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Implementation of the Repairability Index in the Smartphone Industry: An Analysis on Willingness to Pay, Perceived Quality and Purchase Intention.

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Dissertation written under the supervision of
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ABSTRACT

Implementation of the Repairability Index in the Smartphone Industry: An Analysis on Willingness to Pay, Perceived Quality and Purchase Intention.

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Smartphones are important means of communication that are rapidly advancing in technology. Its rather short replacement cycles continue to drive a growing volume of electronic waste. The introduction of a Repairability Index, which provides information on the reparability of an electrical device, is an attempt to extend useful life. By influencing consumers' purchase decisions, pressure is built up on manufacturers to enable their equipment to be repaired more cost-effectively and to provide replacement parts.

The objective of this study is to investigate the influence of the Repairability Index on consumers' Willingness to Pay, Perceived Quality, and Purchase Intention. The importance of repairability is examined in the context of customer-preferred smartphone features to control for interaction effects. In a qualitative preliminary study, these preferred features were identified. Then, the main study was conducted using an experimental approach in which participants were presented with a manipulated smartphone advertisement.

The results show that the Repairability Index influenced consumer purchase behavior by exerting a positive effect on Willingness to Pay and Perceived Quality. However, no effect was found on the overall Purchase Intention. This result is independent of age and gender, but stronger among individuals with high environmental awareness. Attitudes towards repair reinforced the effect of repairability on Perceived Quality. No interaction effect could be found between repairability and preferred features, however, preferred smartphone features revealed a great importance on all three variables in the experiment and therefore managers should not neglect them.

Keywords: Repairability Index, Smartphone Industry, Electrical Devices, Preferred Features, E-Waste, Obsolescence, Purchasing Behavior, Environmental Awareness, Repair

SUMÁRIO

Implementação de um Índice de Repairabilidade na Indústria dos Smartphones: Uma análise da vontade de pagar, da qualidade percebida e das intenções de compra.

Autora: Ricarda Maria Reischl

Os smartphones são importantes dispositivos de comunicação cuja tecnologia está a avançar rapidamente. Os seus curtos ciclos de substituição conduzem a um volume cada vez maior de resíduos electrónicos. A introdução de um índice de reparabilidade, que fornece informações sobre a reparabilidade de um dispositivo eléctrico, é uma tentativa de prolongar a sua duração de vida. Ao influenciar as decisões de compra dos consumidores, aumenta a pressão sobre os fabricantes para repararem os seus dispositivos de forma mais rentável e fornecerem peças sobressalentes.

O objectivo deste estudo é investigar a influência do índice de reparabilidade na vontade de pagar, na percepção da qualidade e na intenção de compra por parte dos consumidores. A importância da reparabilidade é examinada no contexto das características preferidas dos smartphones dos clientes para controlar os efeitos de interacção. Foi realizado um estudo preliminar para identificar estas características preferidas. Depois, o estudo principal foi conduzido utilizando uma abordagem experimental na qual os participantes foram apresentados com um anúncio manipulado de smartphone.

O índice influencia o comportamento de compra dos consumidores, exercendo um efeito positivo na vontade de pagar e na percepção de qualidade. No entanto, não foi encontrado qualquer efeito na intenção global de compra. Este resultado é independente da idade e do sexo, mas mais forte para indivíduos com elevada consciência ambiental. Não foi possível encontrar qualquer efeito de interacção entre a reparabilidade e as características preferidas, mas as características preferidas dos smartphones demonstraram uma grande importância nas três variáveis de experiência.

Palavras-chave: Índice de reparabilidade, Indústria de Smartphones, Dispositivos eléctricos, Características preferenciais, E-Waste, Obsolescência, Comportamento de Compra, Consciência Ambiental, Reparação

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To all of you: Muito obrigada!
I hope you enjoy reading this paper.

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GLOSSARY

APPS	Applications (Smartphones)
CSR	Corporate Social Responsibility
E-WASTE	Electronic Waste
EEE	electrical or electronic equipment
LR	Literature Review
OS	Operating System
PI	Purchase Intention
PQ	Perceived Quality
RI	Repairability Index
TAM	Technology Acceptance Model
WTP	Willingness to Pay

CHAPTER 1: INTRODUCTION

1.1 BACKGROUND AND PROBLEM STATEMENT

Electronic waste (e-waste) is one of the fastest growing waste sectors globally with an annual increase of 8% (Jeita, 2018). The increasing volume and short life cycle of electrical equipment creates a global problem for waste management with implications for workers and the environment (Lu et al, 2015). One possibility to mitigate this is to extend the useful life of the devices and repair them instead of replacing the products. However, this would require smartphone manufacturers to facilitate repair by providing affordable replacement parts, releasing manuals, offering updates, and simplifying the repair process (Proske & Jaeger-Erben, 2019). The implementation of an index that provides information on the repairability of appliances could bring a strategic change in the consumption of electronic devices.

As from January 1st, 2021, manufacturers of certain electronic equipment in France are subject to a regulatory obligation to include a Repairability Index (RI) in their point-of-sale communications and on their websites. This index is based on a number of criteria, including price and availability of spare parts. In this way, France aims to combat obsolescence and encourage consumers to have their electrical appliances repaired (Ministère de la transition Écologique France, 2021). Particularly for smartphones, whose average lifespan is rather short and which have a high value as daily companions in people`s lives (Salleh, Mahbob & Baharudin, 2017), the index could encourage manufacturers to improve the reparability of their devices. This is not only a way for consumers to save money, but also helps to conserve resources and reduce the amount of electronic waste (Proske & Jaeger-Erben, 2019).

The RI has the leverage to get manufacturers to change the way they produce their smartphones and establish repair as a natural alternative to replacement. It is important to gain a better understanding of whether and how the RI influences consumers' smartphone purchase decisions. To measure this, three main metrics were therefore identified on which the RI could have an impact: Willingness to Pay, Perceived Quality, and Purchase Intention.

1.2 PROBLEM STATEMENT

The objective of this study is to understand how the implementation of the RI affects consumers' purchase behavior when buying a smartphone. It examines how the repairability score paired with the preferred features condition affects consumers' WTP, PQ, and overall PI. In addition, an experiment conducts data on whether moderators such as age and gender have an impact on

the effect and interaction between RI and the dependent variables. It is investigated how consumers' general attitude towards repairs and environmental awareness affect the different variables. Essentially, the problem statement for this research can be summarized as the following:

Understanding the impact of the Repairability Index on the purchase decision process when buying a smartphone.

This problem statement is substantiated in the following research questions:
RQ1: What is the impact of the Repairability Index on consumers' Willingness to Pay, Perceived Quality, and Purchase Intentions when buying a smartphone?
RQ2: Does the influence of the Repairability Index vary between different demographic backgrounds?
RQ3: Do environmental awareness, attitude towards repair, and attitude towards the Repairability Index influence consumers' Willingness to Pay, Perceived Quality, and Purchase Intentions?

1.3 RELEVANCE

Preventing the premature end-of-life of electronic devices, such as smartphones, is the first step towards a circular economy, where the population decouples resource consumption from the growing economy, reuse and recycle (Proske & Jaeger-Erben, 2019). In this regard, an index that provides an indication of a device's repairability is essential to help consumers select devices that can be repaired and used longer. By influencing consumers' purchasing decisions, pressure is put on manufacturers to repair their devices more cost efficient and provide replacement parts. Therefore, it is even more important for managers to understand the impact that the RI has on consumers, what factors are influenced, and which target group is particularly receptive. Smartphones as a key communication device and the topicality of the subject give research a high priority.

1.4 RESEARCH METHODS

To address the research question, secondary literature was consulted and analysed to provide a more accurate picture of existing research. To gain a better understanding of the smartphone

purchasing process and to identify preferred smartphone features, 12 in-depth interviews were conducted.

Based on the findings from the literature and the results of the in-depth interviews, a quantitative online study was executed. The primary data was conducted using an experimental study design to investigate whether a poor or good RI has an impact on the three dependent variables. For this purpose, a smartphone advertisement was shown that contained information about smartphone features and RI. Not only was the RI manipulated, but also the preferred conditions, resulting in 2x2 factors.

1.5 DISSERTATION OUTLINE

The master thesis consists of five chapters that build on each other. After a short introduction, the following chapter presents the existing literature. First, the problem of the increasing amount of electronic waste and its improper disposal is presented, then the implementation of an index that provides information about the reparability of electronic devices is examined. Hypotheses are derived about the influence of the index on three variables. Chapter three presents the methodology used to answer the research question, which consists of a preliminary study and a main experimental study. Chapter four consists of the analysis of the obtained data with a detailed description of which statistical test was used. Following this, chapter five summarizes, interprets, and discusses the results. In addition, the resulting implications for managers and the limitations and directions for further research in this area of the study are presented.

CHAPTER 2: LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

The following chapter presents the current status, problems and important developments in the smartphone industry. Due to the increased amount of electronic waste and improper disposal, France has introduced a reparability index for electronic devices from January 2021. It forces electronic device manufacturers to enable more sustainable consumption by extending the life cycle of devices by facilitating repairs (Ministère de la transition Écologique France, 2021). This literature review aims to provide a solid basis for understanding the possible impact of the newly introduced Repairability Index on the consumer purchase decision process.

2.1 ENVIRONMENTAL PROBLEMS IN THE SMARTPHONE INDUSTRY

Electronic waste (e-waste) is one of the fastest growing waste sector worldwide with eight % increase annually (Jeita, 2018). In 2019, 53.6 million tons of e-waste were produced worldwide (Hentschel & Timkanicova, 2020). The increasing volume and short life cycle of electrical equipment is creating a global problem for waste management with implications for workers and the environment. (Lu et al, 2015).

Discarded electronic devices contain valuable material such as rare earths, copper, gold, silver, which can be processed for reuse in a complex recycling procedure (Mao et al, 2020; Panda et al, 2020). However, this complex process requires strict safety precautions and regulations, as e-waste also contains hazardous constituents such as lead, mercury and chromium. Up to 80 % of all types of electrical or electronic equipment (EEE) is discarded in low- and middle-income countries, like China and Africa (Lundgren, 2012), which typically lack the infrastructure and resources for responsible disposal (Heacock et al, 2016). It is estimated that only 25 % of valuable materials can be recycled in such informal e-waste recycling and cause severe pollution and health problems for workers and society (UNEP, 2015).

These described circumstances illustrate the need for changes in the use of electronic devices and the resulting waste. In addition, the average lifespan of electrical appliances has continued to decline in recent years. According to Hentschel & Timkanicova 2020, the reasons for this are a short product life-cycle, cheap material and the increasing lack of repair. Particularly in the smartphone market, the lifespan of devices is out of all proportion to the raw materials used and the expense incurred by electronic waste.

