



# Exploring the inner loops of the circular economy: Replacement, repair, and reuse of mobile phones in Austria

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## ABSTRACT

The 'circular economy' paradigm is taking hold in the mobile phone sector as a solution to increasing resource use. This paper explores three dimensions of the consumption of mobile phones: timing of replacement, repair, and reuse. Combining quantitative evidence from a large-scale questionnaire survey ( $n = 988$ ) with 25 qualitative household interviews, we identify the consumers' motivations underpinning their considerations regarding replacement timing, replace versus repair, and new versus second-hand phones. The findings from this study suggest that mobile phone replacements are not only based on a desire for the new, but primarily on the perceived obsolescence of the current phone. We identify three forms of perceived obsolescence, being either related to a phone's 1) basic functionality, 2) up-to-dateness, or 3) ability to keep up with social practices. Furthermore, it is shown that the perceived speed of obsolescence is key to considerations of phone repair and reuse. Overall, the results call into question the prevalent picture of novelty-oriented mobile phone consumers, exposing the paradoxical nature of consumer strategies to resist the fast pace of obsolescence.

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## 1. Introduction

The global market for mobile phones poses a considerable challenge for a transition towards more 'circular' modes of consumption and production. In many ways, the mobile phone industry has long been exemplary for what has been termed a 'linear' model of resource consumption (e.g. [Ellen MacArthur Foundation, 2013](#)), characterised by low recycling and collection rates, use of toxic chemicals, low levels of reuse and sharing, and short replacement cycles (e.g. [Suckling and Lee, 2015](#)). At least when it comes to recycling and waste collection, however, the market for mobile phones has recently witnessed remarkable improvements and a mushrooming of registered recycling companies, made possible by significant changes in the 'upgrade ecosystem' of mobile phones ([Yau, 2014](#)). This is paralleled by an increasing number of studies exploring the potential of a circular economy for reducing the environmental impact associated with mobile phones (e.g. [Benton et al., 2015](#); [Ellen MacArthur Foundation, 2013](#); [Güvendik, 2014](#); [Page, 2015](#); [Sinha et al., 2016](#)).

Like much of the literature on the circular economy, the bulk of this research focuses on the 'outer circles' of material flows, namely recycling, remanufacturing, and refurbishing. Yet it is widely acknowledged that a much greater potential for reducing environmental impact and resource use lies in the inner circles – product replacement, repair/maintenance, and reuse. The Ellen MacArthur Foundation refers to the 'power of the inner circles': "The closer the system gets to direct reuse, i.e., the perpetuation of its original purpose, the larger the cost savings should be in terms of material, labour, energy, capital and the associated externalities, such as greenhouse gas emissions, water, or toxic substances" (2013, p. 33).

Equally important however, is the speed of circulation. Extending the service life of products can significantly reduce the environmental burden associated with their production and consumption, cutting down levels of waste generation, resource and energy consumption, human toxicity, and greenhouse gas emissions (e.g. [Downes et al., 2011](#)). Furthermore, the fast pace of production and replacement puts enormous pressure on waste management, contributing to the growth of e-waste in developing countries ([Lebel, 2015](#)). Specifically in the case of mobile phones, extending their service lives is considered to be one of the most effective measures to close loops and increase loop efficiency ([Sinha et al., 2016](#)). Given that production is the dominant contributor to their total environmental impact (see [Suckling and](#)

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Lee, 2015), using phones longer would be beneficial even under fast improvements in material and energy efficiency (Frey et al., 2006; Güvendik, 2014; Kwak, 2016). According to recent estimates, one additional year of usage can reduce the overall carbon footprint of a smartphone by 31% (Benton et al., 2015).

The importance of the inner circles and the speed of circulation is well captured in the definition of the circular economy proposed by Geissdoerfer and colleagues: “we define the Circular Economy as a regenerative system in which resource input and waste, emission, and energy leakage are minimised by *slowing*, *closing*, and *narrowing* material and energy loops.” (Geissdoerfer et al., 2017, p. 759 emphasis added). On the basis of this definition, we distinguish between three actions towards a more ‘circular consumption’ of mobile phones:

- Postponing replacement: Phones are held onto for a longer time period, being replaced less frequently.
- Maintenance and repair: Careful use and preventive maintenance of phones, which are repaired in case of defects or malfunctions.
- Direct reuse: Phones are handed on or sold to family, friends, or charity and acquired second-hand.

In contrast to extensive research on the disposal routes and recycling of mobile phones (Jang and Kim, 2010; Li et al., 2012; Ongondo and Williams, 2011; Rathore et al., 2011; Wilson et al., 2017; Yin et al., 2014; Ylä-Mella et al., 2015), none of the aforementioned dimensions received much attention in previous research. In particular the consumers’ considerations regarding repair and the purchase of second-hand devices are heavily understudied. Beyond such gaps in the literature, we note a series of limitations of existing research. First, prior studies mostly relied on quantitative evidence from consumer surveys without examining the reasons for observed variations in consumer behaviour (e.g. Li et al., 2012; Ongondo and Williams, 2011; Wilson et al., 2017). The general lack of qualitative evidence means that results are often difficult to interpret and typically limited to a few pre-determined factors. Second, many studies are based on fairly small sample sizes and focused on young consumers only (e.g. Wilson et al., 2017). This may have led to an over-emphasis of fashion-oriented consumption as opposed to the more pragmatic approach to mobile phones that related research observed among older consumers. A more diverse sample is necessary to make the different experiences of mobile phone consumers visible. Third, the focus of most previous research on either replacement, repair, or reuse means that the interrelatedness of these areas of sustainable consumption have been largely neglected.

This research aims to address these shortcomings by exploring the various motivations underpinning the consumers’ considerations regarding mobile phone replacement, repair, and reuse. By combining quantitative and qualitative evidence from consumer interviews, we are able to capture both the diversity and depth of consumer experiences related to mobile phone consumption. Moreover, this is one of a small number of studies examining the whole “consumption lifecycle” of a consumer good from purchase to divestment (Cox et al., 2013; Evans and Cooper, 2010). Paying equal attention to usage and divestment patterns is an important corrective to the predominant focus on acquisition behaviour in consumption research of durable goods. Finally, this study contributes to the literature by advancing the evidence base on the (potential) role of consumers in the circular economy, which still has its emphasis on governments and companies (Geissdoerfer et al., 2017). The remainder of this paper proceeds as follows. Section 2 presents an overview of existing research on replacement cycles, repair, and reuse of mobile phones and discusses the

research gaps. Section 3 describes the methodology of this work and provides a brief description of the Austrian mobile phone market. Section 4 presents and discusses the findings on each ‘inner circle’. Finally, we conclude the paper and reflect on the implications and limitations of this study in section 5.

## 2. The inner loops of mobile phone consumption

### 2.1. Replacement cycles

Mobile phones are a typical ‘up-to-date product’, characterised by a high proportion of goods that are replaced while still functioning (Cox et al., 2013). Beyond defects and malfunctions, the desire for a more up-to-date device is thus widely reported as one of the main motivations for replacement (Greenpeace, 2016; Huang and Truong, 2008; Li et al., 2012; Ongondo and Williams, 2011; Wilhelm et al., 2011; Wilson et al., 2017; Yin et al., 2014). In addition, many phones are replaced as part of regular service contract renewals, but the popularity of such upgrade schemes varies considerably across countries (Greenpeace, 2016). While resembling other up-to-date products like clothes and small household appliances in many ways, mobile phones are unique *in the extent* to which they follow both the logics of technological change and fashion.

Rapid changes in phone technology may continuously render existing ones obsolete. With increasing demands for higher processing capacity of new applications and software, existing phones gradually slow down and loose performance. Incompatibilities and security issues frequently arise as software updates are offered for a limited time only (Benton et al., 2015). Furthermore, the close connection between the phone and the human body, being constantly and visibly carried around, made the phone an object of fashion (e.g. Fortunati, 2005; Katz and Sugiyama, 2006). The continuous introduction of new phones, most leading smartphone manufacturers currently launch a new flagship model every year, drives obsolescence by making consumers feel outdated and depreciating the resale value of existing phones (e.g. Boone et al., 2001; Collins, 2013; Spinney et al., 2012).

