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Research Article

Intention to Recycle Mobile Phones: Gender Comparison

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Abstract

This paper aims at providing a better understanding in the propensity of university students to recycling their mobile phones and comparing males and females in this regard. Despite many studies that have discussed the students' habits for this purpose, very few have studied deeply the differences between genders. Among the many potentially relevant differences, namely incentives and deterrents, knowledge and awareness are included. This study used a cross-sectional design to portrait the actual situation with a questionnaire distributed widely across university administrators in Turkey who relayed it to their students. A total of 772 answers were received from 74 universities. The questionnaire was built around the past behavior and its reasons, the intention to recycle and its motives. After eliminating improper respondents from the sample, several analyses were conducted with SPSS, namely intensive descriptive statistics and a series of t-tests and Xi2 to test gender effect on most of the questions. As can be expected, the data analysis has showed differences in the reasons invoked to change their devices and less expectation of a financial counterpart to decide on a disposal mode. Female students are less inclined to keep their old phones as a memento; instead, they plan more for a safe disposal or a potential re-use, which shows a possible reason why they attribute less value than males to their old devices. Surprisingly, female students have less knowledge about e-waste than male students, but they are far more concerned about environment.

Keywords: E-Waste, Gender Differences, Mobile Phone, Recycling

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Introduction

Importance of e-Waste and Recycling

Today, the concept of environment is one of the most discussed issues. Opening the Glasgow COP26, Alok Sharma, its president, said that acting now was the last chance to protect our precious planet (Agence France Presse, 2021). Environmental pollution is becoming a high-priority concern, as it threatens the natural resources of many countries. The following principle was declared at the United Nations Conference on the Human Environment, also known as the Stockholm Conference, in 1972: "Man has the fundamental right to freedom, equality and adequate conditions of life, in an environment of a quality that permits a life of dignity and well-being" (United Nations, 1972). The Declaration accepts that environmental protection is a pre-condition to the enjoyment of internationally guaranteed human rights (Öncel and Tzanakis, 2018). The European Union (EU) has another important set of environmental standards. Article 191 of the Treaty on the Functioning of the European Union states that "Union policy on the environment shall contribute to pursuit of the following objectives: (a) preserving, protecting and improving the quality of the environment, (b) protecting human health, (c) prudent and rational utilization of natural resources, (d) promoting measures at international level to deal with regional or worldwide environmental problems, and in particular combating climate change" (European Commission, 2020).

The second principle of the Stockholm Conference states that "The natural resources of the earth, including the air, water, land, flora and fauna and especially representative samples of natural ecosystems, must be safeguarded for the benefit of present and future generations through careful planning or management, as appropriate" (UN Framework Convention on Climate Change [UNFCCC], 2018).

In this context, carbon reduction is seen as a major challenge and concern for the ecosystem (Nobel Prize Nordhaus, 2013; Jirotka, 2020). The main types of pollution are air, soil, water, noise and light pollution and lately e-waste, an emerging type of pollutants, defined as the various forms of electrical and electronic material that have stopped being of value to their users or no longer satisfy their original purpose; one of their special characteristics is that their number grows faster but their expected duration is lowering (Priya and Frenny, 2018). A Findland study estimated that 68% of greenhouse was the result of household consumption, asking what proportion could be reduced (Salo, 2017).

Environmental pollution is one of the issues that humanity has focused on for many years and sought solutions for in terms of both life and economic and social areas. It is the ominous alteration of environmental factors as a result of man's activities, either directly or indirectly. Environmental pollution is a worldwide problem that affects both developed and developing countries and it has drawn the attention of humanity due to the catastrophic long-term implications (Rai, 2016). In the case of e-waste, a recent examination of the literature shows that research on recycling is conducted all over the world in developed countries (Australia, US, China, Finland, India, Italy, UK, Poland, Portugal), as well as developing countries (Bengladesh, Iran, Laos, Malaysia, Nigeria, Romania, Thailand), the most productive country being China with 17 papers (Zheng et al., 2021). Along with scientific and technical developments, human-induced production has caused damage to basic living resources such as air, water, soil and living species. Considering the source of the pollution, it can be said that the share of energy production and use, especially by fossil fuels, is great in the maintenance of industrial activities. Clearly the waste issue requires attention from all. .