Smartphones are a technical development of mobile phones (Ting et al., 2011) and allow the user to freely install applications (Apps) by means of an operating system (OS), which enables

more functionalities to be used (Shiraishi et al., 2011). Lee 2014 defined the term smartphones as follows: ‘a mobile phone that offers advanced capabilities, often with PC-like functionality, and that is no longer limited to making voice calls’ (p. 312). The sales of smartphones have grown steadily since the introduction of the electric device (Ching et al., 2015).
Due to the high demand, the number of market players has also increased, leading to fierce competition in the smartphone industry (Hew et al., 2017).The wide range of products and brands, as well as the fast evolution of devices (Gill, 2008), leads to a short product lifespan as consumers replace their smartphones on a regular basis (Hsiao & Chen, 2015). The extensive and careless use of smartphones leads to various negative social and environmental consequences for humans and nature (Zufall et al., 2019). Ghana is one of the major destinations for so-called "second-hand consumer electronics," which are shipped there cheaply, mainly from Western Europe (Heacock et al, 2016). Since these EEEs are not officially labeled as e-waste, the electronic devices are improperly disposed of, making the Agbogbloshie Area one of the ten worst toxic threats worldwide (Blacksmith Institute, 2013).

Repairs are not worthwhile for the consumer, as the manufacturers' spare parts are expensive and often unavailable. Self-repairs are not possible due to the product design and the costs for external repair services exceed the price of a new device (Hentschel & Timkanicova, 2020). Consumers assume that repairs are too costly and therefore do not consider them as an alternative, which is why customers continue to use the smartphone in the event of minor damage and ultimately replace the device (Wieser, 2015). To address this problem, the entire smartphone industry needs to change toward new business models and move away from high sales rates through short life cycles. These changes need to be seen on the part of consumers as well as policymakers and manufacturers to create holistic change. (Zufall et al., 2019; Boons & Lüdeke-Freund, 2013). In this context, even small changes are a step in the right direction, such as robust product design, long-lasting batteries that are easily replaceable, and a modular and upgradeable design. One of the most important aspects is the provision of spare parts at low cost, so that it is also worthwhile for independent repair services to be able to offer repairs (Frauenhofer, 2016)

2.2 IMPLEMENTATION OF THE REPAIRABILITY INDEX IN FRANCE

Figure 1: Repairability Icon France (www.repair.eu, 2021)

The European Union has recognized these grievances around the issue of e-waste and sustainable consumption and is taking initial action. In 2020, the EU Commission presented their Circular Economy Action Plan along with the Ecodesign Requirements that will apply from March 2021. This concept of CSR and sustainability thinking - reduce, reuse, recycle - includes several measures related to sustainability and circular economy. Manufacturers must increasingly provide spare parts and repair instructions. However, the new EU directives only focus on household appliances and displays (European Commission, 2019). The smartphone industry is therefore not affected by the new regulations.

On January 1, 2021, France went one step further and became the first country in the world to introduce a Repairability Index (RI) for electrical appliances, including smartphones. The scale shows consumers at the time of purchase how easily a device can be repaired. The aim is to achieve a repair rate of 60 % for EEE over the next five years. The pilot project will start with five product categories and will be expanded in the coming years (Ministère de la transition Écologique France, 2021).
The icon allows consumers to see at a glance the repairability of the electrical appliance at the time of purchase, whether shopping online or in-store. The implementation of the RI has been mandatory for manufacturers of electronic devices since the beginning of the year 2021 and will be monitored and sanctioned from 2022 onwards. The index is based on a self-declaration system and on a principle of transparency and subject to the vigilance of consumers and other stakeholders, as well as to the controls and sanctions of the French government (Ministère de la transition Écologique France, 2021).

The RI is evenly composed of five criteria (Figure 2), namely: Availability of Technical Documentation, Ease of Disassembly, Availability of Spare Parts, Price of Spare Parts, and a Device-Specific Criterion. Each category can reach a value from 1 to 20, which is summarized and then divided by 10. This gives the final value between 1 and 10. In addition to the value,

the icon is color matched so that it can be distinguished on a color scale from red - bad index to green - good index (Ministère de la transition Écologique France, 2021).

The information aims to raise consumers' awareness of their ability to extend the useful life and durability of their products, in particular by directing them towards products that are easier to repair and encouraging them to resort to repair in the event of failure. Thus, this is also a tool to combat obsolescence - planned or unplanned - in order to avoid the premature disposal of products and conserve natural resources (Ministère de la transition Écologique France, 2021).

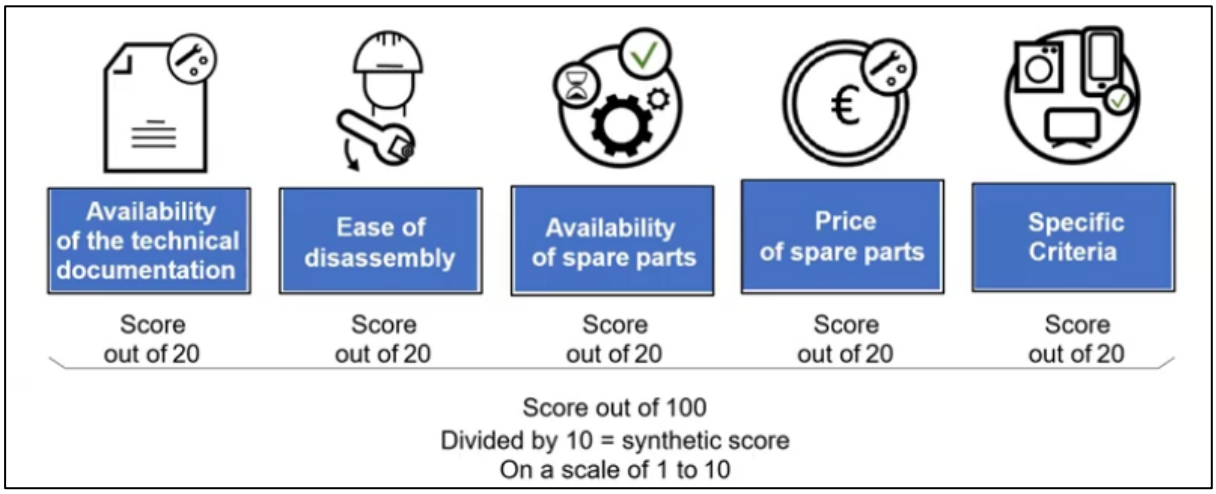

Figure 2: The criteria of the Repairability Index (www.repair.eu, 2021)

2.3 SMARTPHONE FEATURES INFLUENCING PURCHASING BEHAVIOR

To understand the impact of CSR activities such as the RI on consumers' smartphone purchase decisions, it is necessary to take a closer look at the attributes and factors that are considered important in the decision-making process.

A well-established approach to a deeper understanding of why we buy is offered by Sheth, Newman & Gross in their 1991 "Theory of Consumption Values," which defines five different types of values that influence consumer buying decisions: functional value, social value, emotional value, epistemic value and conditional value. However, a distinction must be made here between different types of products. Smartphones in particular must fulfil special characteristics in order to be considered by consumers (Gafini & Geri, 2014). One reason for this is the extensive use of mobile devices. Studies have shown that users check their smartphones every 18 minutes on average (Markowetz, 2015).

Due to the high relevance of smartphones in our daily lives, classical theories of consumer behavior, such as the widely used Technology Acceptance Model (TAM) by Davis (1989), have to be extended. The TAM is based on Perceived Usefulness and Perceived Ease-of-Use as the most influential factors related to the smartphone purchase process. Thokchom (2012) extends this model to include the factors of brand image and price, thus linking the TAM to fundamental elements of the Marketing Mix. In particular, the brand of a smartphone and the associated awareness, association and loyalty towards a brand appear to be key factors for repurchase intentions (Gulera & Parmar, 2015; Asharaf Bany, 2018).

Nowadays, it is argued that the established models, such as the TAM are outdated and some newly emerged factors are neglected (Lunceford, 2009). The constant technological advancement that characterizes the smartphone industry makes it difficult to establish factors (Asharaf Bany, 2018).

2.4 THE INFLUENCE OF THE REPAIRABILITY INDEX ON THE DECISION-MAKING-PROCESS

From a corporate perspective, the RI could be a chance for companies to convince consumers of their corporate social responsibility (CSR) engagement. Generally, besides the sense of responsibility and duty (Bansall & Roth, 2000), companies use CSR activities as a competitive advantage (Klassen & McLaughlin, 1996; Porter & Linde, 1995; Russo & Fouts 1997; Shrivastava, 1995), for product differentiation and establishing of a good reputation, which consequently leads to higher profits (Tian & Wang & Yang, 2011). This strategy could also pay off for smartphone manufacturers with the new RI.

The purpose of this study is to gain a better understanding of how the RI influences consumers' smartphone purchase decision. For this purpose, three possible dependent variables on which the RI might have an influence were identified:

2.4.1 WILLINGNESS TO PAY

The EU proved that simple symbols can influence the purchasing behavior of consumers at the point of sale by introducing mandatory energy labels on electronic devices in 1992 (Waechter, Sütterlin & Siegrist, 2015). The concept behind the colored symbol is quite similar to the French RI, with a letter ranging from A+ to F to consciously draw the buyer's attention to the energy efficiency of the product (Council of the European Communities, 1992). Studies from the U.S.

and Germany have revealed that the Willingness to Pay (WTP) for electronic devices, such as televisions with a good energy efficiency sticker is higher than with a poor one (Heinzle & Wüstenhagen, 2009; Ward et al., 2011). Consumers want to reward companies that are committed to sustainability, save resources, and are consumer friendly with higher WTP and punish those with lower ethical standards with lower perceived price fairness (Creyer & Ross, 1997).

Since price is classified as a key factor in the purchase of smartphones (Thokchom, 2012), the related WTP is important for managers to develop an optimal pricing strategy (Balderjahn, 2003). Some authors see a close relationship between brand equity and consumers' WTP (Farquhar, 1989, Srivastava & Shocker, 1996). Derived from this, the following hypothesis is formulated:

H.1: The Repairability Index influences consumers' Willingness to Pay.
H.1-a: Consumers are willing to pay more for a smartphone with a high Repairability Index.
H.1-b: Consumers are willing to pay less for a smartphone with a low Repairability Index.

2.4.2 PERCEIVED QUALITY

As smartphones are an important part of consumers' lives as reliable digitalised companions, the quality of the devices is a decisive factor when choosing a mobile phone (Proske & Erben, 2019). According to Garvin (1984), the Perceived Quality (PQ) of a device is closely linked to a customer's satisfaction with the product. This satisfaction combines a consumer's expectations of the smartphone with perceived performance (Mullins & Walker, 2010). However, quality consists of several dimensions and is made up of, among other things, the features, reliability and durability of a device (Sernovitz, 2009), which are precisely the values that the RI conveys to the consumer. The RI does not indicate the quality of the device, but the reparability, which makes it easier for consumers to extend the life cycle of the smartphone. It is unclear how a good RI affects smartphone PQ. This results in the following hypothesis:

H.2: The Repairability Index influences the Perceived Quality of a smartphone.
H.2-a: A good Repairability Index leads to a better Perceived Quality of a Smartphone than a bad Index.

H.2-b: A good Repairability Index conveys a better Perceived Durability of the Product when compared with a bad Index.

2.4.3 PURCHASE INTENTIONS

In terms of Purchase Intentions (PI), social and environmental engagement proved to have a positive effect on customers' purchasing decisions (Barone, Miyazaki, & Taylor, 2000; Lichtenstein, Drumwright & Braig, 2004), which is further enhanced when social engagement is complementary to the nature of a firms business (Drumwright, 1996). Major market players such as Apple are increasingly showing social and environmental commitment, such as climate-neutral production and supplier chains (Apple, 2020). Based on the insights just mentioned, the following hypothesis can be derived:

H.3: A good Repairability Index has a positive Influence on Purchase Intentions when buying a Smartphone compared with a bad Reparability Index.