However, few consumers follow the one-year introduction cycle in replacing their phones. Survey evidence and estimations on the basis of discarded devices suggest that phones are replaced every 1.5 and 3 years and thus much less frequently than they are launched (e.g. Coats and Benton, 2016; Deloitte, 2015a; Echegaray, 2016; Jang and Kim, 2010; Li et al., 2012; Milanese and Guenveur, 2016; Murakami et al., 2010; Ongondo and Williams, 2011; Rathore et al., 2011; Riikonen et al., 2016; Thiébaud (-Müller) et al., 2017; Venkitachalam et al., 2015; Wang et al., 2013; Wilhelm et al., 2011; Yin et al., 2014; Ylä-Mella et al., 2015). Unfortunately, most studies provide only descriptive evidence and aggregate figures of replacement cycles without inquiring into the reasons for the considerable variation across different consumer groups. Replacement cycles of phones are not only much shorter than for other electronic devices, but highly unpredictable (Hanks et al., 2008; Ma et al., 2016).

Much research has been devoted to the hedonic and social aspects of mobile phone consumption (e.g. Arruda-Filho and Lennon, 2011; Katz and Sugiyama, 2006; Wilska, 2003), reflecting the prevalent picture of novelty-seeking and fashion-conscious mobile phone consumers. Yet this picture is not entirely accurate, as segmentation studies show that most consumers actually tend to buy phones for rather pragmatic reasons and show a fairly low interest in fashionable design and technology (e.g. Kimiloğlu et al., 2010; Mazzoni et al., 2007; Zhu et al., 2009). Interviewing Korean consumers, Huang and Truong (2008) also encountered signs of resistance and apathy towards frequent replacements among some

consumers. However, few studies have linked the research on consumer attitudes and motivations with questions related to the frequency of phone replacements.

## 2.2. Maintenance and repair

The total service life of a phone may further be related to its maintenance and considerations between repair and replacement in cases of product malfunction or failure. As for the wider literature on repair, empirical evidence on this aspect of phone consumption is extremely thin however (e.g. Sabbaghi et al., 2016). A few studies examined consumer attitudes towards repair, but it remains unclear to what extent general attitudes can explain repair behaviour in the specific context of the mobile phone repair provisioning system. Given the large number of mobile phones in use and their high economic value, there is a huge market potential for mobile phone repair, which yet has to be realised in many countries. Only 23% of Germans and 28% of US Americans have had their phones repaired, compared to 66% in China and 64% in South Korea (Greenpeace, 2016). To increase the share of repairs of defective phones, it is vital to understand the motivations underpinning considerations of phone repair versus replacement.

## 2.3. Direct reuse

Finally, the service life of a consumer good can be significantly extended through reuse. From a consumer perspective, there are two dimensions to a successful reuse system. First, consumers need to use second-hand phones instead of buying new ones and second, phones in working condition need to be handed on in one way or another after replacement to ensure sufficient supply of second-hand phones. A comparison of research on both dimensions reveals a considerable mismatch however. With regard to the second dimension, survey results from various countries show that about 13–28% of replaced phones are being either donated to charity or handed on to friends or family (Deloitte, 2015b; Li et al., 2012; Ongondo and Williams, 2011; Rathore et al., 2011; Wilson et al., 2017; Yin et al., 2014; Ylä-Mella et al., 2015). After storing phones in the drawer, giving phones away as a gift is thus the second most frequent route of disposition. But the high percentage of phones stored in households continues to be a problem for the establishment of a functioning reuse market, as many consumers prefer to keep their phones as back-ups. Another reason for this stockpiling of phones is the lack of demand for used devices. Around 80–90% of phones are purchased new, even among older generations which are generally less demanding and more willing to accept phones being handed down (Deloitte, 2015b). Apart from a small survey among Finnish phone consumers (Ylä-Mella et al., 2015) and comparable research about the consumer acceptance of refurbished and remanufactured phones (Rathore et al., 2011; van Weelden et al., 2016), this lack of demand for used phones has not received sufficient attention so far.

# 3. Methodology

## 3.1. Questionnaire survey

To investigate the underlying motivations for considerations regarding the replacement, repair, and reuse of mobile phones, a combination of quantitative and qualitative research was chosen. In a first step, a questionnaire for an online survey was developed. The main part of the questionnaire inquired into the various phases of mobile phone consumption, comprising 27 questions in total (see Appendix A). To capture the whole 'consumption lifecycle' of mobile phones including their pathways of disposition, all questions

focused on the respondents' previous phone, which was defined as the primary phone that was used before the current one in use. The questionnaire design was inspired by the conceptual work of Van Nes and Cramer (2005). In contrast to the models of replacement decisions in the economic and behavioural economic literature (for an overview see Gultinan, 2010), these authors acknowledge a wider range of potential influences, derived from both qualitative and quantitative research.

The part on mobile phone consumption further included a list of statements to measure each respondent's relationship to her previous phone (see Table 1). The selection of statements was informed by existing research and covered five dimensions that were found to influence the timing of replacements and decisions regarding repair and reuse. *Care of use* relates to the treatment of a product's hardware and has been shown to be positively associated with replacement cycles in other product categories (Evans and Cooper, 2010). Furthermore, we included two dimensions of obsolescence, using the terminology proposed by Burns (2010). While the perceived *aesthetic obsolescence* of one's possession is based on social comparison and relates to style and fashion, *technological obsolescence* denotes limitations in functionality due to changes in technology. A product's *durability* is another possible influence. Considering that consumers may not be able to reliably assess the durability of their phone, however, this construct should be seen as a consumer perception rather than a precise measurement. Finally, three statements were included to measure each respondent's *emotional attachment* to her previous phone. A rich body of work has evolved on this to date, based on the notion that people attached to a product are "more likely to handle the object with care, repair it when it breaks down, and postpone its replacement as long as possible" (Schifferstein and Zwartkruis-Pelgrim, 2008). Each construct is based on three (techn. obsolescence on two) items of measurement and has a reasonably high internal consistency (Cronbach's  $\alpha > 0.6$ ). Three additional statements related to the relationship between the owner and her previous phone were found to correlate very weakly with other statements and were thus used independently (see Table 2).

To prevent potential misunderstandings, all questions in the survey were cognitively pre-tested with nine persons using probing and paraphrasing techniques. The questionnaire was then sent out to 5600 Austrian residents in November 2014. In total, 1009 persons completed the questionnaire, of which 21 indicated to either currently own their first phone or never have possessed a phone. Since we are only interested in the experiences with the consumers' previous phones, this resulted in an overall sample size of 988 survey respondents. Quota sampling ensured a representative distribution in terms age, gender, education, and region of origin of Austrian adult population between the age of 18 and 65. To support the findings from the qualitative part, non-parametric statistical tests were performed to detect differences and trends in our data. Non-parametric tests are more robust against outliers and more accurate when the data is not normally distributed. Test results are reported in brackets, whereby an 'U' signifies a Mann-Whitney U test, a 'p' a Spearman correlation analysis, a 'p' the level of statistical significance, and an 'r' the effect size or strength of relationship. The statistical analysis was performed using SPSS version 21.

## 3.2. Semi-structured interviews

At the end of each survey, respondents were asked to state their willingness to participate in a follow-up study. Of 678 respondents who indicated their willingness, 291 were located in one of the three Eastern-most regions of Austria, which we chose due to their geographical proximity. The resulting list was split up once more into different groups of age and phone replacement cycle to make sure

**Table 1**

Mean values and reliability analysis of each construct.

Constructs and items	Mean value (std. deviation)	Cronbach's $\alpha$
<i>Care of use</i>	3.40 (1.15)	0.77
The phone had a lot of scratches	3.33 (1.37)	
The phone dropped on the ground many times	3.33 (1.44)	
The phone was in a bad external condition	3.53 (1.36)	0.73
<i>Aesthetic obsolescence</i>	3.35 (1.11)	
With this phone I didn't feel up-to-date anymore	3.60 (1.39)	
Most people I know had a more modern phone	2.60 (1.38)	0.73
The phone made me look oldfashioned	3.80 (1.30)	
<i>Technological obsolescence</i>	3.02 (1.22)	
The phone was not compatible anymore with the latest devices and software	3.23 (1.44)	0.73
The phone was technologically outdated	2.81 (1.30)	
<i>Durability</i>	2.81 (0.84)	0.73
The phone was well made	2.28 (1.05)	
The phone worked without malfunctions	2.47 (1.32)	
The phone was robust	2.44 (1.20)	0.69
<i>Emotional attachment</i>	3.09 (1.04)	
The phone was worth a lot to me	3.07 (1.33)	
I really disliked replacing the phone	3.08 (1.38)	0.69
I really liked using this phone in particular	3.17 (1.27)	

Note: 1 = strongly agree and 5 = strongly disagree.

