cycle and thus prevent waste and reduce emissions from production and transport, and save energy (Cooper, 2010). From an environmental point of view, it is generally beneficial to repair defect products so that they remain in use longer (Boldoczki et al., 2020; Downes et al., 2011; Montalvo et al., 2016; Pini et al., 2019). We seek to contribute to increased knowledge in the research field, following Ertz et al. (2019), who elaborate a state-of-the-art framework on how organizations and consumers extend (pro-) actively product lifespans based on research on business models (BMs) in this field. An important distinction is made between product lifespan extension as an outcome of the 'nature' of a product (based on functional durability) and its 'nurture' by consumers (attitudes and behaviours in the use phase which consequently affect a products' lifespan) (Cox et al., 2013). Increased longevity is a result of activities and choices by consumers, as well as organizations and manufacturers, contributing both to product 'nature' and 'nurture'. Consumers' practices will have an impact on the lifespan of the products and on which BMs are both profitable and more sustainable.

Strategies for nature and nurture affect each other. The need for repair can be tied to errors or deficiencies inherent production, transport, or use. There can be a variety of sources of these errors and deficiencies. These include product design, choice of materials, assembly, transport packaging, extensive use and related wear, as well as incorrect use or even accidents. However, at least for the use phase, many such defects can be prevented through appropriate maintenance. This is again linked to proper product design and available information such as product manuals that should enable convenient maintenance. The decision of whether or not to repair the item is mainly placed on consumers, who need to consider several aspects while making this decision. A Euromonitor survey among citizens in EU-28 showed that more than three-quarters (77%) are willing to make an effort to repair broken appliances before buying new ones in order to reduce household waste. Those who disagreed with the statement tend to throw away products as they perceived it to be too difficult or too expensive to get them repaired (European Commission, 2014). However, a more recent survey indicated that a smaller share of EU-28 consumers had actually repaired products (64%) (European Commission, 2018). However, the repair rates are likely to vary between different consumer groups, between types of products, and depending on who is doing the repairs.

Most studies on the repair activities of consumers focus on repair services provided by professionals, particularly consumer electronics (Adler and Hlavacek, 1976; Gerner and Bryant, 1980; Tecchio et al., 2019), with a few recent exceptions that focus on Do-It-Yourself (DIY) movements (Raihanian Mashhadi et al., 2016). Some studies on clothing also focus on private repair (Gwilt, 2014; McLaren and McLauchlan, 2015) and prosumption (production + consumption) aspects as part of DIY movements (Eden, 2017; Gelber, 1997; Watson and Shove, 2008; Williams, 2004). The Norwegian Consumer Council (2019) reports that consumers mainly attempt to repair clothing and furniture themselves, while the majority will use professional services for the repair of electrical appliances. There is, however, a lack of studies that compare the involvement with and experience of repair services by professionals with private repairs conducted by consumers across different product groups.

Many studies have focused on barriers to repair. Tecchio et al. (2019) looked into this from the repair industry's perspective and classified the barriers into three categories:

1) "Consumer choice", when the overall cost of spare parts and labour is regarded as too high by consumers;
2) "Technically infeasible", when the technical barriers (such as the lack of spare parts or an ineffective design for disassembly) hamper repair; and
3) "Non-viable", when although technically feasible the repair was judged non-viable (e.g. for functional reasons, or because the appliance was likely to fail again) and the technicians advised the consumers to discard the appliance. (Tecchio et al., 2019 p.1114).

Consumers will have to consider whether they want to make an effort to repair something prior to delivering the item to repair or attempting to repair it themselves. McLaren and McLauchlan (2015) divide such barriers into practical (such as convenience and access to materials or skills), social (such as not wanting to use visibly mended clothing in order not to appear impoverished), socioeconomic (such as varying availability of money for repair), systemic (such as structural barriers to establishing a repair business, limited availability of original spare parts and manuals, lack of suitable education to learn repair skills) and psychological barriers (such as lack of emotional attachment to a product or the desire for a new one). The most commonly identified constraints are financial costs, lack of time, and lack of skills. However, as Middleton (2015) points out, minor mending of textiles often only requires needle and thread, not necessarily that much time and only rather basic skills. The use of professional repairers can of course be more costly. McCollough (2009) tested various economical factors' contribution to how many television service technicians were employed between 1980 and 2000 in the US. He found that the cost of a new product was a more important variable than the cost of repair. That is, low prices of new products decrease the likelihood to repair. This was confirmed by Consumer Reports (2001), where 34% of survey respondents decided not to repair due to falling prices on replacements. Based on extensive literature review and analysis of time series, McCollough (2009) showed that another factor that contributes significantly is the yearly expenditure on advertising new products, as it informs consumers about the latest technologies, design and functionality features. This negatively impacts repair intention. Surprisingly, the Gross Domestic Product (GDP) growth rate was positively correlated to repair. Usually it is assumed that in recession, people would repair more, but it appears they may try to save money during recessions and rather attempt to repair by themselves. Thus, the rate between professional and private repair varied based on GDP. McCollough (2007) suggests that an increase in income reduces the likelihood to repair and maintain products, due to consumers feeling their time is more valuable. Other identified barriers that were not included in the mathematical modelling were the perceived travel and waiting time, cost of frustration and annoyance that increases between product breakdown and completion of service.

Research indicates that consumers are willing to pay approximately between 19% and 30% for the repair compared to the replacement price of household appliances (Adler and Hlavacek, 1976; European Commission, 2018; McCollough, 2007). An experiment conducted with European consumers indicated that they were willing to pay more for products that are easier to repair and are labelled with this information (European Commission, 2018). The decision to repair, however, is not solely dependent on economic factors. Emotional attachment to a product might contribute to the owner wanting to repair it, even if the market price would not indicate this as profitable. Perhaps we observe the opposite in the contemporary consumer culture, where the sheer number of low priced (and too often low quality) products reduce the likelihood for emotional attachment. As a result, adequate maintenance

and repair are not considered seriously (Chapman, 2005). Emotional factors may also stand in the way of repair because this is a practice that can be connected to economic hardship and negative associations, such as social stigma (Fisher et al., 2008; Kelley, 2009).

Another issue that may impact the decision to repair or not, is the consumer's confidence in the quality of repairs and expectations on whether the repair will be performed correctly resulting in an extended product service lifespan. Consumer studies have shown that the results of repairs may not always be satisfactory. In the US, up to 40% had at least one concern about repairs and 25% had been dissatisfied with the outcome of professional repairs (Consumer Reports, 2001, 2005). In the EU, 20% of consumers who had used repair services reported the quality of repair to be below expectations, and 28% thought the speed of repair was not up to expectations (European Commission, 2018). This may have contributed to survey participants reporting that they refrain from repair services as they considered it as 'too shoddy work' (Consumer Reports, 2001). This negative perception of manufacturers and the repair industry might reduce consumers' enthusiasm for repair and explain their lack of trust in repair shops (Lefebvre et al., 2018; Lilley et al., 2013). Yet another barrier was identified by Harmer et al. (2019). They showed that dirty or damaged appearances can lead to premature disposal, as they are perceived to be less effective. This indicates that maintenance is important for keeping products in use and for motivating consumers to repair them when needed.