2.4.4 COVARIATES AND MODERATOR

Fairphone, a Dutch smartphone brand and pioneer in the smartphone industry with its modular design, uses the RI for its public relations. With a high score of 8.7/10, the brand explains in detail the principle behind its business model on its website and seeks to raise awareness of the problems of careless smartphone consumption through customer education. (Fairphone, 2021). In this way, the brand sensitizes consumers to the longevity of electronic devices and environmental problems, and at the same time promotes its products.
In this regard, there is disagreement in the literature as to whether problem awareness in a product category and the resulting understanding of a company's implemented CSR activities are related to their perception and resulting purchasing decisions (Liang & Wang, 2007; Pomering & Dolnicar, 2009).

Tian, Wang & Yang (2011) link CSR awareness to the cultural, political and economic development in different countries. People's demographic background also influences the impact of CSR activities. In particular, high-income women are more supportive and receptive to sustainable and social engagement of brands (Tiang, Wang & Yang, 2011). Further, the age of consumers must be included in the analysis as there are significant differences in purchasing behavior between generations (Gafni & Geri, 2013). This is due to the rapid technological

progress and the generation-specific issues that have shaped different cohorts. (Lee, 2009). Generation Z is strongly influenced by communication and the use of technology, but also interested in sustainability and responsibility, which affects their purchasing behavior (Salleh, Mahbob & Baharudin, 2017). The potential impact that demographic backgrounds may have on the research will be considered and further explored in the experimental study.

H.4: The Influence of the Repairability Index on Willingness to Pay, Perceived Quality, and Purchase Intention is influenced by the Demographic Backgrounds of the Participants.
H.4-a: The influence of the Repairability Index on Willingness to Pay, Perceived Quality and Purchase Intention is stronger for Women.
H.4-b: The Influence of the Repairability Index on Willingness to Pay, Perceived Quality and Purchase Intention is stronger for Generation Z.

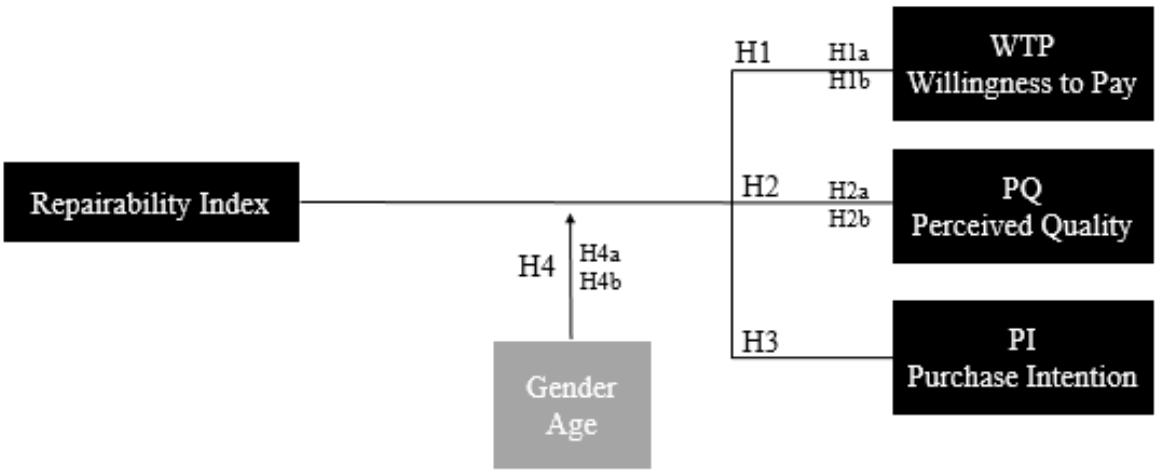

Figure 3: Overview Conceptual Construct

CHAPTER 3: METHODOLOGY

This chapter describes the methodology used to investigate the research question. It provides a detailed explanation of the sample, the procedure, and the design of the experimental study. Included in the design section is the pre-test that was conducted prior to the quantitative study to determine the preferred smartphone features. Finally, the validated measures used to test the dependent variables are presented.

The main objective of the study was to investigate the impact of a RI on the dependent variables of WTP, PQ and PI, using a combination of desk research and primary data collection.

3.1 SAMPLE

The target population for the study was adult consumers aged 18-65 years. Random sampling was used, a type of non-probability sampling, to allow for a large sample size in a short period of time (Fowler, 2009). 34 responses were discarded due to incompleteness or illegitimate answers, resulting in a total of 174 valid responses. Individuals who participated in the study included 70 males and 104 females in an age range of 18 to 55 years. The main age group was young adults aged 23-28 years with 63% of all respondents, resulting in a low average net income. Nearly 53 % of participants reported earning less than 1500 euros net income per month, with 18 % earning between 0-500 euros. More than half of the participants are of German nationality, followed by English and Dutch.

Category		Respondents	Rate
Gender	Female	104	60%
	Male	70	40%
Age	18-23	47	27%
	24-29	91	52%
	30-39	18	10%
	40-55	18	10%
Nationality	German	92	53%
	English	16	9%
	Dutch	8	5%
	Portuguese	7	4%
	Other	51	29%

Average Net Income (per month)	<500€	32	18%
	500€ - 1499€	60	35%
	1500€ - 2499€	38	22%
	2500€ - 3500€	15	9%
	>3500€	12	7%

Table 1: Sample Description

3.2 PROCEDURE

The study consisted of an online survey published between April 5 and April 15, 2021, using the online survey tool Qualtrics and distributed through various Social media platforms.
The survey was pretested with 20 participants and then optimized to further increase validity (Sue & Ritter, 2012). To encourage truthful responses from interviewees and avoid potential bias, confidentiality and anonymity were assured in the questionnaire introduction. The survey language for all participants was English, with a screening question restricting the age range of participants from 18-64 years.
The survey was composed of the following 4 sections (Appendix 2):

Socio-demographic characterization. In the first part of the qualitative interview, participants were asked to provide their sociodemographic data. Age, gender, nationality, and net income were requested in order to later examine possible correlations between the demographic data and the impact strength of the RI.

Advertisement display. Participants started by selecting their preferences for a smartphone. The candidates could choose between two options for both features; small phone size or large phone size; IOS or Android. This information was used to randomly assigned participants to, either a preferred or non-preferred condition. Participants were also randomly assigned to either a high or a low RI condition.

- **Group 1:** Preferred Features + Good RI;
- **Group 2:** Non-preferred Features + Bad RI;
- **Group 3:** Non-preferred Features + Good RI;
- **Group 4:** Preferred Features + Bad RI.

Participants were then shown an advertisement for a smartphone of the applicable condition, with information on brand, operating system, camera, battery capacity, and repairability. Using randomization, the 174 participants were evenly divided among the four possible groups, resulting in a number of 41 - 46 valid responses per group. Respondents were asked to look closely at the advertisement and were allowed to continue with the interview after 15 seconds at the earliest, to ensure a reasonable time frame for viewing the advertisement. On average, participants spent 27 seconds reading the manipulated smartphone ads before moving on to the subsequent questions.

Dependent variables. Subsequent the advertisement, participants indicated their WTP, PQ, and PI for the displayed product.
Following, an awareness test was conducted. First, participants had to select the information shown in the display from a list of 12 smartphone features. The randomized sample consisted of six correct features (brand, OS, camera, battery capacity, RI, phone size) and six features not displayed (memory, screen resolution, speaker, CPU processor, SIM card, fingerprint sensor). Subsequently, the RI was shown without a numerical value thus only the colored icon could be seen. Depending on the group assignment, the color of the RI was red (group 2 & 4) or green (group 1 & 3). Participants were instructed to reproduce the previously shown value.

Attitude and Awareness. In the final part of the quantitative study, consumers' attitudes toward repair, RI and knowledge about issues in the smartphone industry were queried. In addition, questions were asked about the participants' consumption behavior with regard to their smartphone.

3.3 DESIGN

The experimental stimulus consisted of a display advertisement for a smartphone presented to the consumer in the experimental research (Appendix 2). The ad showed a picture of a smartphone with additional information and statements about the functionality and brand of the device along with the RI.

3.3.1 REPAIRABILITY INDEX

Participants were randomly assigned to one of two possible RI conditions. The RI was integrated in the form of the icon officially used in France (Figure 1). Participants either saw

the advertisement with a good RI (green interferer; score of 9.5) or a poor RI (red interferer; score of 1.5). A simplified description of the RI was given since the index is implemented only in France, where it is still rather unknown (Ministère de la transition Écologique France, 2021):

- **Repairability Index**: "*Indicates how easy it is to repair a device based on cost, availability of spare parts, and technical instructions. (Scale 1-10)"*

Further, participants were assigned to one of two possible preferred features conditions. More specifically, they saw the advertisement either with their previously indicated preferred features of a smartphone or with the non-preferred features.

3.3.2 PREFERRED SMARTPHONE FEATURES

The smartphone market is increasingly flooded with competing brands offering a range of new features (Bukhardi et al., 2013), leaving consumers with an expanding choice of features (Gill, 2008). Due to this, it is even more important to identify the features that consumers consider most important when purchasing a smartphone. To gain this understanding of consumers, a preliminary qualitative study was conducted with 12 in-depth interviews consisting of five men and seven women between the ages of 20 and 64 from eight different countries. Given the flexibility of face-to-face interviews, inferences can be made about the nature of a topic and help identify relevant variables for the quantitative study (Boyce, Neale, 2006).

The qualitative interview structure (Appendix 1) was divided into four sections. After a brief round of introduction and a run-through of demographic data, participants were asked about the attributes they value most and least about their smartphone. In section three, purchase behavior and attitude towards repair were examined in more detail. This was followed by a section of general attitudes toward corporate social responsibility and an examination of consumer awareness and knowledge of social and environmental issues specific in the smartphone industry.

In general, respondents owned their smartphone in the time frame between three months and two years, with two to three years generally seen as a good product replacement age. The majority of the participants did not buy the newest smartphone model at the time of purchase, due to price, with four participants stating that they had already bought their phone second hand. The price was evaluated positively if the offer was particularly favorable at less than 300 euros.

The smartphone price was perceived negatively by participants with a newer smartphone model who had to pay a higher amount. This is consistent with previous studies that see price as an important factor in the purchase decision process (Thokchom, 2012; Farquhar, 1989).

Camera quality was the most frequently mentioned feature. Most participants praised the camera quality and desired this attribute for future purchases. Participants emphasized that ease of use is favorable, resulting from several different factors. For instance, half of the participants mentioned the size of the phone as important. It was noticeable that women prefer smaller display sizes, as this makes the phone easier to handle. Eight respondents named ease of use in connection with the OS of a device, resulting in a higher degree of brand loyalty. Changing the OS was mainly seen as an inconvenience and not favorable at all.
The battery performance was perceived negatively by five participants. Three participants perceived a deterioration in performance over the period of ownership. This suggests that besides camera quality, OS and phone size, the battery capacity is a decisive factor in the purchasing process.