**Table 2**

Sample distribution of online survey.

Category	n	%
<i>Gender</i>		
Female	500	50.6
Male	488	49.4
<i>Age</i>		
18–29	234	23.8
30–39	201	20.4
40–49	247	25.1
50–59	202	20.5
60–65	101	10.3
<i>Education</i>		
Primary school	236	23.9
Vocational training	465	47.1
A-levels	185	18.7
University	102	10.3

that a diverse sample can be reached. Based on a random procedure, persons from each list were contacted via telephone until 25 interviewees could be recruited (40 persons had to be contacted). The interviews were carried out over a period of six weeks between January and March 2015 and took place at the participants' homes. The final sample of interviewees is fairly diverse with respect to gender (11 women) and age (between 19 and 65) (see Appendix B). In five interviews, the interviewees' partners joined the conversation. The interviews themselves followed a semi-structured guideline (see Appendix C) and lasted about 95 min on average. The design of the interviews was inspired by practice research (e.g. Hitchings, 2012; Martens, 2012) and built on the findings obtained from the analysis of survey data. Each interview focused on the participants' past experiences with various durable goods. About half of each interview was devoted to mobile phones, in which we invited participants to help us reconstruct their 'careers' as mobile phone users, discussing the various motivations for switching their phones in the past. Finally, all interviews were audio taped and transcribed in full. These transcripts were coded to record patterns and recurrent themes across interviews.

### 3.3. The Austrian mobile phone market

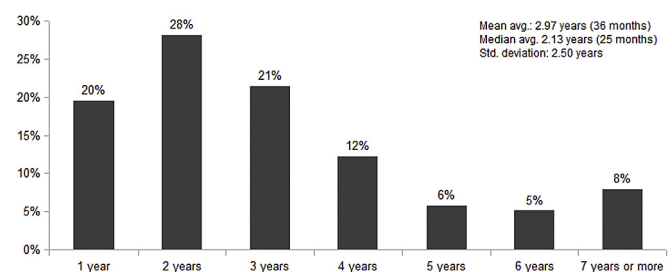
Like in many other advanced economies, the Austrian market for mobile phones experiences a period of stagnating sales, widely

attributed to a lack of innovation in mobile technology and a saturated demand for smartphones (Euromonitor International, 2016). Smartphones surpassed feature phones in sales in 2011 and represented 85% of total sales in 2016. Mobile subscriptions are among the highest in the world at 157 per 100 inhabitants (World Bank, 2016). Furthermore, the market is characterised by fierce competition among the three major network operators (A1 Telekom Austria, T-Mobile Austria, and Hutchinson 3 Austria) and dozens of smaller mobile virtual network operators (MVNOs). Provider subsidies for new handsets are therefore traditionally very high in Austria. According to estimates of insurance company SquareTrade, Austrians spent a total of 686 Million Euros on repair of smartphones and tablets between 2007 and 2014 (SquareTrade, 2016). In light of this, most service providers and banks started offering insurances for smartphones in recent years. Also trade-ins for returned phones are offered by all major service providers.

## 4. Results and discussion

### 4.1. Replacement cycles and motivations for phone replacements

The replacement cycle of a phone can be determined by measuring the time period between the date of its receipt and the date of its replacement. According to our data, this time period is about three years on average. There is a considerable variation across our sample however (Fig. 1). Although the majority of phones were replaced within little more than two years, every third phone was used for a minimum of four years. To a significant degree, this variation can be explained by differences in usage practices and relationships to phones across groups of different age.

**Fig. 1.** Replacement cycle of mobile phones (n = 784).



Confirming the results of previous studies (Jang and Kim, 2010), we find a positive association between age and the replacement cycle of phones ( $\rho=.23$ ,  $p < 0.01$ ). Whereas the youngest group in our sample (aged 18–29) used their phones for 2.2 years, respondents of 50 years and older held onto their phones for 3.7 years on average. The reasons for this discrepancy may be manifold. First, elderly tended to treat phones more carefully ( $U = 6674.5$ ,  $z = -5.911$ ,  $p < 0.001$ ,  $r = -.33$ ) and were more likely to use feature phones ( $U = 7668$ ,  $z = -6.716$ ,  $p < 0.001$ ,  $r = -.37$ ), which tend to be longer-lasting than smartphones. Second, older respondents used phones less intensively ( $U = 3624.5$ ,  $z = -9.797$ ,  $p < 0.001$ ,  $r = -.55$ ) and perceived phones mainly as a means to an end, having attributed less importance to owning a specific phone ( $U = 7581$ ,  $z = -3.712$ ,  $p < 0.001$ ,  $r = -.21$ ). As many made use of basic functions only, they did not see the need to replace their phones for technologically superior ones (see also Brook Lyndhurst, 2011). Interestingly, seniors did not perceive their phones to be more technologically or aesthetically obsolete, despite having used much older devices. This suggests that the elderly made use of different references than young people when assessing the up-to-dateness of their current phone.

Beyond age, only small differences in replacement cycles across socio-demographic groups can be observed. Contrary to previous findings (Hanks et al., 2008; Wilhelm et al., 2011), however, we find a weak, but positive association between phone replacement cycles and the respondents' monthly net incomes ( $\rho=.09$ ,  $r < 0.05$ ), which shows that consumers did not necessarily prefer to replace more frequently, even if they could afford it.

Survey responses show that defective or malfunctioning devices were the most common motivation of replacement, accounting for close to one third of total replacements (Fig. 2). In about a fifth of all cases, this was even the only replacement motivation. Conversely this means that almost 70% of phones were replaced in perfectly functioning condition. In the literature this is referred to as “unforced” as opposed to the “forced” replacement due to product breakdown or performance loss (Bayus, 1988; Grewal et al., 2004). Wear and tear is mentioned as the only “push factor” motivating consumers to replace their products (Van Nes and Cramer, 2005). Yet the mere desire or want for a better, more attractive, or up-to-date device does not tell us anything about the consumers' underlying motivations or where this desire comes from. Our data suggests a much more differentiated picture, as replacements were motivated as much by the perceived obsolescence of existing phones as by the attraction that new phones represent. The perception of obsolescence, in turn, varies greatly depending on the consumers' understanding of what a phone is good for and wherein the value of a phone lies. While specific motivations for replacing a phone may be manifold and based on unpredictable events like defects, gifts, and changing life circumstances (e.g. relocations, new jobs) (see Fig. 2), such an understanding is more stable and can explain why phones were replaced throughout a consumers'

'career'. In particular, three generic perceptions of obsolescence related to mobile phones emerged from our analysis of the interviewees' careers, based on a phone's 1) basic functionality, 2) up-to-dateness, and 3) ability to keep up with social practices. Along with the desire for the new, these forms of perceived obsolescence will be discussed in the following sections. But before, we need to turn our attention to a peculiarity of the mobile phone market: the possibility of replacing a phone upon contract renewal.

#### 4.1.1. 'Upgrades' upon contract renewal

Service contracts are the usual suspects for driving the demand for new mobile phones (e.g. Huang and Truong, 2008). By offering a new phone at a discount upon contract renewal, the 'subsidy model' incentivises regular phone replacements. In Austria, contracts played a significant role in the past, which is reflected in the high share of survey respondents who bought their previous phone as part of a new contract (65%). The average length of these contracts was two years, yet we could not detect a statistically significant relationship between contract length and replacement cycle. In fact, the average contract holder used his phone just about as long as consumers on pay-as-you-go plans (3 years), which is notably longer than the two-year contract period. Moreover, the share of phones replaced due to contract renewals is fairly small, as only 23% of contract holders made use of the 'upgrade' option. This group replaced their phone significantly earlier, already after 2.3 years of usage. In other words, service contracts led to a shortened replacement cycle, but in a minority of cases only. In all other cases, contract holders decided to keep their phones despite the availability of a cheap or even free 'upgrade'. This shows that the timing of phone replacements cannot be determined by contracts or financial incentives alone. As the following sections show, the perceived obsolescence of a phone is crucial for considerations on whether to keep or replace a phone, even when an 'upgrade' is available.