Electronic waste (e-waste) plays an important role in pollution. There are several regulations specifically designed in this matter. Zheng et al. (2021) mention that the first WEEE Directive (Directive 2002/96/EC) went into effect on February 13, 2003 (European Commission, 2003) and WEEE Directive 2012/19/EU went into effect on August 13, 2012, and has been in effect since February 2014 (European Commission, 2012). In Canada, despite the importance and emergency of the situation admitted by 2/3 of Canadians, only half of those would accept to pay 100$ per year to improve the situation (Grenier, 2019).

At this point, it is important to make a distinct definition of what waste is. It is essentially the clear definition of the boundaries between "waste" and "non-waste" that appears decisive for economic actors in the waste market. It is at the level of materials that can be recovered, recycled or reused, and therefore underlying in the definition of terms such as "revalorization", "reuse", "recycling". The whole difficulty is to reach a clear and precise consensus on these definitions. This debate has not been initiated to this day. However, the clear solution from this dilemma is crucial and the stakes are important from an economic point of view, because it encompasses the processes of valorization, markets, trade (circulation and traceability) and economic profitability (Chalmin and Gaillochet, 2009).

Gender Differences

The argument regarding gender variations in environmental concern is divisive. One set of hypotheses predicts that women are more worried about the environment than men, whereas another predicts just the opposite. General opinion is that women are more likely to have pro-environmental attitudes and behaviors than men. Toro at al. (2019) have done research in order to find if the environmental impact of private consumption by men and women differs. They used an environmental extended input-output model to determine the total atmospheric pollutants embedded in the spending patterns of one-person homes of women and men, and then they built an econometric model using Weighted Least Square regression. They found that women have more environmentally friendly consumption patterns than men. Ramstetter and Habersack (2020) examine if male and female politicians have different views and behaviors on environmental issues. Although male and female European parliamentarians indicated equal concerns about the environment, women were much more inclined than men to favor environmental legislations. It is found out that gender, as a determinant, impacts environmental behavior among the Basque Country University students questioned (Vicente-Molina et al., 2017). All categories except attitudes reveal significant variations between male and female students. Contrary to general opinion, MacDonald and Hara (1994) found out that males were more conscious of the environment than females. Many theories like marginality theory can explain this finding. According to this theory, women have historically had less access to the political arena; accordingly, women may be less inclined than men to be concerned about environmental concerns.

Milfont and Sibley (2016) tested a Bayesian path model to determine how accurately empathy and social dominance orientation anticipated environmental values and how well these impacts mediated the starting gender difference. Women showed a greater awareness of environmental consciousness because they were more empathic. In contrast to the general perception, Xiao and Hong (2018) in their study found that Chinese women have a more reduced amount of environmental awareness than men, which affects their engagement in private environmental actions.

Literature Review

It can be expected that a large number of factors have an effect on waste behavior and attitudes, but this research included only a subset of these, representative of previous researches

Incentives to Recycling

Many studies conducted on mobile phone users report incentives to be an important motive to recycle their mobile phones (Arain et al., 2020; Li et al., 2020; Qu et al., 2019); Bai et al., 2018).

Deterrents to Recycling

Many factors are mentioned as deterrents to recycling in several studies; in the case of mobile phones, fear of information leakage can explain the reluctance of owners to recycle (Qu et al., 2019), but many other reasons applicable to other types of objects were mentioned, namely lack of information on disposal channel (Bai et al., 2018; Ramzan et al., 2019; Qu et al., 2019), fee to pay for disposal as per example TV (Cai et al., 2020, Damke, 2018), and collecting distance (Bai et al., 2018; Ongondo and Williams, 2011; Qu et al., 2019; Ylä-Mella et al., 2015). A survey conducted by CBCNews found that about half of Canadians were unwilling to pay more to help the cause (Grenier, 2019).