Product warranties and legislation related to consumer rights also contribute to differences between repair rates in different countries and across product groups. In Norway, the warranty for electrical appliances, including mobile phones, is five years after purchase, while for clothing the warranty is only two years (Consumer Purchases Act, 2002). More than a third (36%) of Norwegian consumers have experienced clothing being damaged during normal use within the two years from acquisition, but only 44% of them had used their right to complain (Bøyum et al., 2017).

Differences between products are also crucial. Some products are more likely to be disposed of even though they still function, based on limited social lifespan and reasons such as fashion and product obsolescence. These affect the disposal of smartphones more than freezers (European Commission, 2018). The use phase of clothes differs from electrical household appliances in several ways. In general, consumers usually only have one of each of the mentioned appliances, while their wardrobes may consist of hundreds of garments (Klepp and Laitala, 2015; Klepp et al., 2019; Maldini et al., 2017). Clothes are rarely purchased as a replacement for discarded garments (Maldini, 2019), which often is the case for household appliances. Although all these products are mostly privately owned, the use of larger household appliances is shared with other household members. The use of clothing and mobile phones is most often dominated by one specific person, however, they can also be shared by several people.

While a broken fridge or freezer is more likely to cause major inconveniences in daily life, a destroyed garment will not necessarily cause an acute crisis or produce an immediate need for replacement, as most people have alternative garments available. Besides, the knowledge and the techniques needed to repair such products are pertinent. There are also great variations in the expected lifespans of the products, for example, mobile phones have increasingly short replacement cycles due to fast technological progress, perceived or real (Proske and Jaeger-Erben, 2019).

As this brief literature review has indicated, many different aspects contribute to the decision about what is repaired. However, there is still a lack of comprehensive knowledge of consumers' repair practices between various product groups in a Norwegian context and what could increase repairs. This article aims to fill this gap and discusses *what can lead to more repair of household appliances, mobile phones and clothing, by studying drivers and barriers for repair in Norway from consumers' and commercial repair actors' viewpoints*. We studied the role of consumers, not only through their own views but also from actors in the repair industry and their experiences with customers (Haugrønning et al., 2019). We focus on three different product groups that are likely to face different challenges repair wise: domestic appliances, mobile phones and clothing. There is often a grey zone between repair, maintenance and upgrade within these product groups, such as when a laundry washing machine stops functioning due to too much lint if this has not been removed during use. If a broken component is replaced by one with superior properties, the repair becomes an upgrade (Cooper and Salvia, 2018). Additionally, for clothing, there can also be an overlap between *repair* and *modification* of the product to fit the user's body, taste or one's needs. As there is no clear distinction between these terms, we have chosen to include both aspects in our study.

The next section of this article presents the applied methods, followed by the result section that reports on findings related to the prevalence of repair by different actors and reasons given for and against repairing. In the discussion section, we will analyse the main barriers and suggest possible strategies to overcome them. Finally, we conclude and give recommendations for further research.

2. Method

This paper is based on two different sets of data, acquired with different methods; a quantitative consumer survey and a series of qualitative interviews with commercial repair actors working with clothing, textiles, shoes and domestic appliances. This enables us to compare and validate the results from different sources and viewpoints against each other (method triangulation).

2.1. Consumer survey

A consumer survey of 1196 respondents was conducted in Norway between December 2018 and January 2019. The web-based survey was conducted by Kantar TNS on behalf of Oslo Metropolitan University. The target group was a representative selection of the Norwegian population aged 18–80. The respondents were recruited from a panel of people over the age of 15 who are willing to participate in surveys (currently approx. 38,000 people). The panel is certified according to ISO 26362 (2009) and the confidentiality, anonymity and privacy requirements were treated in accordance with Personal Information Act and the guidelines of the Norwegian Data Protection Authority (Kantar, 2020a). The sample is representative for population by region, gender and age, but is additionally weighted with a random iterative method so that it is representative for these three variables combined. Demographics of the respondents can be found in Table 1. The anonymous data were analysed with SPSS software, and the results are presented as descriptive statistics.

The survey aimed to map what household products that are repaired, and the consumers' motivations for and barriers to repair and to the use of repair services. The questionnaire was developed based on existing literature on the field and to inform our research questions. The products we focused on were clothes and selected electrical appliances (mobile phones, washing machines, dishwashers, fridges, stoves and freezers). The survey questions used in this paper are presented in Appendix A.

Table 1
Demographics of the respondents (N=1196).

Demographics		Per cent
Gender	Men	50%
	Women	50%
Age group	18–29	21%
	30–44	26%
	45–59	26%
	60–80	28%
Employment status	Work fulltime	47%
	Work part-time	7%
	Self-employed	3%
	Retired	19%
	Unemployed	2%
	Other types of social security	9%
	Student	11%
	Homemaker	1%
	Other	2%
Education	Primary education	5%
	High school – general studies	16%
	High school – vocational studies	16%
	Vocational education (1/2–2 years)	9%
	University/college education (≤4 years)	29%
	University/college education (>4 years)	24%
Personal yearly gross income	Less than NOK 200.000	14%
	NOK 200.000–399.999	23%
	NOK 400.000–599.999	33%
	NOK 600.000–799.999	13%
	More than NOK 800.000	7%
	No answer	9%
Household	Spouse/cohabitant	37%
	Spouse/cohabitant and children	24%
	Living with my children	4%
	Living with my parents	7%
	Living alone	21%
	Shared housing	5%
	Other	1%

2.2. Interviews with the repair industry

During June and July 2019 two of the authors conducted semi-structured interviews with 15 informants (8 females and 7 males) in the repair service industry, representing a variety of repair service workers and administrators. The selection of informants was based on a Google search for repair services in the municipalities of Oslo, Viken and Innlandet and through contacts in the researchers' networks. To narrow the scope of the research, our strategic selection of research subjects consisted of repairers and administrators working with repairs of household consumer goods, such as electrical appliances, clothing, shoes and interior textiles. The background information of the companies and the demographics of each informant are given in Table 2. Six of the companies are small (1–10 employees), five medium size (10–50 employees) and four large (50+ employees). Five of the informants were engaged as tailors or dressmakers and repaired clothing, shoes and interior textiles. Six worked in small and middle-sized retail and aftersale service stores, who provided repair of products, mainly household appliances, or outdoor clothing and equipment, jeans, and bags. The remaining four informants worked as independent or authorized brand repairers including in-house repair services for brands for domestic appliances. The 15 informants represent a variety of backgrounds and levels of experience in repair services. The repair industry is complex and partly consists of large companies where repair is a small part of their business, and of small one-man businesses where repairs can be, but are not always, an important part of the business.

Prior to the interviews, the researchers decided on themes for the conversation based on previous research on the topic and developed a semi-structured interview guide. The guide is presented in Appendix B. The interviews were audio-recorded and lasted between 30 and 60 min, with one of the two researchers present, and took place at the respective repair or retail stores (one exception for which both were present and took place at the researchers' office space). Informed consent was obtained from all individual participants involved in the study. As the interviewees were interviewed in their professional capacity and anonymized, no ethics approval was deemed necessary.