#### 4.1.2. Novelty: attraction and apathy

Annual launches of new phones have become massive spectacles attracting worldwide media attention. Each new release is preceded by months of speculation in specialised magazines about improvements in technical 'specs' and changes in design. As Newman (2013) observed for the videogames industry, this hype surrounding new devices and exclusive future-orientation of the industry makes invisible the continuous, but rapid obsolescence of existing technologies. This orientation towards the new can lead to premature replacements. According to our survey data, phones that were replaced due to the release of a new model had a significantly shorter life, about 1.8 years only. Somewhat counterintuitive, however, these phones were replaced earlier even though their owners were emotionally more strongly attached than the respondents who replaced their phones for other reasons ( $U = 29914$ ,  $z = -2.698$ ,  $p < 0.01$ ,  $r = -.09$ ). This positive link between use period and emotional attachment (e.g. Mugge et al., 2005; Schifferstein and Zwartkruis-Pelgrim, 2008) found for many other products can thus not be observed in the case of mobile phones. A closer look into the relationship between our respondents who replaced their phones due to the release of a new model and their phones reveals that this group attributed much importance to their phones and loved to use them, but did not care more than the average respondent about replacing them. A possible explanation for this is offered by Okada (2006), who argues that the perceived loss experienced when a product is replaced can be offset by the perceived benefits of a substitute that offers additional features. Moreover, tech-savvy consumers may not expect to use their phones for a long time.

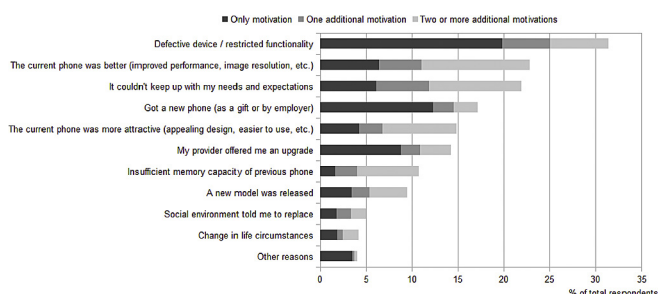


Fig. 2. Replacement motivations (n = 971).

*"Knowing myself, I'm sure that as soon as the iPhone 8 is released and I will have used this phone for three and a half years, I'll be going to buy the new one." [I1]*

As this quote shows, the obsolescence of phones is well anticipated. The replacement of a phone may thus not be experienced as a loss, as the 'mental book value' (Okada, 2001) of a phone is written off in expectation of a new phone's release.

This orientation towards the new could be observed only among a small, exclusively male group of our interviewees. These interviewees shared a fascination for new technologies and bought the latest device available on the market. Although phones freshly released on the market were perceived as particularly appealing, new phones were not blindly adopted as soon as possible, but expected to show significant improvements upon existing models.

*"I'm not so interested when Apple releases just another phone. But it is something different when they have a really great innovation. Then it certainly has an appeal. I'm definitely one of those that would like to have it." [I9]*

The attraction of new phones did not lie in the desire to be the first ones to own the latest device. Rather, our interviewees usually waited a few months to make sure major bugs have been removed and to wait for the first reactions of early purchasers. This 'waiting game' (Arruda-Filho and Lennon, 2011) requires intensive engagement with the most recent developments of each phone, as many phone releases are followed by a series of software updates. To be in the know of the latest trends in mobile technology was thus considered highly important.

By contrast, most of our interviewees did not actively follow the developments in mobile technology. In fact, information about mobile phones was sought only when the need for a new phone arose. As long as these interviewees were satisfied with their phones, information about the latest product launches was absorbed only passively from advertisements and conversations with family members or work colleagues. In many cases, this apathy towards releases of new phones was based on a highly critical stance towards people who tend to go only for the latest and greatest. To many interviewees it was clearly important to point out that they do not belong to this group of "tech-junkies" or "freaks".

*"I don't need to have the latest smartphone. I'm the last one to spend 600–700€ on a phone. To this I say: no thanks, not interested!" [I18]*

*"I only switched [phones] when they were beyond repair. I'm not a freak that needs or wants to keep up with technology." [I19]*

While this was often based on the conviction that the latest phones are primarily bought as signifiers of social status, the unanimous opinion was that phones should be used as long as possible. However, while most of our interviewees were unified in their opposition of novelty- and status-oriented consumption, we find considerable variation in their perceptions of obsolescence and opinions of when a replacement is justifiable.

#### 4.1.3. Basic functionality: resisting the "throwaway society"

The most radical group of interviewees held onto their phones until defects or malfunctions made continued use impossible or too cumbersome. These interviewees cared little about the up-to-dateness of their phone, which is also reflected in the slightly lower perception of aesthetic obsolescence among the phones replaced because of defects ( $U = 89052$ ,  $z = -2.266$ ;  $p < 0.05$ ,

$r = -.07$ ). Some interviewees clearly found it odd to think of an emotional bond to a phone. Rather, their relationship to phones was characterised by a strong aversion to a society that is in 'constant touch' and addicted to smartphones. Some were also highly concerned about the environmental and social consequences of frequent replacements.

*"I'm afraid there are many people who use it [the phone] for only one year and that it is used as a truly disposable product. [...] I find that extremely ... wasteful would be the wrong word, it's simply not sustainable. Because there are many precious resources in phones, gold and who knows what else. Some of these noble metals and rare resources need to be mined under very difficult conditions." [I4]*

'Good old-fashioned' feature phones were thus clearly preferred over smartphones. The former were also used much longer than smartphones (4.3 vs. 2.1 years on average), reflecting the resistance to a culture of constant renewal. Yet intriguingly, this does not necessarily lead to a lower frequency of mobile phone replacements. On the one hand, respective interviewees were not willing to spend more than a very small amount of money for a phone. This may lead to longer-lasting feature phones, but also to budget smartphones, which typically do not receive software updates for a long period and are made of less robust materials. In the case of budget smartphones, there is thus a higher likelihood that devices break or quickly lose functionality, resulting in a short replacement cycle despite the desire to keep the phone for long time period. On the other hand, some interviewees did not take particular care of their phones because they considered them only as means to an end which need to withstand regular shocks. In some cases, this may be seen as an expression of their aversion to modern smartphone culture. One interviewee in particular took little care of his phones, strongly rejecting what he preferred to call the "swipe-society" (referring to the swiping of touchscreens). Although he deeply cared about the working conditions in the smartphone industry, his careless treatment of phones paradoxically led to many broken phones over the years and a much higher replacement frequency.

#### 4.1.4. Social pressures and up-to-dateness

The same interviewee's insistence on using feature phones, or what his wife called a "stone age phone", became a running gag among his friends and family. Other interviewees made similar experiences, such as one person that told us about a situation when she was laughed at for not having a camera phone. The conversations with consumers show that using an 'outdated' phone is associated with both poverty and a high age. I6 and her partner felt particularly strongly about the social pressure this produces.

*"I'm not old-fashioned, but I keep up with fashion too. I also have an awesome phone. I really think it's about fashion. Nowadays, you cannot carry one of those old Nokias and use them in public, because then everyone thinks like, look this poor guy doesn't have a proper phone, he can't afford one." [I6]*

Keeping up with the times made them feel "being a part of society". It was important to them to be able to participate in talk about new technologies, but also to be competent users, which they consider an essential work-related skill. In the case of her partner this went so far that he started checking newspapers for every new story about phones, even though he was neither intrinsically interested in phones, nor intended to buy one. In comparison to consumers who replace their phones only when they are beyond

repair, this is clearly based on a very different perception of when it is necessary to replace a phone, above all grounded in a concern of the phone's 'up-to-dateness'.

Sometimes people are even put under direct pressure to buy a new phone. Especially parents are often encouraged by their children to replace their phones (see also Brook Lyndhurst, 2011, p. 31). For about 5% of our survey participants the influence of friends and family was a motivation to replace their phone. This is not to suggest that such social pressures are accepted without opposition. After all, this group of respondents was only convinced to replace their phones when they used them for about four and a half years already. Instead of resisting the smartphone culture at all costs like the interviewees discussed in the previous section, a compromise was sought between the perceived need to be up-to-date and the preference to keep phones for a longer period. In anticipation of the fast obsolescence of new phones, some interviewees pursued the strategy of deliberately buying the latest device, hoping they could then enjoy it longer.