Convenience

Following a mail survey of 3000 Californian households, Saphores et al. (2006) reported that older people were concerned with the

convenience of disposal and that the availability of collectors was a prerequisite to any action. A survey addressed to councils in Australia revealed that the lack of disposal facilities was one of the main constraints to e-waste management, that the public lacked awareness, that the cost of disposal should be directed to consumers, and that a law should be adopted to deal with that concern (Davis and Herat, 2010). In a study covering 7 years of data from 20 regions in Italy, Favot and Grassetti (2017) concluded that the presence of collecting points is a crucial factor in explaining the collection of e-waste.

Knowledge of how to recycle is also important. Arain et al. (2020) distributed a questionnaire to staff and students at a US university and received 1560 responses. They found that 44% of the respondents never recycle (80% claimed they did not know where and how); that convenience of disposal (87%) and knowledge were critical to explaining respondents' behavior; and that low cost would encourage them to recycle, but 85% would prefer a reward.

In a study conducted by Borthakur and Singh (2020) in New Delhi with 334 students, 69% pretended to be willing to recycle, but 88% did not know how. In Iran, Mirgerami et al. (2018) found that mobile phones were among the electronic devices most frequently gone to waste, in a study that concluded the need for waste processing infrastructure in the country.

Knowledge, Awareness and Perceived Usefulness

In the case of mobile phones, at least two studies mention the lack of information as an important cause of non-recycling (Chen and Yee, 2011; Xu et al., 2014). Also, Sadik et al. (2017) focused on aspects of awareness in carrying out a survey among students from three different cities in Bangladesh in order to learn about their awareness of e-waste management. The researchers gathered questionnaires from 1055 students of 10th to 12th grades and from first- and second-year university students in the age group of 16-22. The survey results showed that the students concerned were not aware of or concerned about e-waste and managed it like ordinary waste.

Ylä-Mella et al. (2015) focused on consumer awareness of mobile phone waste management in the city of Oulu in Finland, which has a population of over 200,000. The survey aimed to examine recycling behavior and awareness. One of the findings was that the respondents to the survey stated they had knowledge of WEEE, but only half of them respected it. Nnorom et al. (2009) study with 1000 pedestrians (mentioned in the previous section) found that willingness grew with awareness and concern about the deterioration of the environment. In a study of 137 students in Portugal, Marques and da Silva (2017) found that 40% were aware of e-waste, 35% were careful and 66% were aware of the consequences in terms of natural resources and environment; 75% ignored the law, although 35% knew about an eco-tax; and 81% ignored the national entity charged with the management and disposal of e-waste.

Analyzing data from a survey collected from 850 students from high-ranking educational institutions in China, Ramzan et al. (2019) reported that students had no (20%) or low (61%) awareness of e-waste and no (30%) or low (56%) awareness of recycling; 40% had never or only a little (53%) participated in recycling in the past; 66% had no idea of the relevant laws, while 23% had only a low awareness; and 42% ignored recycling programs and 55% had only a low awareness of the initiatives. In another study conducted in China, a survey of 474 families living in a city reported that 76% of the respondents were aware of the threat to the environment due to the improper processing of e-waste, although only 38% were willing to pay a fee (Cai et al., 2020).

A study of 430 consumers in a Brazilian city reported that a majority of the respondents were not aware of the law regulating electronic devices due to a lack of advertising; 72% were not aware of the law enforcing the recycling of mobile phones, although 71% knew they contain toxic substances (Damke et al., 2018).

A survey of 150 students at an IT college conducted by Chen and Yee (2011) in Malaysia found the following results: one third of the respondents knew about the existence of collectors; around one third had no idea about e-waste, while 55% had little awareness, and only 11% had a clear understanding; and one third did not see the importance of recycling. These results indicate that there is a certain lack of awareness of recycling and its importance.