In the interviews, the informants were asked about financial aspects and drivers and barriers for the repair service development in Norway. The aim was to explore the challenges facing the repair industry, and the questions addressed repair services concerning economic affairs and the experiences with customers and repair. Some of the questions were based on findings from the consumer survey. The interviews were subsequently transcribed. All informants were granted anonymity in the analysis of the findings. The resulting material was analysed by reading and searching for words, phrases and themes in the material. This was followed by deduction into three overall topics; quality, price and employees. Further detailed coding was not deemed necessary, as we were more focused on the topics that came up, rather than the exact wording/phrasing. The material was then reviewed and summarized in text, guided by the three topics.

3. Results

We will first present the range of repairs for household appliances and mobile phones, followed by clothing, including who is doing the repairs and whether they are successful. The consumers' own experiences are presented based on the survey results, and for each aspect, we employ insights from the qualitative stakeholder

Table 2
Overview of informants from the repair industry (N=15).

Ref.	Company size	Company age	Type	Product categories	Location	Informant position	Informant gender	Informant age group
Int.1	Small	1–5 years	Independent repair network	Clothing, shoes, bags and interior textiles	Oslo	Owner	Female	30–40
Int. 2	Medium	6–10 years	Retail sector	Jeans	Oslo	Store manager	Male	20–30
Int. 3	Large	Over 20 years	Retail and aftersale sector	Outdoor clothing, bags, shoes	Norway	Sustainability leader	Female	30–40
Int. 4	Small	6–10 years	Dressmaker/tailor	Clothing, folk costumes, motorcycle clothing, interior textiles, shoes	Innlandet	Owner	Female	50–60
Int. 5	Small	Over 20 years	Dressmaker/tailor	Clothing, shoes, interior textiles, folk costumes	Oslo	Owner	Female	50–60
Int. 6	Small	1–5 years	Dressmaker/tailor	Clothing, shoes, interior textiles, folk costumes	Oslo	Owner	Male	30–40
Int. 7	Small	1–5 years	Dressmaker/tailor	Clothing, shoes, interior textiles, folk costumes	Viken	Owner	Female	30–40
Int. 8	Large	Over 20 years	Retail sector	Clothing	Oslo	Sustainability leader	Female	30–40
Int. 9	Large	Over 20 years	Retail sector	Children's clothing	Oslo	Marketing coordinator	Female	40–50
Int. 10	Medium	Over 20 years	Retail sector	Outdoor clothing	Oslo	Store manager	Female	20 –30
Int. 11	Medium	6–10 years	Authorized brand repair	Household appliances	Oslo	Daily manager	Male	30–40
Int. 12	Small	11–20 years	Independent repair shop	Household appliances	Viken	Owner	Male	40–50
Int. 13	Medium	11–20 years	A brand's in-house service department	Household appliances	Viken	Head of department and senior staff (2 persons)	Male	40–50 50–60
Int. 14	Large	Over 20 years	Retail and aftersale sector	Household appliances	Oslo	Head of the department	Male	50–60
Int. 15	Medium	Over 20 years	A brand's in-house service department	Household appliances	Oslo	Head of the department	Male	50–60

interviews to explain, nuance and problematize. Then we will show what repairers and consumers think about drivers and barriers for repair organized in two sections; quality and price.

3.1. Who repairs what

Many survey respondents reported having experienced that their electrical appliances had broken down over the past two years. Of the electric appliances included in the survey, mobile phones were most frequently broken (28%), followed by 12% of dishwashers and laundry washing machines, while 10% or less had experienced a broken refrigerator, freezer, or stove (Fig. 1).

Repairs were attempted in less than half of these instances (Fig. 2). It was most common to try to repair a washing machine (47% of those that got broken) and least common to repair a freezer (20%) (Fig. 2). The same order of how common it is to repair these items was observed in a previous survey in Norway from 2017, where the largest share of consumers had repaired washing machines (33%), followed by dishwashers and clothes dryers (15%), and fridges (10%), while fewest had repaired freezers (5%) (Strandbakken and Lavik, 2018). These numbers are much lower than the recent consumer survey in EU-28, where 74% reported having repaired dishwashers and 62% mobile phones the last time they broke (European Commission, 2018).

There is a remarkably high number of unsuccessful repairs. More than half of the repair attempts of washing machines, dishwashers, mobile phones and fridges were unsuccessful, and only stoves and fridges had more successful repairs than failed ones. When combining results from all these broken products, on average 15% were repaired successfully, 19% were attempted repaired, but failed, for 60% repair was not even attempted, and 5% of the products were used further despite the defect. It was most common to continue to use defect mobile phones and stoves. There were no significant differences between genders in the occurrence of failures or share of repair attempts in any of the product groups.

Due to the limited number of responses within each product category, the responses for the different major domestic appliances are combined in further analysis, while mobile phones are kept as a separate group. When examining who repaired the products, we see that several instances were used, and all of them have both successful and failed outcomes (Fig. 3). For all electrical appliances, the success rate was higher for the professional repairers than in the private attempts. For mobile phones, only 28% of private repair attempts were successful compared to 55% by the professionals, and similarly, 39% of the private repairs of household appliances succeeded as opposed to 48% of the repairs by professionals. When comparing the specific professional repair instances, the stores and producers (brands) had the highest success rates (70% and 73%) in repairing household appliances, while other repair specialists only succeeded in 30% of cases. This corresponds to findings from our interviews with professionals who repair domestic appliances, as they generally reported a high success rate, although sometimes requiring more than one repair attempt before achieving the goal. These figures are also very similar to those found in an analysis of washing machine and dishwasher repair database, which showed that machines with diagnosed failure were repaired with success rates of 77% and 72%, respectively (Tecchio et al., 2019). In that study, the main reason why some machines were not repaired was the consumer's concern over costs.

An interesting category is "Store replaced it with a new item (warranty)" because some respondents have interpreted this as successful repair, while others have reported it as a failure. This may be because the repair itself failed, but the complaint process during the warranty period has been successful. The interviews with the informants who repaired appliances revealed that they often experienced that customers wanted a new item instead of repair,