*"If I take one, then the most recent, because I'm not the kind of person that switches phones every few months and I always use it for a relatively long time if it works. [...] I didn't buy it because it's new and I can say, hey I now have the new [iPhone] 4s, but because I knew that when I'm happy with it I would have it longer. That's why I wanted to buy the latest generation."* [I13]

#### 4.1.5. Changing social practices

Beyond such 'spectacular' forms of consumption of mobile phones, we noted that many phones were replaced for very pragmatic reasons related to the practices phones afford rather than due to changes in the consumers' relationships with phones themselves. Alan Warde's dictum that "practices, rather than individual desires, [...] create wants" (2005, p. 137) provides a useful starting point for this. More than half (57%) of our survey respondents report that their previous phones were merely means to an end to them. From this perspective, a phone's technological or aesthetic obsolescence is not perceived as a problem as long as it continues to fulfil its purposes. Conversely, the failure to support a certain practice may justify the replacement of an otherwise perfectly functioning device. One interviewee, for example, used mobile phones mainly to keep in touch with her family. A phone had no emotional value to her and was used simply as an "object of utility just like a vacuum cleaners or a shopping trolley". Consequently, she replaced her previous phone without hesitation when 'What-sapp' (messaging application), her main connection to the kids, stopped working. While the phone was still functioning in principle, it had no use to her anymore. Considering the infinite number of practices of mobile phone use and the rate at which they change, phones are particularly vulnerable to this form of obsolescence. The replacement cycle is thus negatively associated with the variety of purposes our respondents used their phones for ( $\rho = -.23$ ,  $p < 0.01$ ).

#### 4.2. Maintenance and repair

The careful use of phones is associated with a lower likelihood of phones having to be replaced due to defects ( $U = 85475$ ,  $z = -3.327$ ,  $p < 0.001$ ,  $r = -.11$ ). However, as this effect is rather small, treating phones carefully does not significantly contribute to a longer replacement cycle on average. We could not identify a statistically significant association between care of use or the usage of a protective case and the replacement cycle, suggesting that other factors outweigh the benefits of careful use. Moreover, the likelihood that a phone had to be repaired is independent of the way it was treated.

About every fifth survey respondent repaired the previous phone at least once before replacing it and in 7% of the cases phones were repaired even more than once. Our analysis suggests that the chances that a phone needs repair is not a pure matter of product durability and robustness, but depends on the relationship between the phone and its owner. While we could not find any statistically significant differences across socio-demographic groups, the share of repaired devices was highest among Apple phones (34%) ( $U = 33017$ ,  $z = -3.285$ ,  $p < 0.001$ ,  $r = -.10$ ). Considering the low failure rates of iPhones (SquareTrade, 2010), this result reflects the higher willingness of consumers to repair an iPhone than any other phone. At least in part, this can be explained by the higher upfront costs of iPhones and the stronger emotional bond between iPhones and their owners (Shaw et al., 2016). Moreover, it is financially more attractive to repair an iPhone, as they are known to retain their resale value for the longest time period (Reardon, 2014).

As shown in Fig. 2, almost one third of phones were replaced due to defects or malfunctions. The most common failures among these phones were a broken or weak battery (40%), mechanical or technical defects (33%), slowness (30%), software bugs (17%), broken screens (17%), and broken casings (8%). Why have these phones not been repaired? According to our survey data, the main problem is that two thirds of respondents did not even attempt at repairing their phones (Fig. 3). The interviewees who never had a phone repaired, expressed a high degree of scepticism towards the repair system of mobile phones.

*"As much as I have heard, not much can be repaired anyway and if they can repair it, it's lost in some unknown firms for months."* [I19]

The impression that a phone could not be repaired anyway was based on various beliefs about the current condition of the repair sector, such as a doubt that manufacturers would not keep any spare parts in a fast-changing industry like this and the assumption that repairs would never pay off considering the high wages paid to repair specialists. By contrast, respondents who had the same phone repaired already before were more likely to repair it again ( $U = 3418$ ,  $z = -6.09$ ,  $p < 0.001$ ,  $r = -.40$ ), suggesting that previous repair experiences may reduce the scepticism towards the possibilities of repair.

Attempts at repair are also more likely in cases of mechanical or technical defects ( $U = 5006$ ,  $z = -3.962$ ,  $p < 0.001$ ,  $r = -.20$ ) and software bugs ( $U = 3818$ ,  $z = -2.368$ ,  $p < 0.01$ ,  $r = -.15$ ) than in cases of a broken screen, battery, or casing. However, some 70% of attempted repairs failed because phones were beyond repair or the problem could not be identified (some respondents might not have remembered the problem at the time of participating in the survey). What remains is the share of phones that were replaced despite having been repairable. When confronted with the possibility of repair, our interviewees considered a series of factors that eventually led them to decide in favour of a replacement, above all the financial costs of repair and the time that it would take to repair the phone (see also Brook Lyndhurst, 2011). Central to such considerations is the perceived obsolescence of the current phone however. If repair is cheaper than buying a new phone, the costs of repair and expected additional years are weighed against each other. In fact, several interviewees opted against repairing their phone because they doubted that this would yield enough additional years of use. In some cases the perceived obsolescence of their phone held the interviewees even back from attempting a repair in the first place.

#### 4.3. Reuse

A local reuse cycle can only work if consumers are willing to use second-hand devices. Among our survey respondents, however,

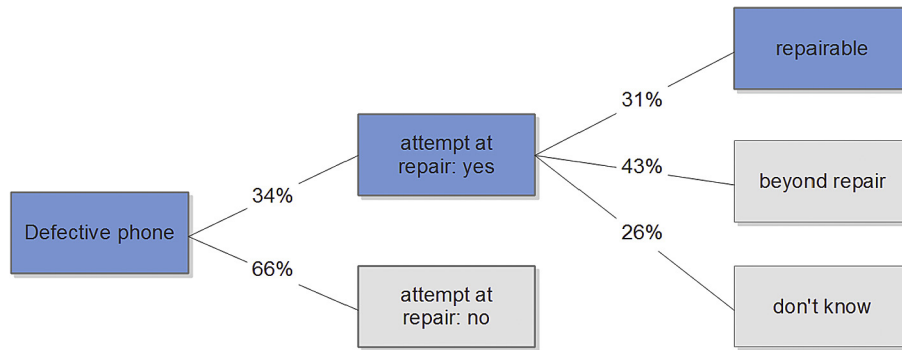


Fig. 3. Attempts at repair of phones replaced due to defects or malfunctions (n = 305).

only 10.5% got their previous phone second-hand (Fig. 4), which is about the same share that was found in other European countries (Deloitte, 2015b). In line with the Deloitte-study, we could not find a statistically significant association between the respondents' age and the share of new versus second-hand phones. Indeed, our interviewees suggest that the rejection of used phones is not based on their outdatedness, but on the perception of various risks associated with buying second-hand (see Ylä-Mella et al., 2015). Given the difficulty of assessing the condition of a phone by its appearance, there is a high uncertainty regarding the life expectancy of used phones. Several interviewees fear that a used phone would not last as long as a new one, echoing the concerns people expressed in relation to refurbished products (van Weelden et al., 2016).

Interviewer: You have always bought new phones so far. Do you also look for used phones sometimes?

I2: No, because I think that my phones last too shortly anyway. Used ones would certainly not last longer.

Interviewer: So you're afraid they would break soon?

I2: Yes, especially because they don't come with a warranty. It's difficult to know how long you can use them.

A warranty is thus considered a precondition for buying a phone second-hand. However, the perceived performance risk associated with used phones might well be somewhat exaggerated. Intriguingly, we find that second-hand phones were not used shorter than new ones, despite having been already two years old on average at the time of acquisition. This shows that consumers clearly

overestimate the importance of product durability when thinking about the potential life expectancy of a phone.

The low willingness to acquire a phone second-hand compares with a high willingness among consumers to hand on or sell replaced phones. This means that even though many consumers would be willing to get rid of their phones, most of them end up in the drawer and are never reused again (Fig. 5). As a result, a huge number of phones are stockpiled in Austrian households. In fact, our survey respondents reported to possess up to 11 unused phones, with about half of them having had at least one unused phone and almost 30% of them even two or more. This number is especially high among respondents who kept their previous phone too ( $U = 26605$ ,  $z = -5.303$ ,  $p < 0.001$ ,  $r = -.22$ ).