Laws and Rules as Sources of Control Belief

As an example about the diversity of approaches due to country and culture, Liang and Sharp (2016) administered a survey in three countries (Thailand, Laos and China) to two subgroups (retailers and consumers) and interviewed members of three other subgroups (manufacturers, e-waste recyclers and policy makers). They gathered information on policies, which they measured using the knowledge of the respondents of e-waste laws, their willingness to comply, and concern about the environment and how to improve its condition. They found significant differences among countries, Lao receiving the highest score for both policies and practices. China received the highest score for a combined measure of policy, process and practices.

Studying the situation with regard to e-waste in Poland, Nowakowsky (2016) reported a 40% rate of collection of devices for recycling, which was resulted by new programs to process waste equipment and to the effort of information directed toward retailers, manufacturers and consumers. A study by Laroche et al. (2002) also showed the importance of culture in relation to environmental knowledge, attitude and behavior.

Data Analysis

Participants and Data Collection

The present survey was sent to 74 universities in Turkey, allowing a large scope of students, from cities to rural areas, from public and private sector and of diverse sizes. The data were collected from a website during one month. 772 answers were received but only 684 were kept; those who did change too often (over five times) or did not change their mobile devices were removed from the sample. 15 respondents with undefined gender were namely removed in this process.

Table 1 shows the distribution of gender among respondents' frequencies about mobile device change. The mean for women was 1.56 (std dev=.701) with a median of 1.0 while the mean for men was 1.61 (std dev=.732) with a median of 1.0. A t-test between means yields -1.049 (sig=.295) indicative of the absence of significant difference between genders. A chi-square between gender and number of lately changes of phone was computed, and result showed insignificant difference in the distribution with CHI2= 8.641 (sig=.071).

Table 1: Frequency of change

How often respondents changed their phone in the last five years	Pct Women	Pct Men
1	53.6	50.7
2	39.3	39.7
3	6.1	7.6
4	0.0	1.7
5	1.0	0.3

Examination of the Past Behavior in Relation to Renewing a Mobile Phone

The following sections present the main motives invoked to keep or change the old phone and the disposal method used in the latter case.

Reasons to Renew (Past)

On a scale varying from irrelevant (code=1) to crucial (code=5), respondents were asked to mention their motive to change their mobile. Table 2 presents the results.

Table 2: Main motive to phone replacement

Main reason to change phone	Women mean	Men mean	t-test	sig
Q5a) Broken phone-cannot repair	3.14	3.31	-1.604	.109
Q5b) Poor functions-cannot upgrade	2.98	3.11	-1.363	.174
Q5c) More storage needed for my music/pictures	2.93	2.72	2.089	.037
Q5d) It is no more fashionable	1.49	1.47	.421	.674
Q5e) Newer products cheaper	1.46	1.57	-1.423	.155
Q5f) I got an upgrade phone from my network operator	1.35	1.36	-.240	.810
Q5g) To get a phone with a longer battery life	3.13	3.10	.236	.814

The scores are relatively low, indicating that the need is far from being crucial for both genders. Three reasons score very low, those related to fashion or opportunity. The main reasons are the battery life, the impossibility to repair, or the impossibility to upgrade. Picture storage variant seems to be the only difference between men and women to change their devices.

Choices for Disposal Actions

When asked how they disposed of their old mobile phones, respondents declared the following approaches, presented in table 3 below:

Table 3: Preferences for disposal method

Approaches chosen	Pct women	Pct Men
I haven't disposed of it yet, I kept it for myself	49.9	51.2
I haven't disposed of it, I kept it to donate to a friend/relative/charity	28.8	28.3
I donated to an organization that re-uses/recycles old mobile phones	0.8	1.1
Traded in to get a discount on a new mobile device	3.8	5.7
Sold it online or otherwise–second hand dealer	11.1	11.0
Sent to an official organization for safe disposal	0	0
Threw it away in the recycle bin	1.3	1.8
Threw it away in the general waste	4.3	1.1

It is worth to notice that half of the respondents did not dispose of their phones and preferred to keep the devices for themselves. Both genders seem to adopt a similar pattern. A CHI2 statistics computed show no significant difference in the gender way of disposal (CHI=7.458, sig=.281). It should be noted that no participants mentioned sending their devices to an official organization for safe disposal, at least for their old devices.