Half of the respondents indicate a positive attitude toward repair and use repair services for their smartphones as a natural consumer choice. It is striking that this is especially true for iPhone owners in connection with the Apple Store, which can be attributed to the brand's good communication regarding its own repair centers. Among the neutral or undecided attitudes toward smartphone repair, the time required, the inconvenience and the cost were the deciding factors for whether respondents would have their phone repaired. Three respondents were skeptical of repair, citing excessive cost and the rapidly evolving smartphone industry as reasons. These factors will be explored furtFive out of twelve participants stated that they were aware of problems in the smartphone industry and mentioned the exploitation of workers in poor countries. The short lifespan of smartphones, the growing amount of electronic waste, and its improper disposal were not mentioned by any of the respondents.

Based on the findings from the in-depth interviews, the following smartphone features were selected for the experimental study. A distinction must be made between generally preferred features, such as a good camera, and individual preferences.Five out of twelve participants stated that they were aware of problems in the smartphone industry and mentioned the exploitation of workers in poor countries. The short lifespan of smartphones, the growing

amount of electronic waste, and its improper disposal were not mentioned by any of the respondents.

Based on the findings from the in-depth interviews, the following smartphone features were selected for the experimental study. A distinction must be made between generally preferred features, such as a good camera, and individual preferences.

- **Brand and Operating System**: This represents an individual preference of the consumers and is queried at the beginning of the quantitative study. The interviews showed that most participants are owners of an Apple iPhone or a Samsung smartphone, which is why these two brands and their operating systems IOS and Android were used for the experiment.
- **Camera Quality:** A high quality camera was identified as an important smartphone feature.
- **Battery Capacity:** A long-lasting battery was identified as an important smartphone feature.
- **Phone size:** The size of the smartphone plays a particularly important role for women. Individual preferences are evident here, which is why this the preferred size was also asked about at the beginning of the study.

Based on this pre-test, the participants in the subsequent quantitative study were able to individually select the features OS and size of the phone according to their own preferences. Preferred features included good camera quality and battery capacity by default. Poor camera quality and low battery life are considered non-preferred features according to the results.

3.4. DEPENDENT MEASURES

Willingness to Pay. WTP was measured using two questions developed by Marbeau (1987). Marbeau avoids a direct demand for an accepted price, due to the sensitivity of respondents answering money related topics. The WTP is determined by asking about an upper and lower price limit of the respondents with the following questions:

- *Above which price would you definitely not buy the shown smartphone, because you can't afford it or because you didn't think it was worth the money?*

- *Below which price would you say you would not buy the shown smartphone because you would start to suspect the quality?*

Perceived Quality and Purchase Intentions. PQ was measured based on Yoo & Donthu (2001) with slight adaptations to the product category. Perceived durability and reliability were also queried in conjunction with two statements about the high quality of the smartphone. PI was investigated using a direct approach, first as a positive statement "*I would buy this smartphone*" and second as a negative statement "*The likelihood that I would consider buying the smartphone is low.*" This validated technique was used by Grewal (1998) and yielded an alpha of 0.92. PQ and PI were measured using a five-point Linkert scale that required participants to indicate their level of agreement with the statements from strongly agree to strongly disagree.

Attitude. Following Yin, Gao & XU (2013), two questions were posed regarding consumers' attitude towards smartphone durability and reasons for purchasing new smartphones. Attitude towards repair were measured using a five-point semantic difference scale with an alpha of 0.83 following Madden et al. (1992), which was slightly adjusted based on the results of the preliminary study. This resulted in the following three scales: pleasant - unpleasant; useful - useless; cheap - expensive. To measure problem awareness in the smartphone industry, especially in relation to e-waste, the Environmental Awareness Scale published by Yin, Gao & Xu (2013) was used, which is based on a four-point scale principle. Since the majority of the study participants are not expected to have any touch points or knowledge about the RI, the RI was briefly explained and then attitudes toward the RI were measured using a 5-point Linkert scale by Huang (2004).

3.5 VALIDITY AND CORRELATION

The integrated attention test provides information on how attentively the participants viewed the advertisement and how memorable the RI was. It indicates that participants identified more than four correct smartphone features out of six (*M = 4.30, SD = 1.37*). In contrast, they selected less than one incorrect feature (*M = .77, SD = 1.05*). This indicates a high attention span of consumers during the experiment.

Camera quality was the most frequently mentioned feature with 148 participants, followed by battery capacity (*N = 137*), OS (*N = 136*) and phone size (*N = 124*). 104 participants were able

to recall the RI as a feature. The bad RI was remembered more often than the good one, which was also evident in the question about the value shown.

Due to the use of validated scales, a high reliability can be assumed. In addition, the test of Cronbach's coefficient alpha was performed for all factors to ensure the reliability and internal consistency of the item variables. Both dependent variables PQ and PI yield an alpha above the recommended value of 0.70 (Table 2), indicating high reliability (Hair et al., 1998). The two items of the dependent variable WTP show a statistically significant correlation, with 2-tailed significance $p = 0.00$ and $r = 0.64$. In order to merge the two items of the PI scale, the second question had to be recoded in reverse. This also serves as a test of attention, which again shows by its significant correlation that the participants processed the study attentively ($r = 0.58$, $p = 0.00$). The semantic difference scale measuring attitude toward repair was reduced from three to two items to achieve a higher alpha of 0.64 and thus higher validity of the scale. The three-item scale to query attitude toward the RI, presented after a brief introduction of the index, obtained an alpha of 0.89, which is a high value and indicates high validity of the scale. The three items of the environmental awareness scale only received a Cronbach's Alpha value of 0.56, so it was decided to use only the second question for the correlation analyses. This question is more general and addresses awareness of initiatives that address electronic waste.

Factor	Number of Items	Cronbach’s Alpha
Perceived Quality	4	0.85
Purchase Intention	2	0.73
Attitude towards Repair	2	0.64
Environmental Awareness	3	0.60
Attitude towards RI	3	0.89
All variables	12	0.70

Table 2: Overview Cronbach’s Coefficient Alpha

CHAPTER 4: RESULTS AND ANALYSES

This chapter presents the main findings of the analysis conducted. First, a brief characterization of the consumer was made in terms of the dependent variables. Then, the four hypotheses described in Chapter 2 were tested (Table 3) by the analysis of the effect of RI and preferred features on the dependent variables and the analysis of how these effects were influenced by the selected covariates.

No.	Hypothesis	Finding
H.1	**The RI influences consumers' WTP.**	**Supported**
H.1-a	Consumers are willing to pay more for a smartphone with a high RI.	Supported
H.1-b	Consumers are willing to pay less for a smartphone with a low RI.	Supported
H.2	**The RI influences the PQ of a smartphone.**	**Supported**
H.2-a	A good RI leads to a better PQ of a Smartphone than a bad Index.	Supported
H.2-b	A good RI conveys a better Perceived Durability of the Product when compared with a bad Index.	Supported
H.3	**A good RI has a positive Influence PI when buying a Smartphone compared with a bad RI.**	**Rejected**
H.4	**The Influence of the RI on WTP, PQ and PI is influenced by the demographic backgrounds of the participants.**	**Rejected**
H.4-a	The influence of the RI on WTP, PQ and PI is stronger for women.	Rejected
H.4-b	The influence of the RI on WTP, PQ and PI is stronger for Generation Z (18-24 years).	Rejected

Table 3: Summary Hypotheses Outcome

4.1 INSIDE CONSUMER'S MIND

Examining the individual preferences of the survey participants reveals a balance in smartphone size (small/ large) and a slight preference for the Apple IOS with 59% of respondents.

On average, respondents indicated 691 euros as the upper payment limit and 299 euros as the lower limit, from which the WTP average of 495 euros was calculated (Table 4). The range between too expensive and too cheap is on average at 392 euros. Participants perceive the cell phone to be of high quality (*M = 2.24, SD = 0.91*) and are indifferent to the PI, with a slight reluctance to buy (*M = 3.16, SD = 1.23*), with a scale ranging from 1 - strongly agree to 5 - strongly disagree.

	WTP high	WTP low	WTP average	WTP range	PQ	PI
Mean	690.92€	299.17€	495.05€	391.75€	2.24	3.16
Std. Deviation	419.56	206.56	287.32	327.421	0.91	1.23

Table 4: Overview of Result Mean Dependent Variables

Half of the respondents cited damage as the most common reason for replacing their smartphone, followed by outdated function (*37%*). The average lifespan of a smartphone was 2-3 years. In general, interviewees see smartphone repairs as beneficial, with only 17% considering repairs as useless, and convenient, with 65% finding it pleasant rather than unpleasant. Repair price perception is less positive with only 10% of the participants considering repairs to be inexpensive and the majority (*64%*) considering repairs rather expensive ($M_{Q1} = 3.26$, $SD_{Q1} = 0.88$; $M_{Q2} = 2.87$, $SD_{Q2} = 1.05$; $M_{Q3} = 2.17$, $SD_{Q3} = 0.96$).

In general, respondents reported an average knowledge of environmental issues in the smartphone industry with $M = 2.23$, $SD = 0.67$, where 1 represented no knowledge and 4 represented good knowledge. However, a decrease in awareness was particularly evident for more specific topics such as e-waste management initiatives and government regulations ($M_{Q1} = 2.84$, $SD_{Q1} = 0.10$; $M_{Q2} = 2.15$, $SD_{Q2} = 0.87$; $M_{Q3} = 1.71$, $SD_{Q3} = 0.89$).

Attitudes toward the RI, which was briefly introduced in the last section of the survey, were very positive, with a mean of 1.70 $(SD = 0.85)$, with 1 = strongly agree and 5 = strongly disagree. Participants generally perceived the index as beneficial and a high value as a better choice including in relation to price ($M_{beneficial} = 1.71$, $SD = 0.91$; $M_{choice} = 1.66$, $SD = 0.97$; $M_{price} = 1.72$, $SD = 0.94$).

4.2 REPAIRABILITY MATTERS

4.2.1 WILLINGNESS TO PAY

To examine the WTP in more detail, two new variables were calculated on the basis of the two questions on the lower and upper price limits. First, the mean value derived from the two questions was calculated, and second, the range was calculated by subtracting the lower limit from the upper limit. The range gives the possibility to test how far consumers set the upper and lower limit for the manipulated smartphone. To test the manipulation, a multivariate ANOVA was performed with all three dependent variables and the two fixed factors preference and repairability (Table 5).

The ANOVA reveals a **significant main effect of the preferred features manipulation across the three WTP dependent variables**. Accordingly, WTP high, WTP low, WTP average and WTP range is always higher in the preferred features than in the non-preferred features condition (*WTP high: M_{pref} = 776, SD_{pref} = 392 versus M = 604, SD = 432; WTP low: M_{pref} = 328, SD_{pref} = 173 versus M = 270, SD = 233; WTP average: M_{pref} = 552, SD_{pref} = 262 versus M = 437, SD = 302; WTP range: M_{pref} = 448, SD_{pref} = 305 versus M = 334, SD = 342*; Figure 4 and Figure 5). This result supports the effectiveness of the preference manipulation on the WTP.