Consistent with previous studies, our respondents indicated the use as a back-up device as the main reason for keeping their previous phones (Fig. 6). Somewhat counterintuitively, however, this reason was mentioned as frequently by the group of respondents who already possessed an unused phone. Instead of continuing to use an existing phone as a back-up, the secondary phone is 'updated' as well. As Wilson et al. (2017) pointed out, back-up devices are continuously replaced by the most recent ones as each phone moves along a chain from primary to secondary and so on. By the time back-up phones are replaced, they are likely to have become entirely obsolete.

While dominant, the motivation to keep the previous phone as spare is far from the only one. A considerable share of phones continued to be used as secondary phones or were only kept until

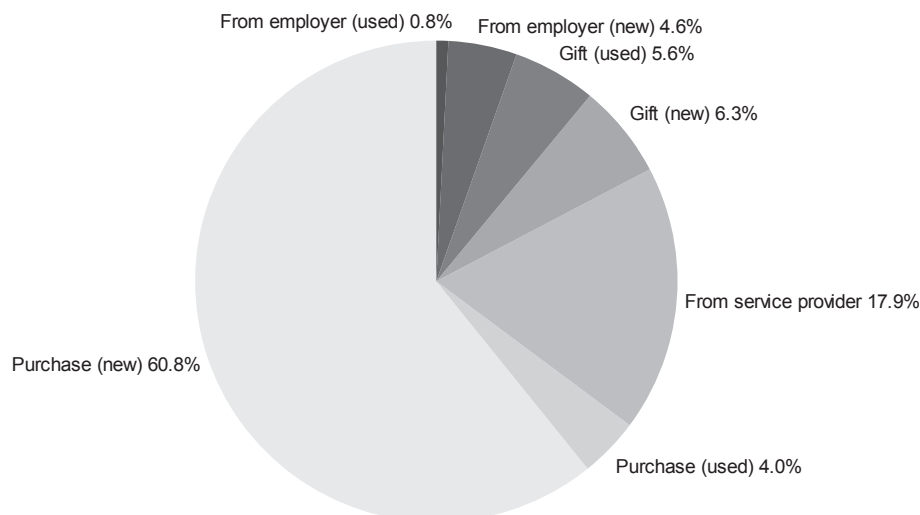


Fig. 4. Modes of acquisition of previous phone (n = 974).



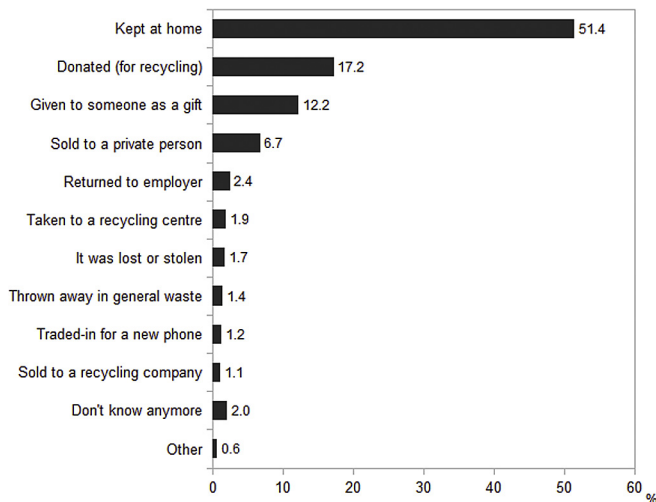


Fig. 5. Disposition routes of replaced phones (n = 988).

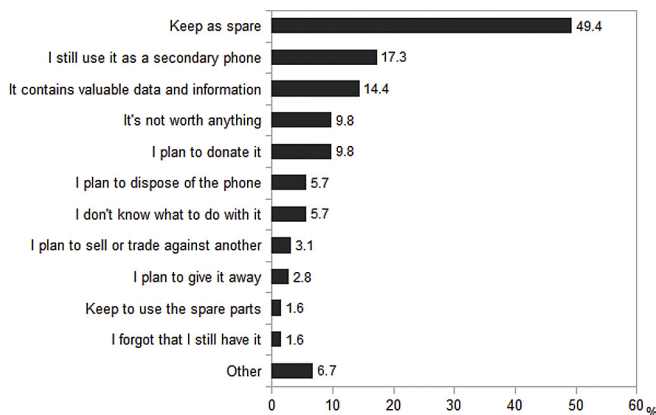


Fig. 6. Motivations for keeping previous phones once replaced (n = 508).

they could be sold, donated, or given away. Furthermore, previous research suggests that many phones may be stockpiled at home because they have a 'sentimental value' to consumers (Wilhelm et al., 2011; Ylä-Mella et al., 2015). Indeed, several of our interviewees kept certain phones due to some kind of emotional attachment, typically based on positive associations with the qualities of a phone. On a more aggregate level, however, our analysis of survey data does not reveal any differences in emotional attachment between the respondents who kept their phone and those who chose another disposition pathway. This would support the argument put forward by Wilson et al. (2017) that consumers are more attached to the data contained in phones rather than to the hardware itself. Some 14% of respondents who kept their phones indicated the preservation of valuable data and information stored on these devices as a motivation for this.

Beyond the phones kept at home, we find that one in five phones took the recycling route and another one in five was either sold or handed on for reuse. Notably, only a tiny share of replaced phones directly entered the waste stream. Far from reflecting a 'throwaway culture', throwing a functioning phone away is very negatively connoted. Intriguingly, our interviewees made little distinction between throwing a phone away and donating it for recycling, both of which were implicitly considered as means of disposal and therefore inferior to reuse. Instead of having made phones available for recycling, they were simply stored at home

with the small hope that someone would find use in them some day.

Furthermore, we find that the route of disposition depends on the perceived residual value or obsolescence of a replaced device. Intuitively, defective devices were more likely to be donated for recycling or thrown away ( $U = 84458$ ,  $z = -5.988$ ,  $p < 0.001$ ,  $r = -.19$ ). Phones that were recycled or thrown away were perceived as slightly more aesthetically ( $\rho = -.09$ ,  $p < 0.01$ ) and technologically ( $\rho = -.12$ ,  $p < 0.001$ ) obsolete than other phones. Moreover, the mode of disposition varies depending on the age of the replaced device. Phones given away or sold for reuse were significantly younger than those that were recycled or thrown away ( $U = 8847.5$ ,  $z = -4.318$ ,  $p < 0.001$ ,  $r = -.24$ ). This evidence reflects the preference for reuse over disposal, as the latter was only chosen when a phone was considered to be worthless. At the same time, however, the significantly younger age of sold devices may also reflect the common practice of trading-in or selling mobile phones to make the purchase of a new phone more affordable. In that case, reuse is not chosen as a way to prevent waste, but to enable more consumption and get a new phone sooner (see Gregson et al., 2013).

## 5. Conclusions

This study provides novel insights into the consumers' motivations underpinning considerations of mobile phone replacement, repair, and reuse by combining quantitative and qualitative empirical evidence and looking at the whole consumption cycle of mobile phones.

First, the preceding analysis demonstrates the centrality of the consumers' perceptions of obsolescence in considerations of mobile phone replacement, repair, and reuse. Beyond the desire for novelty, the perceived obsolescence of one's possession is a common reference for considerations regarding the timing of replacements, even in the case of an 'up-to-date product' like mobile phones. Moreover, when obsolescence is perceived as fast, consumers find it more attractive to replace rather than repair and purchase a new rather a second-hand phone. The widespread feeling of living in throwaway society and scepticism towards the durability of new products among consumers (Echegaray, 2016) thus clearly weakens the demand for repair and second-hand.

Second, it is worth noting that the focus of this paper on replacements led to a very different categorisation of consumer motivations than the ones that dominate diffusion research. There is only very little consideration of 'non-innovativeness' or resistance to innovations in this type of research (see Bartels and Reinders, 2011). Even when consumer resistance to innovations is studied, it is assumed that this derives only from established habits and that consumers have a generally favourable attitude towards new products and innovations. By contrast, our research shows that while some embrace the novelties innovations in mobile phone technology and design bring about, other reactions to continuous change and obsolescence range from conformity to outright resistance. A phone can be perceived as obsolete when it is beyond repair, but also when it makes its owner feel outdated or when it no longer performs the functions necessary to continue the social practices that are important to its owner, such as the ability to keep in touch with friends. Depending on one's understanding of obsolescence, consumers replace their phones at different points in time. Yet it is important to emphasise in this context that none of these forms of obsolescence is fully in the hands of a phone's owner. Changes in the practices phones are used for, cultural understandings of up-to-datedness and obsolescence, and the qualities of phones are beyond an individual's control. The cultural production and negotiation of these phenomena was beyond the scope of this paper and needs to be explored in future research.