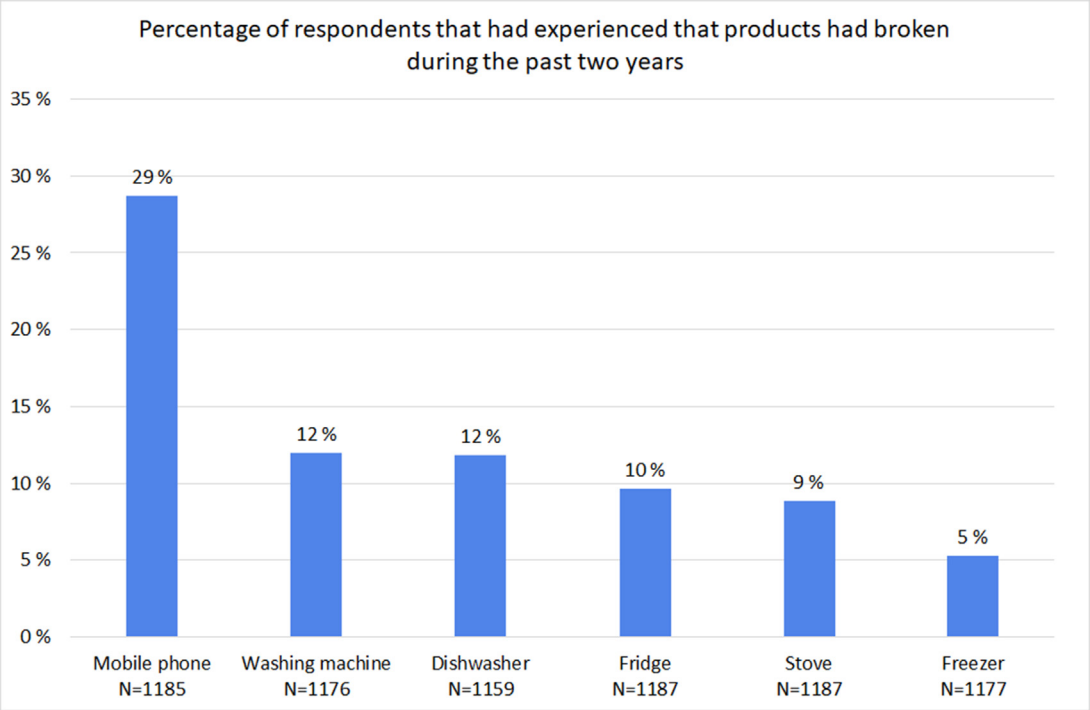

Fig. 1. Percentage of respondents that had experienced that products had broken during the past two years (Percentage of those that owned or had access to the product type in question).

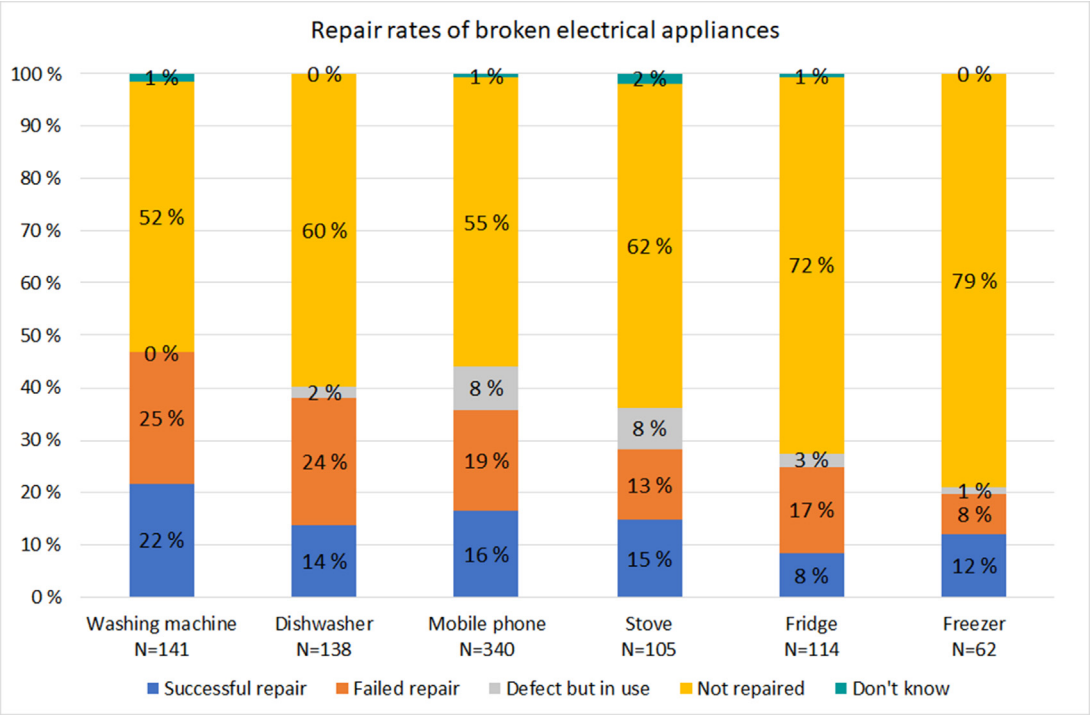

Fig. 2. Repair rates of electrical appliances that had broken during the past two years.

even when the defect was minor, and the warranty would have covered the cost of repair. These barriers to repair are discussed in section 3.3.

Clothing had a much higher share of successful repairs than electrical appliances. When asked "Have you had any of your clothes repaired or adjusted in the last two years?", the majority (56%) had not repaired or adjusted any clothing. The remaining 41% of respondents had repaired clothing successfully, while 3% said that they had tried but the repair failed (Fig. 4). Comparing the results presented in Figs. 3 and 4 shows that it is far more common

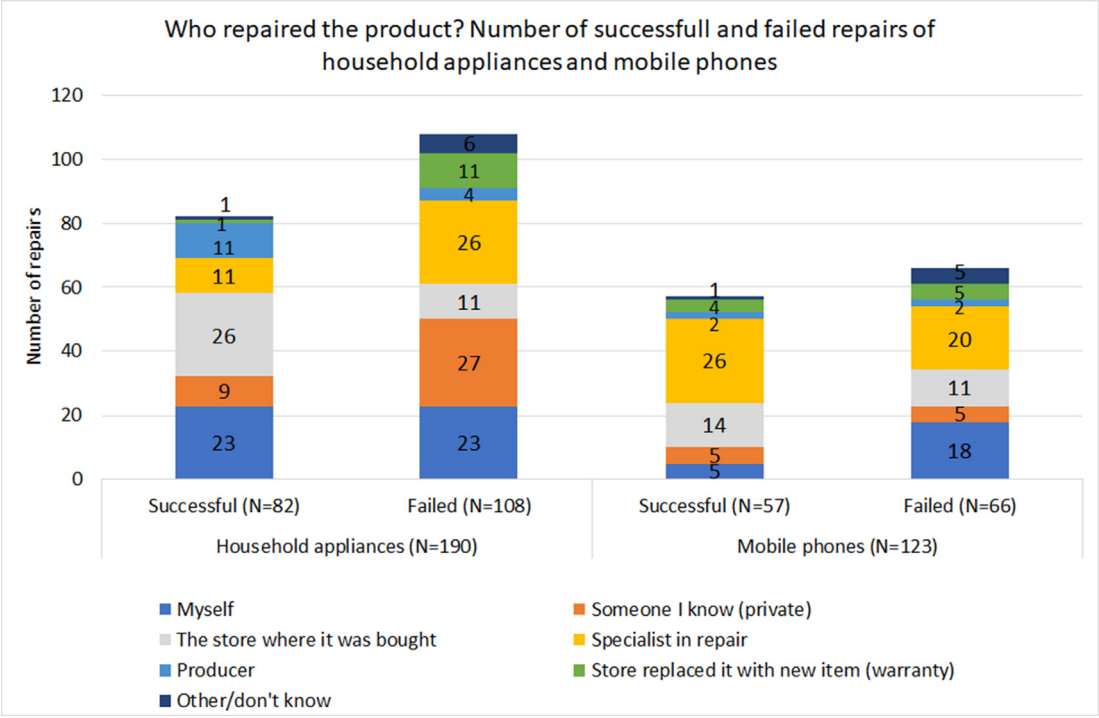

Fig. 3. Number of repairs categorized by who attempted repair and whether the outcome was successful by main product groups (household appliances and mobile phones).

to repair clothing privately than electrical appliances. Of the 43% of respondents who had repaired or attempted to repair clothing over the past two years, 72% had done this by themselves or through someone they know, 18% had used professional services, such as tailors or delivered to the store, and 11% had used both forms. This means that private clothing repair is at least three times more common than using professional help.