The ANOVA also shows **marginally significant main effect of the RI manipulation on the WTP high, WTP average and WTP range**. In more detail, WTP high, WTP average and WTP range is always higher in the high RI than in the low RI condition (*WTP high: M_{high} = 746, SD_{high} = 484 versus M = 636, SD = 337; WTP average: M_{high} = 531, SD_{high} = 338 versus M = 459, SD = 221; WTP range: M_{high} = 430, SD_{high} = 362 versus M = 354, SD = 286*; Figure 4 and Figure 5). This result is consistent with the established predictions and shows that RI manipulation has an important impact on the WTP.
Comparing the main effects of preference and repairability, the differences between high RI and low RI are consistently smaller than the differences between preferred and non-preferred features across WTP high, WTP average and WTP range *(WTP high: M_{RI} = 110 versus M_{pref} = 171; WTP average: M_{RI} = 72 versus M_{pref} = 115; WTP range: M_{RI} = 75 versus M_{pref} = 114).* This result suggests that the manipulation of preferred features had a greater impact on WTP than the manipulation of the RI.

Finally, the ANOVA results highlight that the main effects of preference and RI are not qualified by an interaction (Figure 4 and Figure 5). This indicates that the effect of RI is the same across both preference conditions.

In summary, **Hypothesis 1 can be supported**. There is a marginally significant effect of the RI on consumers' WTP, except for the lower price limit. Consumers are willing to pay more money for a smartphone with a high RI and less for a poor RI, **which is why Hypotheses 1-a and 1-b can be supported**. Not to be neglected is the fixed factor preference, which showed a stronger statistically significant effect than reparability for all four items of the WTP. Preference has a stronger effect on the WTP than the RI, from which it can be concluded that consumers value preferred smartphone features more than the RI.

	WTP high	WTP low	WTP average	WTP range	PQ	PI
	F	F	F	F	F	F
Pref.	8.10**	3.67*	7.69***	5.74**	18.24***	76.92***
RI	3.65*	1.45	3.36*	2.75*	3.73*	0.98
Pref. * RI	0.18	0.00	0.09	0.30	2.16	0.01

* $p < 0.07$
** $p < 0.05$
*** $p < 0.01$

Table 5: Overview Outcome ANOVA Dependent Variables

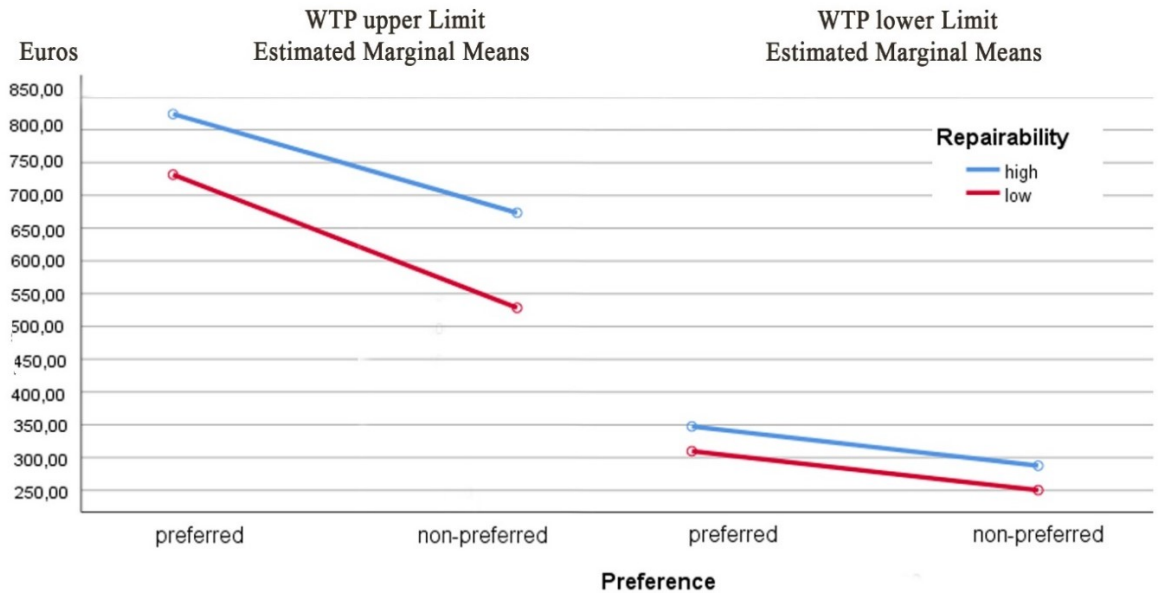

Figure 4: Upper and lower Limit WTP

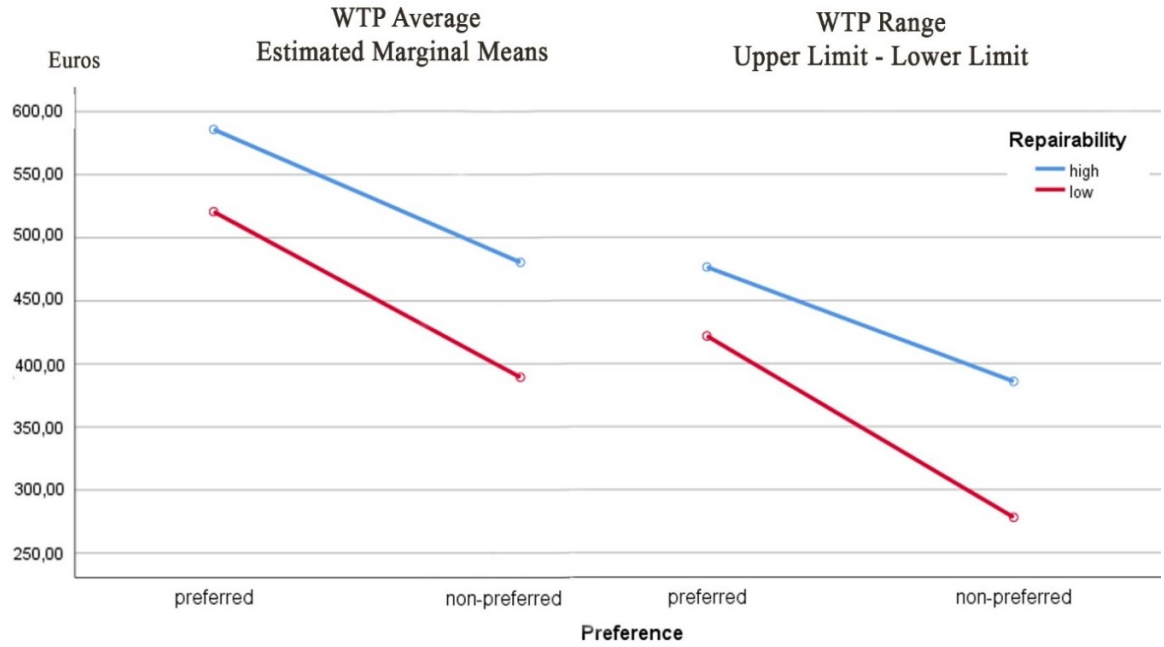

Figure 5: WTP Average and WTP Range

4.2.2 PERCEIVED QUALITY AND PURCHASE INTENTION

When examining the dependent variables PQ and PI, the ANOVA indicates a **highly significant main effect of the preferred features manipulation**. Respondents in the groups with preferred features were more likely to buy the smartphone shown and rated the overall quality of the phone higher *(PQ: M_{pref} = 1.97, SD_{pref} = 0.73 versus M = 2.51, SD = 0.10; PI: M_{pref} = 2.48, SD_{pref} = 1.00 versus M = 3.84, SD = 1.04; 1 = strongly agree to 5 = strongly disagree).*

The effect of the **RI manipulation is marginally significant for PQ and not significant for the PI variable**. Participants with a high RI perceive the smartphone to be of higher quality than the poor RI groups, which is consistent with the established theory. This supports the statement that RI is an important factor in the smartphone purchase decision process. However, no effect of RI on PI could be found (*PQ: M_{high} = 2.12, SD_{high} = 0.79, M = 2.35, SD 1.00).*
As with the variable WTP, the factor preference s is revealed to have a stronger effect on PQ than RI, as the values diverge more between the two conditions (*PQ: M_{RI} = 0.22 versus M_{pref} = 0.55*; Figure 6).

Combining the reparability and preference manipulatives, it is noticeable that the difference in PQ between the high and low RI is stronger in the groups with the non-preferred characteristics (Figure 6). Nevertheless, **the interaction of RI and preferred features is not significant for the dependent variable PQ, nor for PI**.

To test hypothesis 2-b, one item of the PQ variable (question 4) must be considered in isolation, as it concerns the interaction of perceived durability and repairability. The comparison suggests that respondents perceive the smartphone with a high RI to be more durable than a smartphone with a low RI (Figure 8). **The main effect of RI is highly significant, so that the assumption that consumers associate a good RI with higher durability can be confirmed**. (*$F(1,173)$ = 6.97, p = 0.01; M_{high} = 2.44, SD_{high} = 1.15; M = 2.87, SD = 1.20;).*

In summary, the RI influences PQ, with a high index value indicating a positive influence on perceived quality and durability, and therefore **Hypotheses 2, 2-a, and 2-b can be supported**. Since no statistically significant main effect of the RI on participants' PI was identified, it follows that **Hypothesis 3 must be rejected**.