Motives for Keeping the Old Devices

Given the important number of respondents who preferred keeping the devices instead of disposing them, a distribution of the reasons invoked to keep the devices is presented in table 4 below, the choices varying from irrelevant (=1) to crucial (=5):

Table 4: Motives mentioned to keep old phone

Reasons invoked	Women mean (std)	Men mean (std)	t-test	sig
Q7a) Keep it in case I need a spare (e.g., for emergencies)	3.04 (1.182)	3.06 (1.292)	-2.02	.840
Q7b) I don't know what else to do with it	1.98 (1.170)	1.99 (1.263)	-0.158	.875
Q7c) It is not convenient to send it to official recycling organization	1.66 (1.044)	1.77 (1.146)	-1.152	.250
Q7d) Valuable information stored on handset (e.g., contacts, texts, videos, music)	2.98 (1.301)	2.94 (1.407)	0.343	.732
Q7e) Don't think it has a high value	2.06 (1.068)	2.39 (1.270)	-3.302	.001
Q7f) Fear that someone can get access to my private data	2.71 (1.424)	2.63 (1.505)	0.667	.505
Q7g) I plan to give it away at a later date to a relative	2.58 (1.249)	2.50 (1.220)	0.851	.395
Q7h) I plan to sell it at a later date or trade in return for another purchase	2.11 (1.133)	2.05 (1.211)	0.580	.562
Q7i) Keep to use the spare parts (e.g., battery)	1.76 (1.003)	1.74 (1.117)	0.196	.845
Q7j) Old technology is collectable	2.08 (1.137)	2.07 (1.187)	0.161	.872
Q7k) I keep it as a memento	1.69 (1.019)	1.98 (1.197)	-3.062	.003
Q7l) I plan to send away for re-use or safe disposal later	2.52 (1.156)	2.32 (1.250)	2.050	.041
Q7m) None of the above	1.50 (.875)	1.54 (.874)	-0.395	.693

Table 4 shows that the main reasons to keep the device is in case of need (as a spare). Significant differences between men and women were observed about the value of the old phone (women see less value), the intention to keep it as a memento (higher for men), and concern for re-use or recycling, (higher for women).

Motives to Dispose of an Old Phone in Waste

Contrary to the vast majority of the respondents, other (5.5% of women and 2.9% of men) throw their devices as waste to the recycle bin or in the general bin when changing their phone. Table 5 shows their motives.

Table 5: Reasons mentioned to dispose as a waste

Reasons to throw the devices to waste	Women	Men
Q8a) no colleting value	4	2
Q8b) no time	5	2
Q8c) complex-tiresome	8	2
Q8d) no longer a necessity	3	0
Q8e) no law forcing	4	0
Q8f) no environmental awareness	0	0
Q8g) don’t know where to send it	15	3

It can be seen from the table above that more women are throwing the old devices to waste than men. According to this table, the main reason is that women lack information about

where and how to dispose of their devices. Nevertheless, they dominate men in their intention, for all reasons.

Recycling as a Potential Behavior in the Future

A behavior displayed in the past does not necessitate that the behavior will remain exactly the same in the future. In our case, specifically, there has been a serious increase in advertisement and news about the need to protect the Earth, which allows the mobile phone users to increase their awareness of this matter. Accordingly, respondents were asked to mention their next decision or preference in regards to recycling.

Intention to Recycle

Table 6 presents the choices offered to respondents as a gradation of intentions from definitively not concerned and reactive to affirmation of a will to recycle. It seems that mobile phone users have an increasing tendency to recycle their old devices.

Table 6: Intentions mentioned in regards of the old phone

Intention	% Women	% Men
I will not send it; I don't see the necessity of recycling	3.6	3.2
I will not send it, even if I know the importance of recycling	7.3	12.1
I will send it only if there is a monetary term in return	25.5	39.1
I will send it to recycle center	63.6	45.6

A chi-test was performed to compare the intentions of men and women, which yields the score of 23.390 (sig=.000), showing a significant difference between genders. Women are more inclined to recycle than men, with or without a monetary compensation. Clearly there is a gender gap.