The data does not provide information about the number of clothes that have been repaired, but the quantity is probably larger when the repairs are done privately. There is also a significant difference in the repair success rate when clothing is compared with electrical appliances, and this holds for both private and professional repair. Compared to the repair of electrical appliances, producers and retailers have a much smaller role in repairing clothes. Six of our informants were retailers engaged in repair of the products they sold, but the actual repair work was done by independent tailors or dressmakers contracted by the respective stores. This means that the professional services used for clothing are companies mostly independent of the production and sales of the clothes.

The five tailor informants reported that the most common services were customization of the Norwegian national costume ('the bunad') and wedding dresses, adjusting the length of trousers, zipper replacement and various patching of holes in expensive, often older, quality garments. One of the tailors had 95% repair and customization jobs and only 5% were sewing new tailored garments. The other tailors had similar assignments, although one was specialised in sewing bunads. The survey showed that it was more common that women had their clothing repaired or customized (48%) than men (39%, $p < 0.05$). As could be expected, there was also a significant difference between genders in who does the private repairs. 74% of women said they had repaired clothing themselves, compared to only 32% of men. For men, it was more likely that they had asked someone they know to repair (47%). The same figure for women was only 26%. These results are very similar to previous findings on mending clothing in Norway, where women were more active in repair, including sewing on buttons, fixing unravelled seams, and darning clothing (Laitala and Klepp, 2018). Ekström et al. (2012) interviewed various consumer groups in Sweden, and their results indicated that especially the elderly were concerned about clothing repair, and conducted simpler repairs themselves while also using tailors when larger repairs were needed. This was less common among the younger consumers, but they too undertook some simpler repairs, especially of jeans. Families with small children did not prioritise mending clothes due to lack of time. Similarly, our study found that the tailors were rarely engaged to repair children's clothing. However, one of our informants was employed in the retail sector for children's clothing where they provided repair of clothing from their own brand.

3.2. Reasons to repair: quality

The survey showed that many of the reasons for repair were equally important for electrical appliances and clothing. The price and quality of the broken products were particularly important reasons for all products (Fig. 5), and this was also the experience shared by all of our informants in the repair industry.

The quality of products is a crucial factor if we are to promote longer product replacement cycles, but assessing the quality is complex and difficult for consumers to gauge (Connor-Crabb and Rigby, 2019; Jian and Guoqun, 2007; Swinker and Hines, 2006). Quality is the degree to which the product satisfies a specified set of attributes or requirements and includes technical and social aspects. The quality of something can be determined by comparing a set of inherent characteristics with a set of requirements. Since consumers do not have access to information about these properties, price is much used as an indicator of quality. This is reflected in the survey, but there is not necessarily a correlation. Some of the survey respondents' reasons to repair mobile phones differ from domestic appliances (Fig. 5). Factors contributing to a higher degree

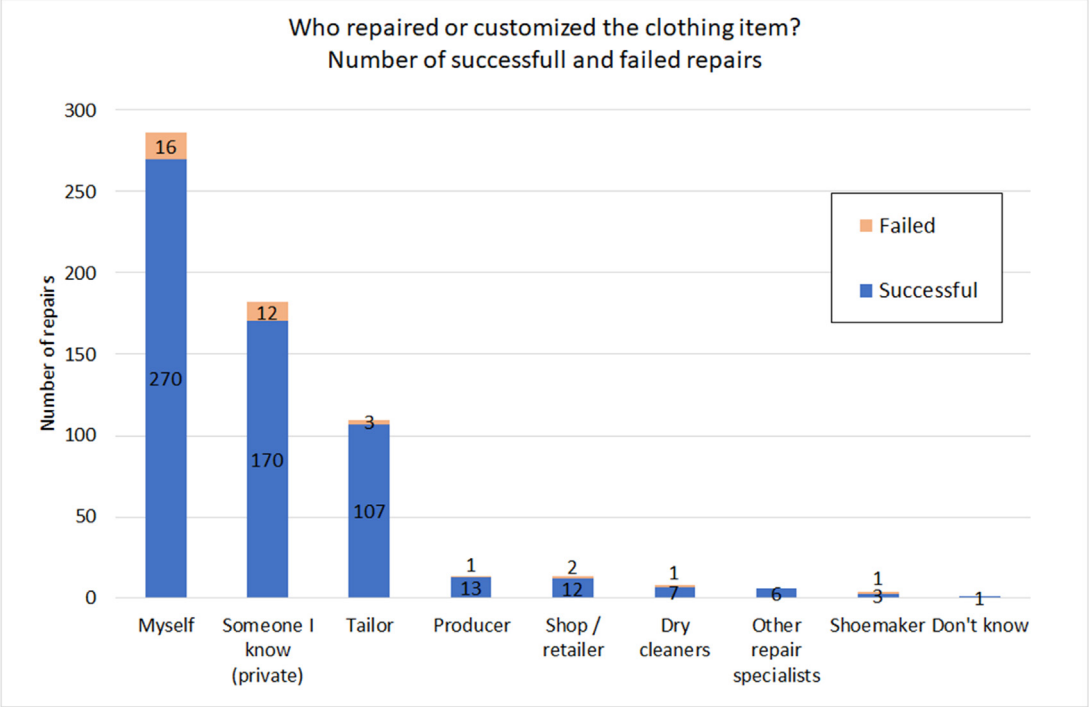

Fig. 4. Who repaired or customized the clothing item? The number of successful and failed repairs. Multiple answers were allowed. (N = 625 repairs).