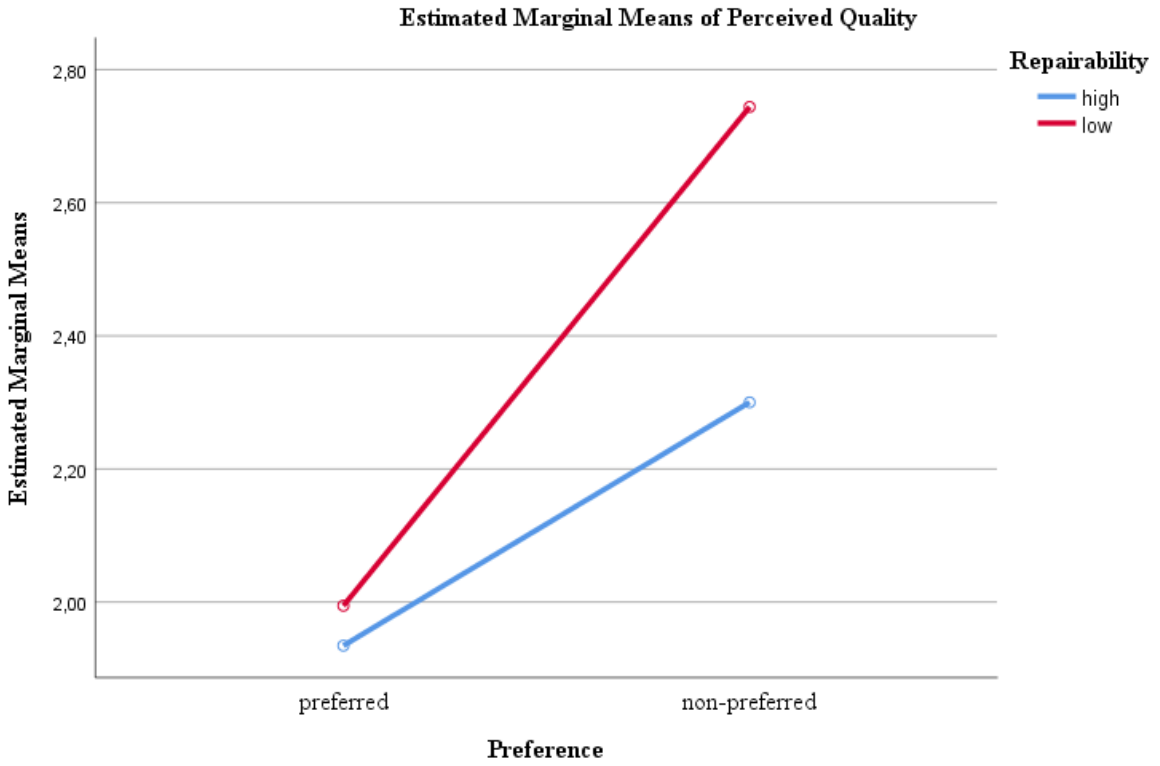

Figure 6: Perceived Quality

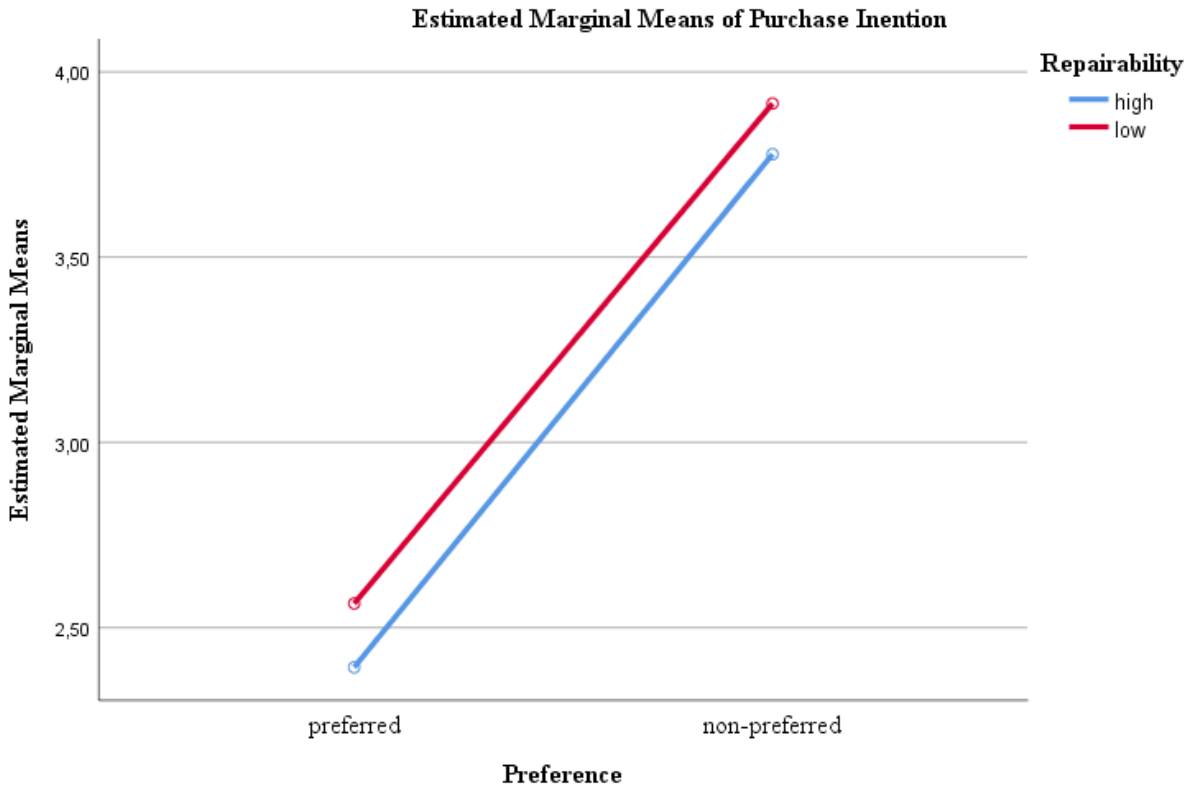

Figure 7: Purchase Intention

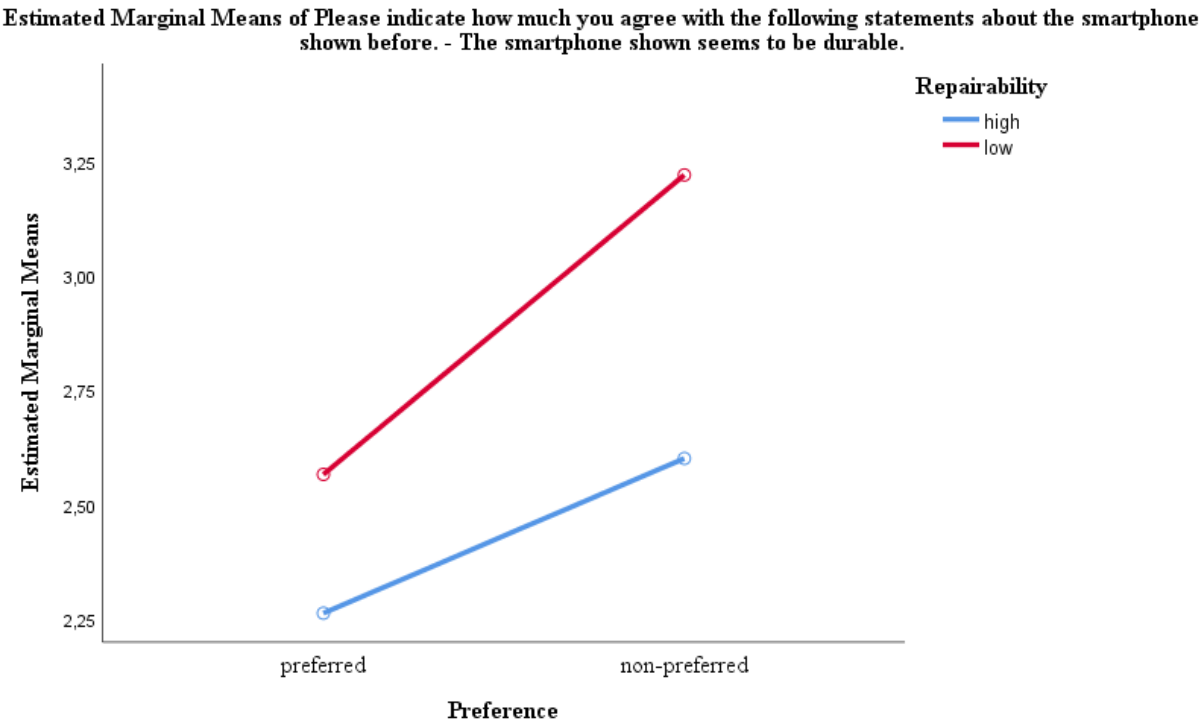

Figure 8: Perceived Durability

4.2.3 TESTING FOR THE EFFECT OF AGE AND GENDER

To test whether the dependent variables were influenced by the demographic characteristics of the participants and to see main interaction effects with the RI, age and gender were used as fixed factors in the ANOVA. To examine the influence of participants' age, the respondents in the study are subdivided into generation X (42-65 years old), Y (25-41 years old), and Z (18-24 years old). It should be noted that Generation X consists of only 15 participants and therefore the results are less representative of this age group.

The main effect of preference and RI, as well as the interaction, replicates the previous analysis and is therefore not examined further in this context. The **categorical factor of gender has no statistically significant effect for all variables tested**. However, the ANCOVA indicates that **participant age has a statistically significant effect on the price upper limit, WTP average, and WTP range** (Table 6). Specifically, the analysis reveals an overall higher price limit for Generation Z than for older participants, which thereby has an impact on the WTP range and the WTP average. It can be concluded from this that the younger generation, irrespective of the associated group in the experiment, are willing to pay a higher amount for smartphones (*Gen Z: M = 799, Gen Y: M = 631, Gen X: M = 537;* Figure 9).

Finally, the ANOVA results show that the **main effects of gender and age in combination with the RI are both not qualified by an interaction** (Table 6). This suggests that the effect of RI is the same across different age and gender groups.

Thus, although individual demographic characteristics have an influence on some dependent variables, no significant main interaction with reparability was found. **Therefore, the general Hypothesis 4, as well as 4-a and 4-b, must be rejected**.

	WTP high	WTP low	WTP average	WTP range	PQ	PI
	F	F	F	F	F	F
Gender	0.48	0.23	0.11	1.43	1.69	2.61
Gender*RI	1.24	0.18	0.93	1.34	0.01	0.01
Age	4.40**	2.03	4.22**	3.05**	0.44	0.07
Age*RI	0.62	1.28	0.94	0.22	0.56	0.14

* $p < 0.07$
** $p < 0.05$
***$p < 0.01$

Table 6: Overview of the Influence of Demography on the Dependent Variables

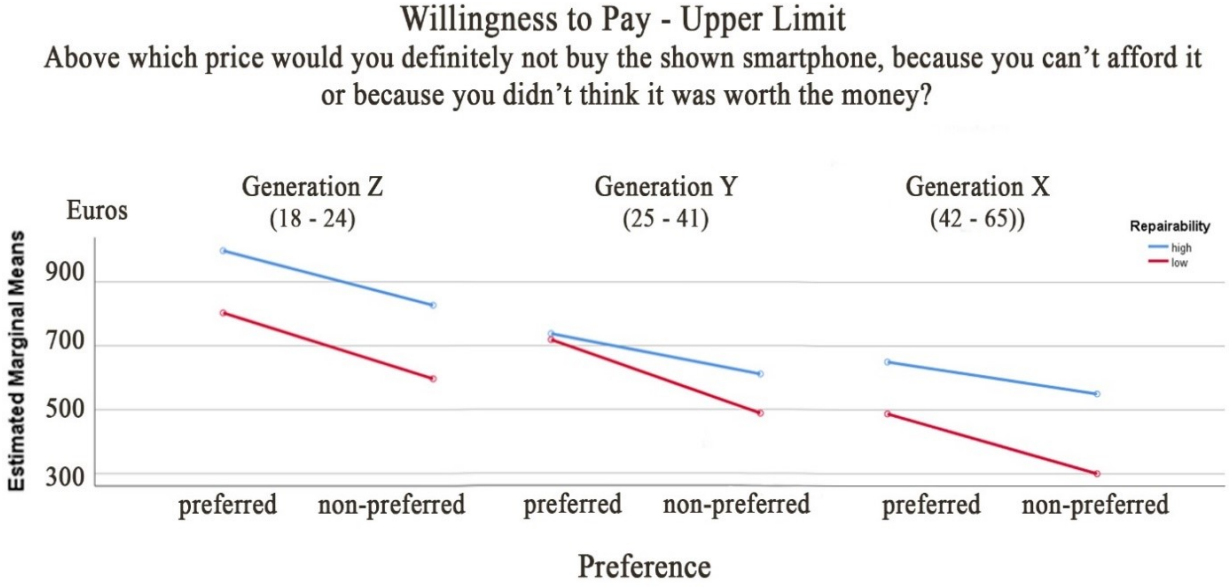

Figure 9: WTP upper Limit Generation X, Y and Z

4.3 CONTROLLING FOR COVARIATES

A one-way ANCOVA was conducted to compare the effectiveness of the RI, while controlling for attitude towards repair and environmental awareness (Table 7). These continuous variables are not an integral part of the experimental manipulation, however, to avoid possible undetected influences on the dependent variables, the covariates were to be tested. The first step was to ensure the independence of the independent variables and the covariates. Neither preference not RI manipulations have effects on environmental awareness and attitude towards repair (respectively, $F(1,174) = 1.69$, $p = 0.20$ and $F(1,174) = 0.09$, $p = 0.77$).