Motivators for Recycling

In order to understand the motives behind the intentions expressed, an analysis was performed and presented below in table 7.

Table 7: Reasons mentioned in regards of recycling

Motives	Women mean (std)	Men mean (std)	t-test	sig
Environmental concern	3.66 (1.404)	3.57 (1.391)	0.883	.378
Receiving a counterpart	2.98 (1.340)	3.27 (1.368)	-2.710	.007
Convenience of disposal	2.81 (1.315)	2.73 (1.246)	0.734	.463
A law forcing recycling	2.81 (1.507)	2.71 (1.509)	0.861	.389

Environmental concern is the most frequent choice with a mean of 3.66 for women and 3.57 for men on a 5-points scale, where 1= "no influence" and 5= "very strong influence". The main difference between genders appears to be related to the possibility of a counterpart, while men being more motivated than women in return for a monetary incentive (t-test=-2.710, sig=.007). The law does not appear to be a very strong motivator in this matter. It can also be understood that the ease of disposal is less important than the convenience of disposal.

Knowledge about e-Waste

Since environmental concern appears to play an important role in the decision to recycle, young people were asked about their knowledge about e-waste within the frame of our study. Table 8 below summarizes their relative degree of knowledge; the possible answers being organized as an ordinal variable. It shows that about one third of the respondents does not have sufficient level of information about this subject, one other third knows it on a basic level, while the last third is well aware of the issue.

Table 8: Familiarity of respondents with the term "e-waste"

Knowledge	Pct Women	Pct Men
No, it is the first time I read about the term E-waste	12.7	6.9
I have heard about it but do not know exactly what it is	22.8	19.7
I only know that it consists of electronic material	36.3	34.5
I know what it is and I have a clear understanding	9.4	17.2
I know what it is and I try to be careful in disposal	18.8	21.7

A CHI2 test was performed, providing a result of a significant difference between genders (CHI=15.240, sig=.004). It appears that women have less knowledge about e-waste than men. In order to better understand that fact, a correlation was computed to verify if the intention to recycle is related to knowledge level or to environmental concern. Table 9 summarizes the findings:

Table 9: Gender difference in regards of the intention to recycle

Correlation with intention to recycle r (sig)	Women	Men	Both
e-waste knowledge	.100 (.049)	.059 (.321)	.068 (.082)
environmental concern	.348 (.000)	.323 (.000)	.338 (.000)

Table 9 shows that there is a very significative relationship (r=.338, n=670, p=.000) between the intention to recycle and the environmental concern, but not with e-waste knowledge.

Limits and Conclusion

Nowadays, it is important to keep the protection of environment in each of our life decisions in mind, especially with the need of a safe disposal of the electronic devices that we use. If in the past people could neglect finding a safe approach to disposal of electronics, it is no more the case. It is unfortunate that, even today, not so many people are aware of the threats and dangers caused by e-waste.

The research presented in this paper shows that men and women had a similar behavioral pattern in regards to their phone disposal in the past, with some differences in their reasons to change (women needing more space for photos) and having less financial expectation relative to their decision on how to dispose of their devices. It is understood that women planned to find a useful or non-destructive disposal method in this regard. They are more inclined to recycle compared to men, without any expectation of money. Although women are less aware of the recycling subject, it is found out that they are more concerned about the environment. At the same time, although the past has witnessed bad situations in this regard, the future looks more promising as long as adequate measures are taken, such as increasing interest in the environment for women and finding a reward for men.

This project was based on the need to understand the past behavior of students and to predict their future behavior. The life styles and behaviors of students change quickly after graduation, sometimes depending on their new financial capacity and life habits, so the results obtained by this study must be tinged with a necessary doubt about the future.

This paper has shown that necessity (battery and storage needs, etc.) is the main reason to change a device. In recent years, many governments have forced electronic device producers to implement a standard charger interface in order to limit the waste of electronic parts. Further and more advanced research is needed in order to determine if a similar approach applies to battery life and capacity, and to storage limits.

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