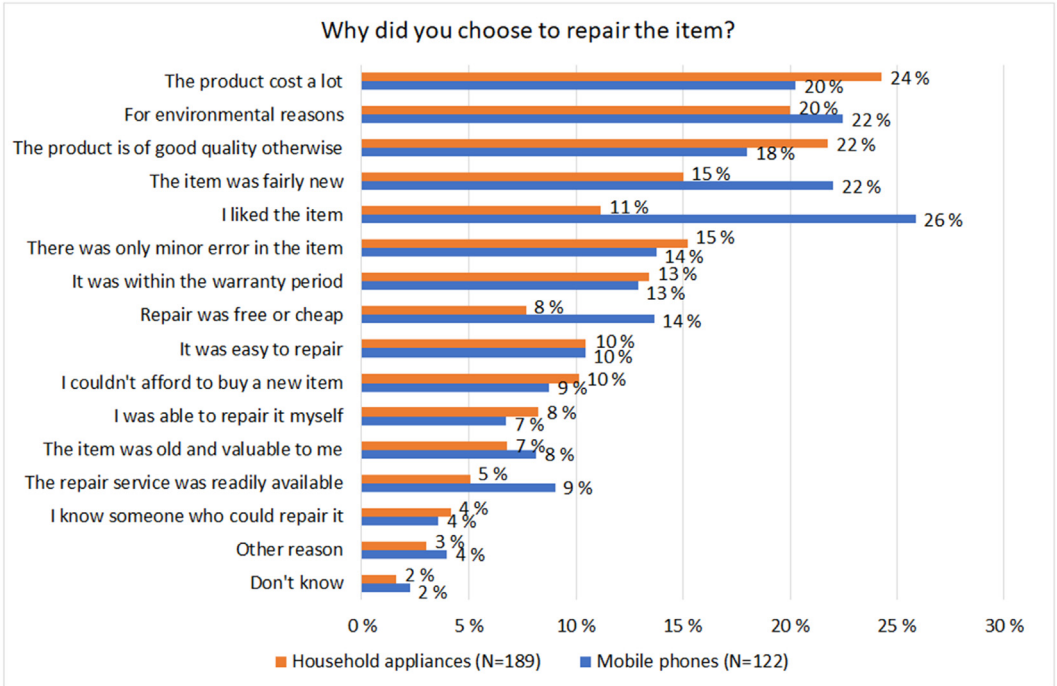

Fig. 5. Reasons to repair household appliances and mobile phones Respondents could give up to three reasons per product. Percentages by respondents.

of repair for mobiles were whether the owner liked it or not, and if it was new, relating to social aspects rather than technical.

For clothing, the question was formulated differently, and we were interested in what might contribute to the longer use of clothing. We gave our respondents a series of statements about what would make them use their clothes longer (Fig. 6). There was only one statement to which a majority of respondents agreed; namely that clothes would be worn longer if they were of better quality. This statement was followed by "if repair services were cheaper", which 32% of respondents either fully or partially agreed with. The statement that respondents agreed the least with was that they would wear their clothes longer if fashion did not change so often. This is in line with previous studies of Norwegian dress habits (Klepp and Laitala, 2016; Laitala and Klepp, 2013a). Our

informants also mentioned quality as an essential reason for why their customers repaired their clothes, in addition to emotional attachment. It is difficult to assess information on the quality of clothing in the contemporary market. There are no labelling schemes that inform consumers about the technical quality of clothing. Knowledge of clothing's technical attributes is also low among the general population in Norway (Laitala and Klepp, 2013b). These various factors together make price the most important marker of quality, even though it is not a trustworthy indicator.

There are a few differences in the survey between women and men in how they respond to the statements about increasing the lifespans of their clothing (Fig. 6). Women agree to a greater extent on two of the claims; they could use their clothing longer if their body size/shape was more stable, and if fashion didn't change so often. Additionally, although it is not a significant difference, there is a tendency that men agree more that cheaper and more accessible repair services would lead to a longer life for clothing. Women put more faith in factors that have to do with themselves, such as buying fewer new items and being better at repairing themselves. This corresponds with women repairing more themselves than men, and previous research showing that fit is one of the most important causes for women to dispose of clothing (Collett et al., 2013; Koch and Domina, 1999; Laitala et al., 2015). The youngest respondents between 18 and 30 years agreed more with all the statements than the older age groups. The young are generally more inclined to think that they could wear their clothes longer than they currently do.

For electrical appliances, we found some significant differences between respondents ($P < 0.05$). Men were more likely to repair appliances when they were easy to repair, if they were able to do it themselves, or because the repair was cheap or free of charge, while women were more likely to repair if they knew someone who could repair the product in question. Students were more likely to repair items if they were expensive. Those with low income were more likely to repair if they knew someone who could repair the item. Single parents, households with lower incomes and those living on social security were more likely to say they could not afford to buy a new product.

3.3. Reasons not to repair: price

In the survey, we asked about reasons why broken household appliances and mobile phones were not repaired (Fig. 7). The main reason was that the product was considered too old and damaged beyond repair. Further, the survey and our interviews show that the original price of the product compared to the price for repair is critical for the decision to repair. This finding confirms previous research on barriers to repair, such as a recent Norwegian study where 49% of consumers had chosen not to repair a broken product because it was too expensive to do so (Norwegian Consumer Council, 2019). An essential barrier affecting the number of repaired products is the low cost for a new one. The price of home appliances is nominally almost the same as 20 years ago (Statistics Norway, 2020), while wages have increased significantly over the same period (Pedersen, 2020). This further shifts the balance towards replacement over repair. Changes in the consumer price index on clothing are even more extraordinary, as they show that clothing prices in Norway are now at the same level as in 1980 (Statistics Norway, 2020).

The results from Fig. 7 differ some from the impression of our informants from the domestic appliance industry, as they rarely see consumers who are willing to pay much for repairs or repair old products. The informants estimate that only 10–15% are willing to pay for the repair themselves after the five-year warranty has expired. However, even 5 years could also be perceived as old to some consumers, as this is a relative concept. Four years could for some (particularly young consumers) be old for a mobile phone, but probably less so for household appliances like a freezer. In Norway, the Consumer Purchases Act (2002) that gives the right to

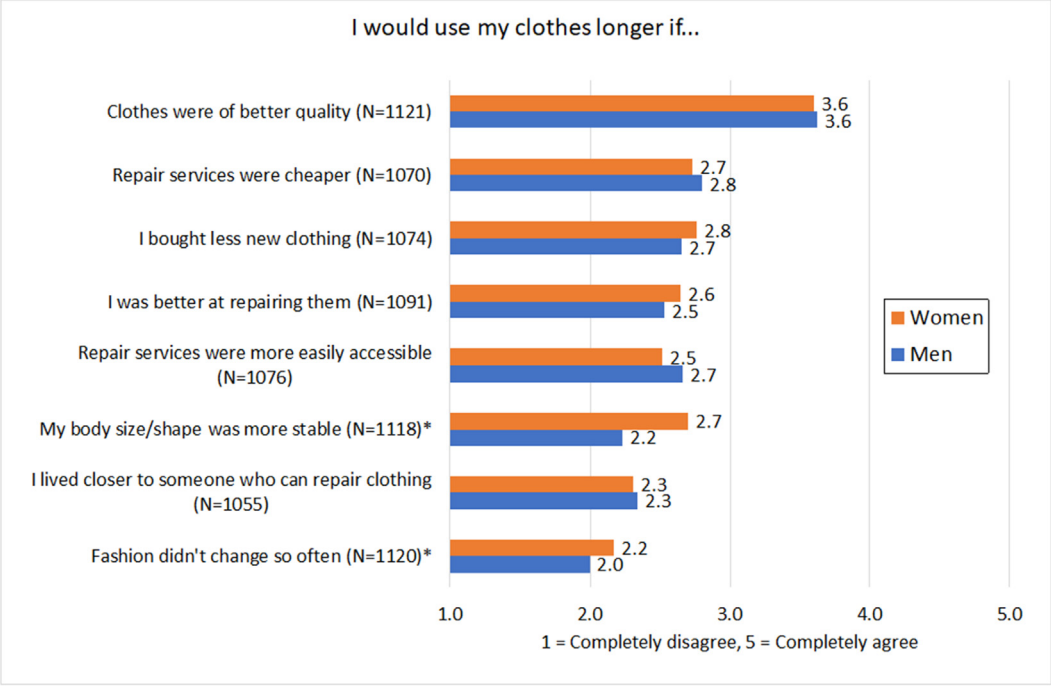

Fig. 6. *What could contribute to you wearing your clothing longer? By gender. Average values of scale from 1 to 5, where 1= completely disagree and 5= completely agree. (Significance indicated with * when $p < 0.05$).*