Third, this research casts doubt on the prevalence of a 'consumerist syndrome' in which it is "all about speed, excess and waste" (Bauman, 2005, p. 84) and related arguments which infer a throw-away culture among consumers from the increasing amounts of waste that is generated. Only a small share of mobile phones was binned, as consumers kept replaced phones in the hope that they might be of use to someone some day. While this may be less related to care and love relations as in the provision of food (Evans, 2012) or divestment of furniture (Gregson et al., 2007), our research shows that consumers are equally determined to avoid their phones turning into waste. Furthermore, we have shown that the relation between a consumers' considerations regarding replacement timings and the pace of obsolescence can be highly paradoxical. On the one hand, buying the latest device may be an expression of a desire for novelty as much as a strategy to cope with the fast pace of change in mobile phone technology and extend a phone's potential service life. On the other hand, short replacement cycles are not necessarily a sign of careless throwaway behaviour, but may result from the low importance that is attached to phones by the people who actively oppose the fast-paced obsolescence and throw-away character of mobile phones. Hence, consumer strategies to resist the obsolescence resulting from the continuous introduction of new devices are sometimes indistinguishable from the orientation towards novelty that co-creates the problem in the first place.

### 5.1. Implications

The findings from this research have implications for debates on the transition pathways towards more sustainable modes of consumption and production. While the preoccupation of previous research on improving the collection rates of mobile phones was justified at the time, current trends towards trade-ins and recycling have shifted problems. At the moment, the success of trade-ins in many advanced economies is only possible on the basis of a seemingly insatiable demand for second-hand and refurbished phones in developing countries to which most of these phones are exported (Coats and Benton, 2016; Tojo and Manomaivibool, 2011). As markets become increasingly saturated in those countries, the demand for used devices in advanced economies will be crucial for a successful reuse markets of mobile phones in the medium to long term. Our findings suggest that offering warranties for used phones may be the most effective measure for establishing a domestic reuse market.

Beyond this, longer replacement cycles have the potential to significantly reduce the environmental impact of mobile phone consumption and production. A functioning repair system and phones that are easy to disassemble are essential components for this. However, this study shows that many consumers do not even attempt to repair defective phones, partly due to the high costs of repair and the belief that phones could not be repaired. A combination of tax benefits for repair and more information about the reparability of phones could encourage more consumers to repair defective devices. The central role of the consumers' perceptions of the speed of obsolescence suggests that neither changes in infrastructure (e.g. an improved repair network), nor behaviour change initiatives might be sufficient however. Instead, circular economy initiatives need to put more efforts in tackling the speed of circulation. An important dimension to this is to ensure that products retain their functionality and usefulness over a longer period of time, also in fast-paced industries like the mobile phone sector. This would not only lengthen the replacement cycle, but also increase the consumers' willingness to repair and buy second-hand by changing their perceptions of the pace of obsolescence. Moreover, this study shows that some consumers deliberately buy the latest phones to ensure a longer usage period, suggesting that consumers might be willing to pay a premium price for longer-lasting phones.

Ideally, the three sources of obsolescence identified in this study can be addressed already at the design stage. Although the consumption of mobile phones is characterised by fast changes in technology and fashion, many phones need to be replaced due to defects. More durable phones, specifically with a longer battery life and shock-resistant screens, would allow for longer replacement cycles. Design for emotional attachment appears less effective in the case of mobile phones. Specifically in the case of smartphones, regular updating of software may be an effective approach to prevent obsolescence related to social practices. Also modularity may extend the service life of smartphones, making them easier to repair and allowing consumers to keep up with fashion trends. The implications for the speed of circulation of measures like these need to be evaluated on a case by case basis however. The modularity of phones could also lead to higher material consumption if consumers replace modules more frequently to keep pace with technological change or to personalise their phones (Schischke et al., 2016). In a similar vein, resale markets and the availability of trade-ins may backfire and shorten replacement cycles under certain conditions (Gregson et al., 2013; Wieser, 2016).

### 5.2. Limitations and further research

Combining survey data with in-depth evidence from qualitative interviews, this paper examined the motivations underpinning the consumers' considerations of mobile phone replacement, repair, and reuse. The triangulation of methods allowed for a deeper understanding of the phenomena under study than a single-method approach would have made possible, but there are also limitations to each method that need to be acknowledged. A central limitation of studying the whole consumption cycle of a product is that this can only be covered by looking at products that have been replaced already. This means that survey data gathered on the purchasing and use phase may not reflect the latest practices and motivations among consumers. Moreover, the focus on the previous phone puts a high demand on the respondents' capabilities to remember their motivations for buying the phone and the ways they experienced the phone. This is evident in a fairly high share of survey respondents who could not remember the date of acquisition or replacement and are therefore not included in statistics on replacement cycles. To address these limitations, future research would highly benefit from longitudinal research.

An additional limitation of this study is that it investigated the motivations and practices of consumers only. To accelerate the transition to a more circular mobile phone economy, it will be necessary to develop an integrative approach that involves actors across consumption and production and takes into account how these actors are interlinked. For the Austrian mobile phone market, for instance, existing research is insufficient to identify the most effective points of intervention. Little is known about its current repair and reuse network as well as the role of network providers in the market for used phones. Future research needs to fill such gaps and investigate the linkages between different actors to develop circular economy strategies for the mobile phone market.

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## Appendix A

Survey questions on socio-demographic characteristics and in mobile phone section.

Q1: You are ... ? [1. Female, 2. Male]

Q2: How old are you? [

1. Below 18 years
2. 18–29 years
3. 30–39 years
4. 40–49 years
5. 50–59 years
6. 60–65 years
7. 66 years or older]

Q3: What is the highest level of education you have completed? [

1. Primary school
2. A-levels
3. Vocational training
4. University

Q4: Where do you live? [

1. Vienna
2. Upper Austria
3. Lower Austria
4. Carinthia
5. Styria
6. Tyrol
7. Salzburg
8. Burgenland
9. Vorarlberg]

Q5: Do you currently use a phone? [1. Yes, 2. No]

Q6: Please think about the phone currently in use. Is this your first phone or did you have phones before? [

1. This is my first phone
2. This is not my first phone, I used other phones before
3. I don't use a phone]

Q7: Which three aspects of a phone are most important to you? [open question]

Q8: How many phones do you own? Please include also unused phones. [\_\_\_ phone(s)]

Q9: How many phones do you use regularly? [\_\_\_ phone(s)]

In the following questions, please think about your previous phone, i.e. the primary phone you used before you turned to the current phone in use.

Q10: Into which category fell your previous phone? [

1. Feature phone (basic functions)
2. Smartphone/phone with touch screen
3. Qwertz-phone (with computer keyboard)
4. Clamshell/flip phone
5. Slider phone]

Q11: What was the brand of your previous phone? [

1. Samsung
2. Apple
3. LG
4. Nokia
5. Lenovo
6. HTC
7. ZTE
8. Huawei
9. Sony
10. TCL/Alcatel
11. Siemens
12. Motorola

13. Other brand

14. Don't know anymore]

Q12: How did you get your previous phone? [

1. Purchase (new)
2. Purchase (used)
3. Gift from provider
4. Gift (new)
5. Gift (used)
6. From employer (new)
7. From employer (used)
8. Other:\_\_\_
9. Don't know anymore]

Q13: How old was your previous phone at the time of receipt? [years:\_\_\_ months:\_\_\_]

Q14: When did you get your previous phone? [\_\_\_ = year of receipt; \_\_\_ = month of receipt]

Q15: Which of the following options applied to your previous phone? [

1. Locked to a contract (SIM-lock) with a minimum contract period
2. Unlocked phone with a service contract
3. No contract (SIM-only)]

Q16: How long was the minimum contract period for your previous phone? [\_\_\_ months of minimum contract period]

Q17: For which purposes did you buy and use your previous phone? [

1. To keep in touch with friends and relatives
2. To be available by phone
3. To be up-to-date (to be in the know)
4. To play games and use various applications
5. To play music and take pictures or videos
6. To have mobile access to internet
7. For work purposes
8. For time management
9. As a navigation device
10. Other:\_\_\_]

Q18: Thinking about your previous phone, to what extent do you agree with the following statements (scale from 1 = strongly agree to 5 = strongly disagree) [