The ANCOVA replicates the main effect of preference on the WTP, PQ and PI dependent variables, the main effect of reparability in PQ, and the non-significant interaction of preference and RI. Additionally, the ANCOVA does not replicate the main effect on WTP high, WTP average and WTP range, most likely because the reparability manipulation has a significant interaction with the covariates.

The analysis of the covariates show that attitudes towards repair interacts with RI for the PQ. A categorical variable with 1 = “positive attitude towards repair” ($N = 121$) and 0 = “negative attitude towards repair” ($N = 27$) was recoded using one standard deviation above average and one standard deviation bellow as a criteria. The analysis of the slopes shows that the average difference in PQ between high RI and low RI is higher for the group with a positive attitude than with a negative attitude *(respectively, $M_{pos} = 0.15$ versus $M_{neg} = 0.08$).*

The ANCOVA reveals that environmental awareness interacts with RI on WTP high, WTP average, WTP range and PQ (Table 7). Similarly to that attitudes towards repair, respondents were divided into two groups, "little knowledge" ($N = 44$) and "good knowledge" ($N = 11$), using one standard deviation above average and one standard deviation bellow as a criteria. The slope analysis indicates that the average difference in WTP between high and low RI varies between the groups “no knowledge” and “high knowledge”. More precisely, for the dependent variables WTP high, WTP average, and WTP range, the effect of reparability is always bigger for participants with high knowledge than for participants without knowledge. More specifically: in the high reparability condition participants with high knowledge are willing to spend more money than participants with low knowledge; and in the low reparability condition,

participants with high knowledge are willing to spend less money than participants with low knowledge (Figure 11).

Regarding PQ, a larger difference between low and high RI is observed in the high knowledge group (Figure 14). Thus, it can be concluded that environmental awareness of problems in the smartphone industry amplifies the effect of RI on the dependent variables PQ and WTP *(WTP high: $M_{highKnow}$ = 447 versus M_{noKnow} = -93; WTP average: $M_{highKnow}$ = 388 versus M_{noKnow} = -47; WTP range: $M_{highKnow}$ = 118 versus M_{noKnow} = -92; PQ: $M_{highKnow}$ = 0.73 versus M_{noKnow} = -0.40, Figure 10-13*).

	WTP high	WTP low	WTP average	WTP range	PQ	PI
	F	F	F	F	F	F
Pref	7.81*	3.58*	7.44***	5.51**	18.19***	78.44***
RI	3.31	1.12	2.93	1.12	5.33**	0.63
Pref*RI	0.14	0.00	0.07	0.25	2.10	0.00
Atti. Repair*RI	2.85	2.12	3.11	1.46	4.16**	2.13
Envr. Awar.*RI	6.13**	2.88	5.86**	4.33**	4.28**	0.61