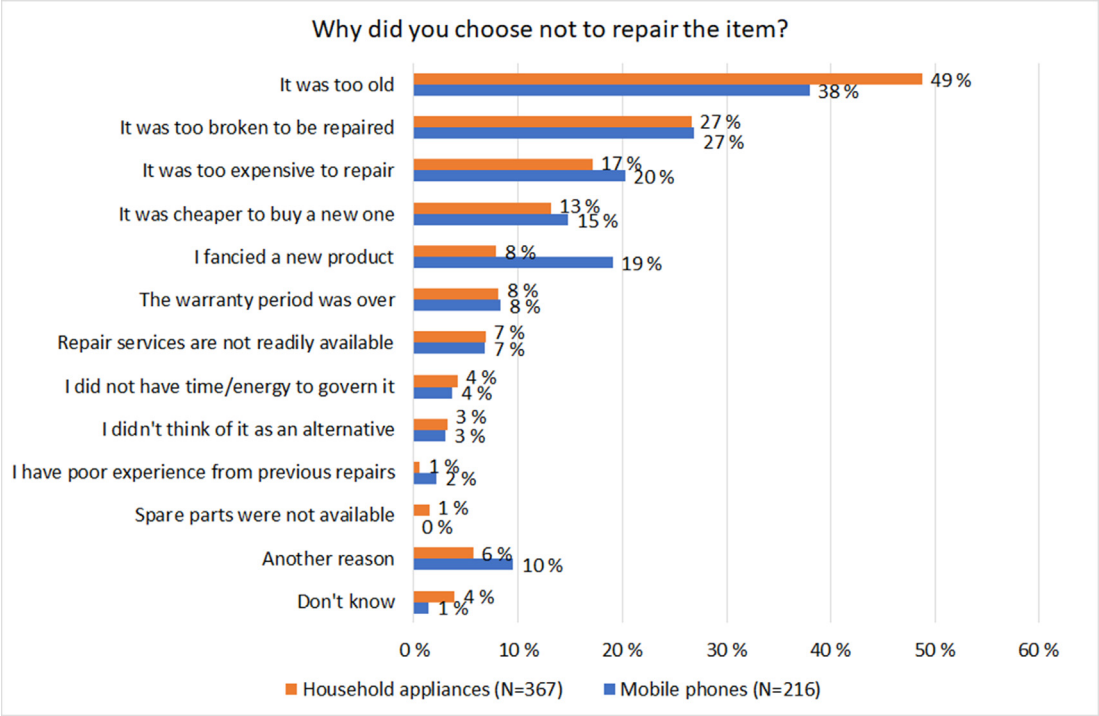

Fig. 7. Reasons to not repair household appliances and mobile phones. Respondents could give up to three reasons per product. Percentages by respondents.

repair or replacement has led to a situation where most repairs on domestic appliances and mobile phones are performed on products that are less than five years old, as these usually are offered free of charge. This may explain why for many survey respondents the age and condition of the product were even more important than the price and availability of repair services.

For clothes, the warranty is only valid for two years. However, this matters less as consumers appear to have little knowledge of their rights and seldom use the warranty. The price for repairing clothes depends a lot on the type of garment and repair needed, but a general trend noted by the informants is that consumers are not willing to pay much for the repair of clothing, and especially not for low-priced garments. They find that consumers compare the price to a new garment, which often is the same or even lower than repair or adjustments done by the tailor. Additionally, two of the informants in the retail sector offered repair free of charge on products from their own brand, and they experienced a high demand for this service. The price of clothes from this particular brand was in the middle to high range.

Based on the replies in Fig. 6, lack of quality is a barrier to use clothing longer and shows a general disappointment with the low technical quality of garments. It is not worth repairing them as they will still be of poor technical quality and because new garments are priced low. This can be seen as a vicious circle because when clothes are not repaired, there will not be an incentive to buy something better in the future either.

Another barrier not captured by the consumer survey but reported by the repair industry was connected to better accessibility of original spare parts, tools and product manuals, as well as know-how. There is limited availability of competent personnel in the repair industry. This is also a significant challenge for the appliance repair sector, which is now facing a generation shift, and the industry considers that not enough young people are choosing to become repairers of electrical appliances. The lack of competent personnel leads to repair businesses having difficulty increasing their capacity and can impact consumers' willingness to repair based on longer waiting times. The situation also impacts private clothing repairs, as basic textile education in school is lacking.

4. Discussion: What could increase repair rates?

We found a surprisingly high proportion of self-repair by consumers, especially of clothing but also of electrical appliances. The proportion is high in itself but also when compared with previous research (European Commission, 2018; McCollough, 2007; WRAP, 2012). For example, Ertz et al. (2019) found that within the business models on product lifespan extension, the "consumers' input lies mainly in access and redistribution schemes, whereas the bulk of product lifetime extension activities, consisting of design, maintenance and recovery falls predominantly under the corporate realm" (p. 878). This means that the question of increasing repair is not only about an increase in this as a business, but also an increase in private repairs and an increase in the proportion of successful ones.

There is consensus between consumers and the repair industry about what can contribute to more repairs: better quality of products. Higher quality means that a product can be used longer before it needs repair, but in addition, consumers were more likely to choose to repair products they experienced to be of good quality. Further, better quality will also increase the profitability of repair because the product is likely to have a longer service lifespan left after the repair, and thus make it more worthwhile. Previous research has assessed the repairability of products but focused to a lesser degree on their inherent quality (Cooper, 2012; Cooper and Salvia, 2018). For many consumers, the age of products and the condition of household appliances were even more decisive factors than the price for the repair. However, based on our repair informants' experiences, in cases where consumers had to pay for the repair when the repair was not covered by warranty, many would choose to buy a new product. This was especially the case when the

repair price was comparable to buying a new product based on cost-value consideration (McCollough 2009).

As many repairers are already struggling with slim margins, instead of making repairs cheaper we suggest that the price of new products could be adjusted. Several studies document that consumers are only willing to pay a small fraction of the price of a new product for repair work (Adler and Hlavacek, 1976; Cooper and Salvia, 2018; European Commission, 2018; McCollough, 2007). It is more profitable to repair clothes of higher technical quality, and many consumers are positive to an increase in the price of clothes (10–20%) if it guarantees better quality (Klepp and Laitala, 2016). Means could include everything from increasing value-added taxes (VAT), to imposed fees and clearer producer responsibility. Good candidates for imposing such measures could be disposable products and other items that cannot easily be repaired or maintained. There is a new European standard for measuring the repairability of energy-related products (EN 45554, 2020), which could be used as a starting point for such regulation.

Since the warranty period was decisive for many consumers on whether they chose to repair the products, increasing the period further could lead to a larger share of products being repaired, as also suggested by Cooper and Salvia (2018). This measure could also be part of increased producer responsibility, where producing higher quality would pay off in the long run.