1. The phone was well made
2. With this phone I didn't feel up-to-date anymore
3. The phone was in a bad external condition
4. The phone worked without malfunctions
5. Most people I know had a more modern phone
6. The phone was robust
7. The phone was not compatible with the latest devices and software
8. The phone was technologically outdated
9. The phone made me look oldfashioned
10. I really disliked replacing the phone
11. The phone was just a means to an end to me
12. The phone was worth a lot to me
13. The phone had a lot of scratches
14. The phone dropped on the ground many times
15. The phone was tedious to use
16. The phone's design and functions could be changed
17. I really liked using this phone in particular]

Q19: Did you use a protective case for your previous phone? [

1. Yes, always
2. Sometimes
3. No]

Q20: How long did you use your previous phone on average per day? [\_\_\_hours; \_\_\_minutes]

Q21: How often did you have your previous phone repaired? [\_\_\_ repair(s)]

Q22: What did you do with your previous phone when you stopped using it? [

1. Kept at home
2. Thrown away in general waste
3. Taken to a recycling centre
4. Sold to a private person
5. Sold to a recycling company
6. Traded in for a new phone
7. Given to someone as a gift
8. Donated (for recycling)
9. It was lost or stolen
10. Returned to employer
11. Other:\_\_\_\_\_
12. Don't know anymore]

Q23: Why did you keep your previous phone at home? [

1. Keep as spare
2. I still use it as a secondary phone
3. I don't know what to do with it
4. It contains valuable data and information
5. I plan to sell or trade against another
6. I forgot that I still have it
7. It's not worth anything
8. I plan to give it away
9. Keep to use the spare parts
10. I plan to dispose of the phone
11. I plan to donate it
12. Other:\_\_\_\_\_
13. Don't know]

Q24: Why did you replace your previous phone? [

1. Defective device/restricted functionality
2. The current phone was more attractive (appealing design, easier to use, etc.)
3. The current phone was better (improved performance, camera resolution, etc.)
4. Insufficient memory capacity of previous phone
5. Social environment told me to replace
6. Got a new phone (as a gift or from employer)
7. My provider offered me an upgrade
8. It couldn't keep up with my needs and expectations
9. A new model was released
10. Change in life circumstances:\_\_\_\_\_
11. Other:\_\_\_\_\_]

Q25: What was defective or malfunctioning? [

1. Broken or weak battery
2. Broken screen
3. Broken casing
4. Software bug
5. Mechanical or technical defect
6. Slowly reacting phone
7. Other:\_\_\_\_\_
8. Don't know]

Q26: Why was your previous phone defective or malfunctioning? [

1. The phone dropped on the ground
2. Water damage
3. It was already old
4. Other:\_\_\_\_\_
5. Don't know]

Q27: Did you try to repair or have your previous phone repaired? [1. Yes, 2. No]

Q28: Was your previous still repairable? [1. Yes, 2. No, 3. Don't know]

Q29: Can you estimate how much repairing the phone would have costed? [1. Yes, 2. No]

Q30: How much would the repair have costed? [\_\_\_\_Euro]

Q31: When did you replace your previous phone as the primary phone? [\_\_\_\_ = year of replacement, \_\_\_\_ = month of replacement]

Q32: How high is your personal netincome per month? [

1. I have no income
2. Up to 500 Euro
3. 501–1.000 Euro
4. 1.001–1.500 Euro
5. 1.501–2.000 Euro
6. 2.001–2.500 Euro
7. 2.501–3.000 Euro
8. 3.001–3.500 Euro
9. More than 3.500 Euro
10. Prefer not to say

Q33: Our contractee would like to continue this research and conduct some interviews in person. Participants are given an allowance to compensate for their time and effort. Are you principally interested in participating in this follow-up study? By agreeing to this, you are not entering into an obligation, but merely expressing your interest. [

1. Yes, I would like to participate
2. No, I don't like to participate]

Q34: Many thanks for your interest. Please indicate your e-mail address and telephone number below. Our contractee will contact you if required. [\_\_\_\_ = e-mail address; \_\_\_\_ = phone number]

## Appendix B

List of interviewees

Interviewee	Age	Sex	Living with	Region
I1	19	Male	Mother and two siblings	Lower Austria
I2	21	Female	Parents and one brother	Vienna
I3	23	Male	Roommate (student housing)	Vienna
I4	28	Female	Partner	Vienna
I5	29	Male	Single	Lower Austria
I6 and partner	29	Female	Partner and one child	Vienna
I7	32	Male	Partner	Vienna
I8 and partner	33	Male	Partner and two children	Lower Austria
I9	33	Male	Partner and two children	Lower Austria
I10 and partner	35	Female	Partner and two children	Vienna
I11 and partner	35	Female	Partner and two children	Lower Austria
I12	39	Male	Parents and his sister's family	Burgenland
I13	40	Female	Single	Vienna
I14	40	Male	Partner and two children	Lower Austria
I15	42	Female	Partner	Vienna
I16	42	Female	Single and two children	Vienna
I17	45	Female	Partner and three children	Vienna
I18	47	Male	Partner	Lower Austria
I19	52	Male	Single	Burgenland
I20	54	Female	Daughter and son-in-law	Lower Austria
I21	56	Male	Partner and one child	Vienna
I22	58	Female	Partner	Vienna
I23	60	Male	Partner	Vienna
I24	60	Male	Partner and two children	Vienna
I25 and partner	65	Male	Partner	Lower Austria

## Appendix C

### Interview guideline

All participants were asked to prepare for the interview by bringing together all current and past mobile phones that they possess. This was taken as a starting point to initiate a conversation about all the phones participants used throughout their 'careers'. After two basic questions, "When did you get your first mobile



phone?” and “How many mobile phones did you have so far?”, participants were encouraged to tell the story of how they moved from the first to the latest phone, explaining why they replaced and how long they had used each phone. This was followed by various probing questions about the replacement, repair, and/or reuse of each phone. Due to the interviewees' different experiences with each phone, a flexible guideline supported the interview. The guideline contained the following probing questions, organised around seven broad themes:

- 1) Usage
  - How long did you use this phone before discarding it, giving it away, ... ?
  - How intensively did you use this phone?
  - For which purposes did you use this phone?
- 2) Meaning
  - Which phone did you like the most?
  - How did you like this phone?
  - How important was this phone to you?
  - Did you enjoy using this phone? What did you enjoy about it?
  - What did your friends and family think about this phone?
- 3) Timing of replacement/repair:
  - IF defective device:
    - What was defective? What didn't work anymore?
    - How did you find out?
    - How did you react to this (defect)?
    - Did you try to repair the phone?
    - What did the repairpeople recommend?
    - Was it possible to repair the phone?
  - IF desire or need for new phone:
    - What was better about the new phone?
    - Was there anything wrong with the previous phone?
    - Why did you replace the phone at that specific point in time?
    - Did you wait for the release of the phone?
    - How long did you wait since the release before purchasing the phone?
    - How did your friends and family react to the new phone? Did you talk about it?
  - IF upgrade upon contract renewal
    - Was the upgrade at the right time for you?
    - How did the upgrade work? Did you pay some extra money for the new phone?
  - IF gift:
    - How did you react to the gift?
    - Who gave you the gift?
    - Did that person know that you want or need a new phone?
- 4) Divestment
  - What did you do with this phone after having replaced it?
  - To whom did you give/donate the phone?
  - How did you find someone interested in the phone?
  - Why did you keep the phone?
  - Did you try other options like giving it away or recycling?
  - How did you find out about this option?
- 5) Purchase
  - Why did you buy this specific phone?
  - Which criteria did you consider when purchasing the phone?
  - Did you consider buying a used phone?
- 6) Competences and up-to-dateness
  - Do you try to keep up to date with the latest technological development of mobile phones?
  - How do you find out about the latest trends?
  - Do you know which phones are most trendy these days?

- In your opinion, how long do other people normally use their phones? Which people are you thinking about? Do you use your phones generally longer or shorter than other people?
- How long-lasting are mobile phones in your opinion? How do you assess the longevity of a phone?
- Do you update the software of your phone? How regularly? What were your experiences with software updates so far?

#### 7) Preferences and expectations

- How long do you expect a phone to last?
- How long do you expect the current phone to use?
- Did you consider buying a new phone? What is attractive about that phone?
- In general, did your expectations and preferences related to mobile phones change over time? What has changed?

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