Another factor affecting both consumers and the repair industry is the reported lack of knowledge on how to repair various products and faults. The survey showed that 24% of respondents had repaired their own clothing, which is the same share as reported in the EU-28 study for self-repair of clothing (24.4%) (European Commission, 2018). At the same time, 27% of our respondents agreed that they would wear their clothing longer if they were better at repairing them. A third of the respondents in the survey who had experienced their electrical appliances breaking had tried to repair the appliances themselves or asked somebody they know. However, there were also many unsuccessful repairs reported from this group. One of the reasons for this could be related to the poor repairability of products (Cordella et al., 2019). If the number of repairs, and especially the number of successful repairs, is to increase, then the product must be designed for easy repair, and consumers must become better equipped for repairing. Increased repair knowledge can lead to better care, which in itself prevents the product from becoming defective and prolongs its service lifespan. Better knowledge will also make it easier for consumers to see when it is necessary to leave the repairs to professionals. Increased knowledge can also lead to better purchases and, in the long run, better goods. The repair industry will also benefit from this.

The ability to repair is often dependent on the availability of original spare parts, proper specialised tools and product manuals, which especially impact independent repair businesses (i.e. not authorized by any particular brand) and private consumers. This is first and foremost a political responsibility, to impose regulations on manufacturers to increase the affordable access to these.

Increasing repair competence at all levels would also make it easier for the repair actors to recruit new personnel and increase profitability. Simple repairs of small holes or sewing on buttons are not particularly profitable (or even very interesting) for the tailoring business, and therefore a solution would be a more appropriate division of labour between consumers and tailors. Tailors with a large selection of equipment could increase their capacity in repair while also being able to offer more interesting and lasting jobs for their personnel.

Many consumers are uncertain about their rights when purchasing products. In a recent survey, half of the respondents were not aware of the legal rules for warranty, complaints and guarantees (Norwegian Consumer Council, 2019). Every third consumer had experience faults in clothing before the warranty limit of 2 years had passed, but more than half of them had not complained (Bøyum et al., 2017). If knowledge of consumer rights increased it could have a positive effect on repair rates, as long as the store offers to repair the items instead of replacing with a new item.

Both industry and the authorities argue for change towards a circular economy and increased repair. So far, few of the many policy options have translated into legislation (Cooper and Salvia, 2018). One exception is reduced value-added tax (VAT) rates for repair services (European Commission, 2009). This has been tried out in Sweden (Orange, 2016), with unclear results according to Swedish media (Borsiin, 2018; Johansson, 2017; Sundberg, 2016). This measure is also discussed in Norway. However, our results indicate that the price of repair is not the most decisive factor for whether something is repaired. The main reason for this is that many repairs are conducted privately and thus not paid at all. Secondly, repairs within the warranty limit are not paid by the consumer. In instances where consumers pay for repair services, there would be a need for a more significant price reduction to be able to compete with the low price of new products. These types of initiatives are currently tested in few Austrian federal states that have implemented repair bonuses or vouchers that are up to 50% of the total cost of a repair, with a maximum limit of €100 (Ekovjesnik, 2020; Piringer and Schanda, 2020).

Within the work of developing new BMs for longer product service lifespans, there is little focus on product improvements. After reviewing the literature in the field, Ertz et al. (2019, p. 867) conclude that the "product nature improvement through design is found less prevalent than product nurture strategies, such as maintenance (maintenance/advice/training/consulting), recovery (remanufacturing and repair), redistribution and access schemes». In other words, there is little focus on the measures that our informants, both the industry and consumers, believe are the most important. Better quality of products will reduce the need for repair, but is also likely to contribute that higher share of repairs are successful, thus further extending the service lifespan.

4.1. Limitations

The study has focused on the repair of three product groups in one country, and our findings may not necessarily apply to other product groups and other countries. Even though clothes, mobile phones and household appliances are rather different product groups, the results are strikingly similar. It is therefore a reason to believe that our results will apply to a variety of other consumer goods as well. The study is based on industry interviews and consumer survey responses. Better knowledge of the products and repairs would involve methods that included combinations with technical examinations, observations and registrations.

5. Conclusions

Repair should be considered as a crucial part of the circular economy through its contribution to increased product service lifespans and thus better resource utilisation and less waste. At the start of this paper, we asked what might lead to more repair of household appliances, mobile phones and clothing and studied the roles of consumers, both through their own and the repair industry's point of view. Our most important finding is that better quality products, the 'nature' of the products is most important. Other factors like improved consumer rights, better accessibility to original spare parts, tools and product manuals, in addition to increased knowledge of repair, rights and warranties, are crucial for what will

lead to more successful repairs and thus longer service lifespans. Increased consumer knowledge and rights in the form of the right to complain and/or extended warranty will not only be one of the things that can increase the number of repairs the most, but it will also enhance the balance of power between consumers and producers – and in the long turn make it unprofitable to produce low-quality products.

The price and the availability of repair services are also important for the repair of goods, especially for mobile phones and domestic appliances. For clothing, the number of repairs conducted privately is at least three times more frequent than professional repairs, and measures here will have the potential to increase the scope even more. Being able to repair something by using private networks, such as family or friends, entails allocating time, and the prerequisite is to know someone with repair skills. DIY and private repair were common for all the studied product groups. For mobile phones and home appliances, this amounted to close to 37% of the repairs, while private repairs dominated for clothing. Clothing repairs were reported to be successful more often than repair of the electric products.

The transition to a circular economy also requires the development of new BMs that increase product lifespans. In order for them to be financially profitable, customers – consumers – must be willing to pay for circular solutions such as repair. Knowledge of consumers' understanding of different BMs must therefore be included in this development. Our results indicate that not only the prices of the repair services themselves, but equally what these prices are compared to, is crucial. These conditions can best be regulated by the authorities and other matters outside the business-to-consumer relation. Our study has raised new questions and points to areas with knowledge gaps. Why do so many repairs on home appliances and mobiles fail? What kind of repairs are being done privately and how can they get even better results? Why did we find a surprisingly large self-effort from consumers, compared to previous studies? Future research should address these knowledge gaps by using a variety of research methods, including experiments and repair data, and further focus on the consequences of implementing the measures suggested here. We believe our most important contribution has been to simultaneously look at private and commercial repair and we welcome further research that examines different circular models with the same combination. Consumers are important actors in new BMs, but should also play an active part during the acquisition, use (maintenance and repair), and disposal (reuse and recycling) of products. This article has shown that it is not just professional repairers who repair products. It provides opportunities in the development of instruments for increased self-repair by consumers, and solutions that combine private and commercial efforts.

CRediT authorship contribution statement

Kirsi Laitala: Conceptualization, Formal analysis, Investigation, Methodology, Visualization, Writing - original draft, Writing - review & editing. **Ingun Grimstad Klepp:** Conceptualization, Formal analysis, Investigation, Methodology, Writing - original draft, Writing - review & editing. **Vilde Haugrønning:** Conceptualization, Formal analysis, Investigation, Methodology, Project administration, Writing - original draft, Writing - review & editing. **Harald Throne-Holst:** Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Writing - original draft, Writing - review & editing. **Pål Strandbakken:** Writing - review & editing.

Declaration of competing interest

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

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jclepro.2020.125349.

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