* p < 0.7
** p < 0.05
***p < 0.01

Table 7: Outcome Covariates Attitude towards Repair and Environmental Awareness

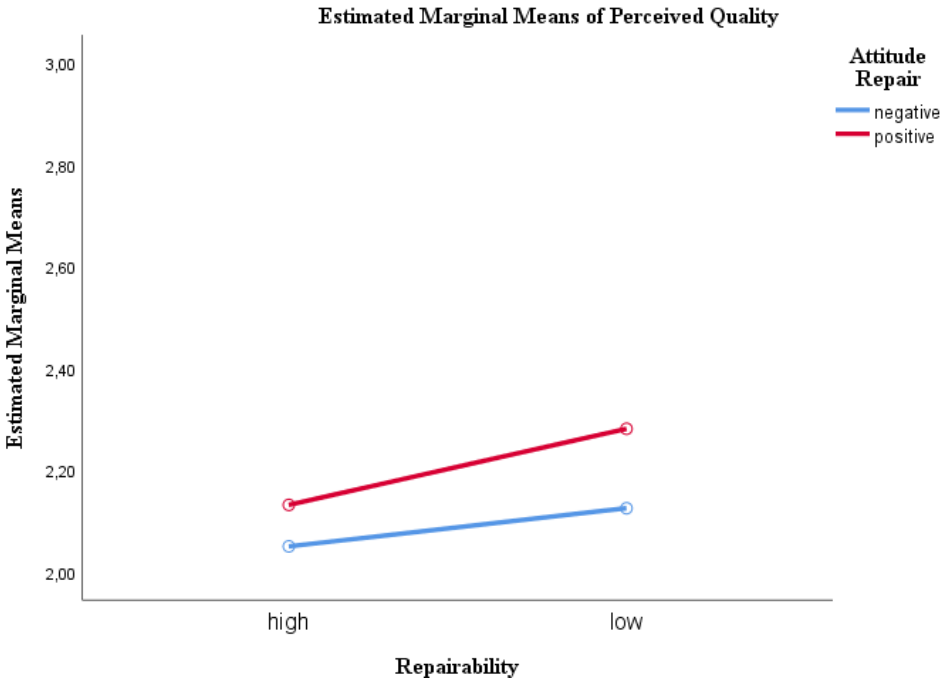

*Figure 10: Perceived Quality * recoded Attitude towards Repair*

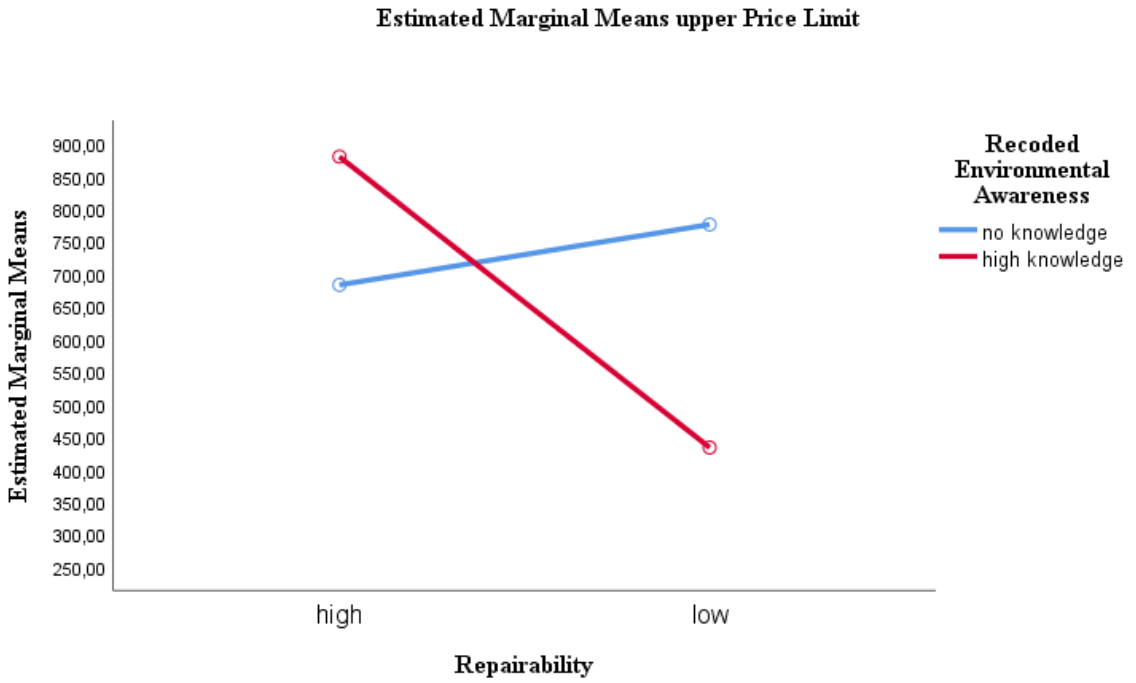

*Figure 11: WTP high * recoded Environmental Awareness*

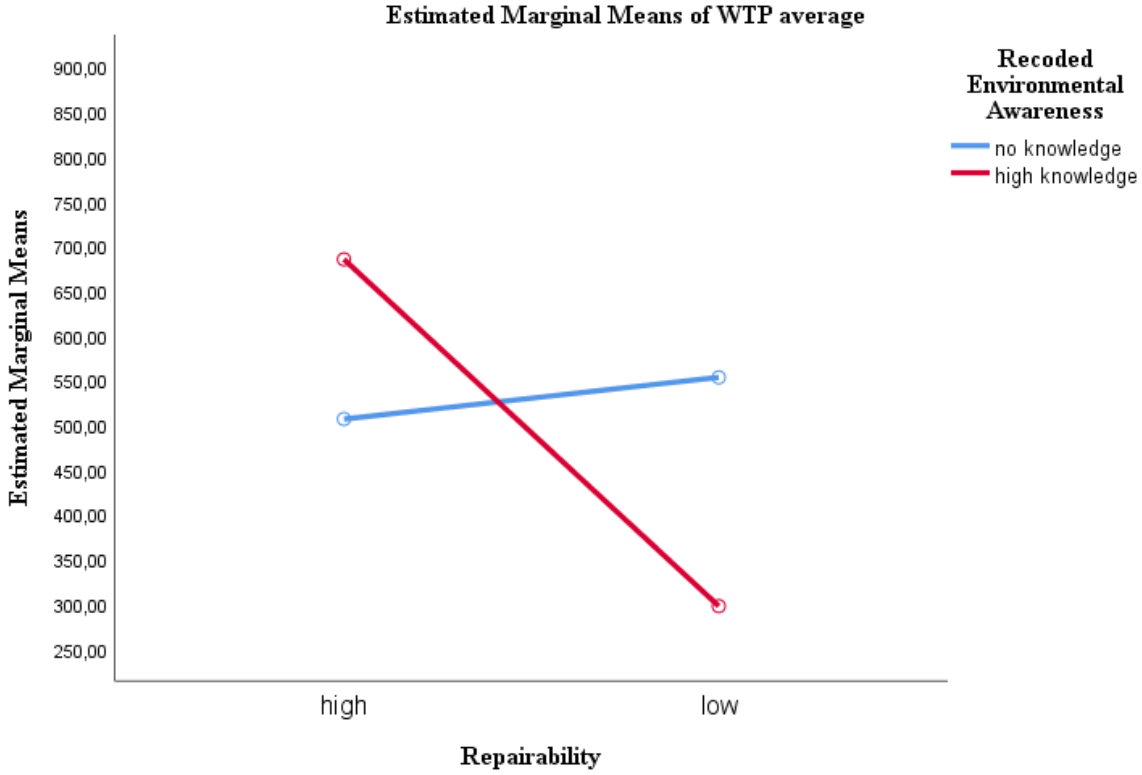

*Figure 12: WTP average * recoded Environmental Awareness*

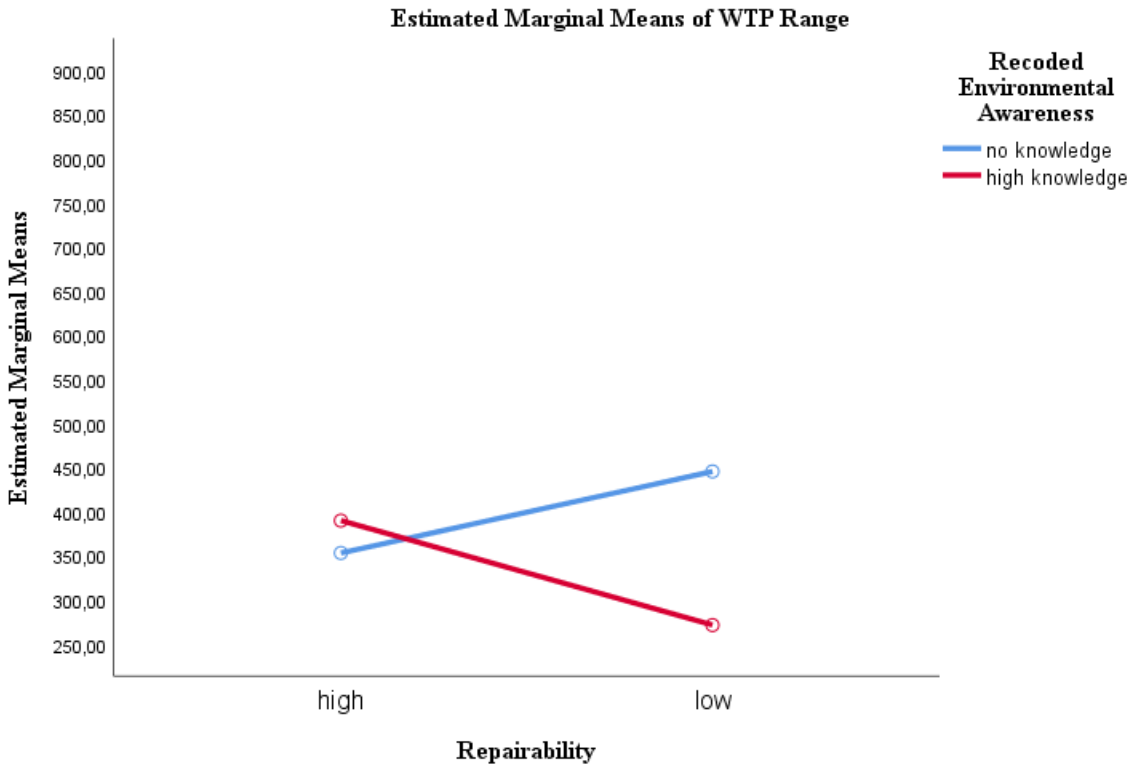

*Figure 13: WTP Range * recoded Environmental Awareness*

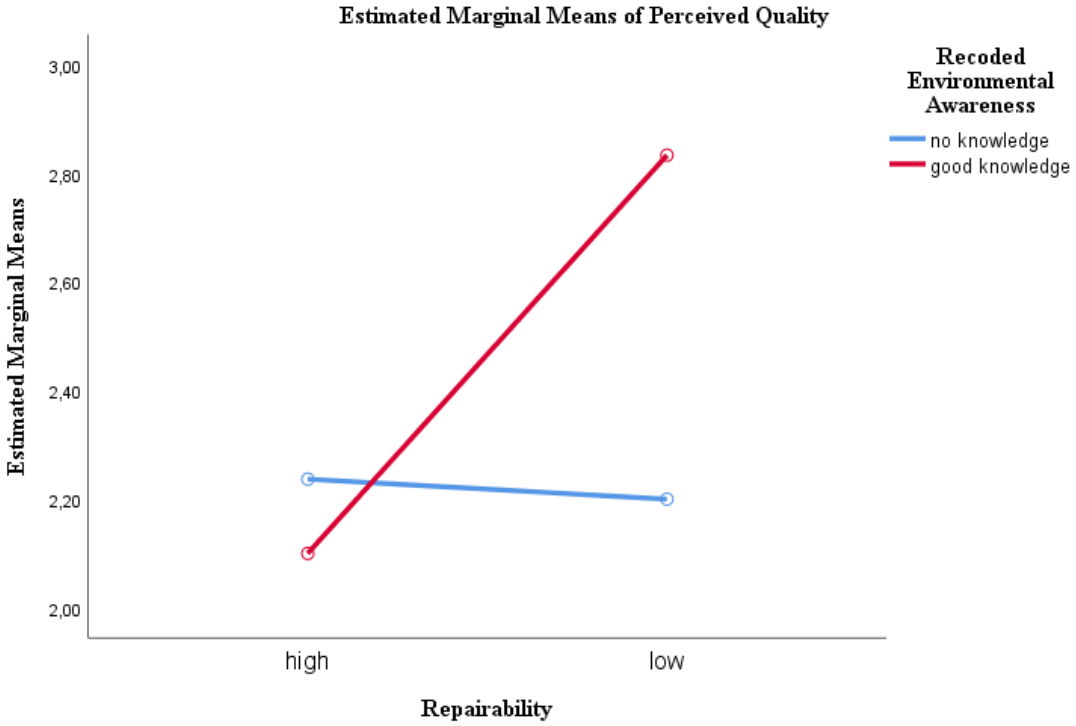

*Figure 14: PQ * recoded Environmental Awareness*

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CHAPTER 5: DISCUSSION

After detailed analysis of the collected results, this section will gather the main insights that can be derived from the findings. Furthermore, managerial implications and limitations that leave room for further research will be presented.

5.1 MAIN FINDINGS AND CONCLUSIONS

Invest in Repairability.

The experimental study demonstrated that repairability, and thus the RI introduced in France, matters. The mostly unknown RI generated attention and was perceived by consumers even with a short memorization time. Although the effect is statistically small, the RI reveals an effect in terms of WTP and PQ. In general, the concept behind the RI was very positively received and considered beneficial by study participants.

Participants of the study were willing to pay a higher amount for the smartphone if the ad displayed a good RI compared to when it had a poor index value. A good repair value produces positive effects on the maximum consumers are willing to spend, but no significant effect on the minimum. The lack of effect on the lower price limit may be caused by the fact that consumers are generally very price sensitive when it comes to smartphones (Thokchom, 2012). Customers deliberately accept low prices and therefore do not expect high standards, such as good repairability.

The overall WTP was higher for a smartphone with a good RI than with a bad one. The range of WTP, the difference between upper and lower limits, is also larger with a high index value. This indicates that consumers are less critical of the price of a device with a good repair score than with a poor RI.

With regard to PQ, the RI also exhibited its influence in the experimental study. A high repairability value has a positive influence on the quality perceived by the consumer. The same applies to the perceived durability of a device. The quality and durability of smartphones were frequently mentioned in the in-depth interviews of the preliminary study. This highlights the importance of these two factors, the perception of which can be improved through good RI.

Do not neglect preferred features.

The preferred features condition had a significant impact on all dependent variables, suggesting that the individual features identified in the preliminary qualitative study were highly relevant

to customers in terms of PI, PQ, and WTP. In this regard, customers attributed higher importance to the preferred characteristics than to the RI, as indicated by the significantly larger difference in WTP and PQ. In addition, preference, unlike repairability, had an effect on PI. The data suggests that the information about brand, camera quality, operating system, battery capacity and size is crucial for customers when buying a smartphone and therefore should not be neglected as its importance is salient.

No interaction effect was found between reparability and preferred features for any of the dependent variables. This indicates that the RI should be considered as an additional feature and not as an individual condition. Accordingly, a high RI would be a preferred feature that is highly relevant, particularly with regard to PQ and WTP, and can positively influence these variables in the purchase decision process.

Sociodemographic data without any influence on the effect of the RI.

Demographics had no influence on the effect size of the RI. The assumption that one gender or a certain age group is particularly susceptible to the index could not be confirmed. However, participant's age did have an effect on the overall WTP. Younger participants (18-24 years) were willing to spend a higher amount on the smartphone and had a higher price tolerance. This may be attributed to the high value that smartphones have in the lives of Generation Z (Salleh, Mahbob & Baharudin, 2017).

The contemporary culture of environmental awareness makes reparability even more important.

Attitude toward repair exhibited a moderating effect in interaction with RI on the dependent variable PQ. A positive attitude toward smartphone repair amplified the effect of RI, resulting in a high index value leading to improved PQ.

The data suggest that the effect of repairability on consumer behavior is stronger for individuals with high environmental awareness. With sound knowledge of environmental issues, consumers have a higher WTP for a smartphone with a high RI. In contrast, the effect of RI was shown to disappear or reverse for consumers without knowledge. In terms of PQ, the effect size of RI was also larger for participants with high knowledge. This suggests that educating consumers about e-waste, obsolescence, and repairability in conjunction with RI can be an effective communication tool to achieve higher WTP and improve PQ.

5.2 MANAGERIAL IMPLICATIONS

The RI has been an integral part of the purchase of electrical appliances in France since January 1st, 2021. As part of a new anti-waste legislation, the index is intended to provide consumers with a quick overview of the repairability of an appliance. Due to the topicality of the subject, no studies on the effect of the RI are known, which makes this experimental study highly relevant. A Europe-wide implementation of the RI is not entirely unlikely given the Right to Repair Directive introduced by the European Parliament last year (European Commission, 2019). This would force manufacturers to disclose the repairability of their electronic devices, which will be poor for most suppliers due to non-existent and expensive spare parts (Hentschel & Timkanicova, 2020). Therefore, it is imperative for managers to understand the dynamics and impact of the index on consumers.

The insights on consumers' WTP in conjunction with the RI are valuable insights and can help to optimize pricing strategies (Balderjahn, 2003). This is especially important for managers, as price is classified as a major factor in smartphone purchases (Thokchom, 2012). Based on the findings, by creating a higher RI, manufacturers can not only contribute to a more conscious use and consumption of electronic devices, but also use it in the communication to increase profits. The long life cycle of a smartphone should not be seen by manufacturers as a loss of revenue, but rather as an opportunity to gain competitive advantages that lead to better PQ and a higher WTP. This study showed that environmental awareness can enhance the effect of the index on WTP and PQ. This can be used to address consumers through education and targeted communication. The manufacturer Fairphone is a pioneer in this field, cleverly using the RI for communication around electronic waste and revealing its own product benefits (Fairphone, 2021).

5.3 LIMITATIONS AND FURTHER RESEARCH

The experimental study faced some limitations, which are presented in the following section. Based on this, recommendations for further research are presented.

Despite efforts to achieve a diversified sample group, a large proportion of participants are of the same nationality and in the same age group. One solution would be to repeat the study with a larger and more diversified sample group. Additionally, repeating the study after one year with only French respondents would be interesting, since the index was introduced there at the

beginning of the year and is rather unknown. The results of a long-term study could examine changes in attitudes and the impact of the RI on purchasing behavior.

At the current state, the RI initiative covers smartphones, laptops, televisions, washing machines, and lawn mowers, with the option to expand to other product categories in the future. This experimental study focused only smartphone devices. A further study could evaluate the effectiveness of the RI on other device types to be able to develop a holistic statement about the effect on the consumer.

The investigated covariates attitude towards repair and environmental awareness showed partially significant results, whereupon these effects were further investigated. However, limited validity was found, particularly for the scales of the covariates themselves. By implementing different scales that achieve higher validity, interaction effects can be examined in more detail to gain a deeper understanding of the moderating effect.

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APPENDICES

APPENDIX 1: QUALITATIVE INTERVIEW STRUCTURE

1. Introduction

- Welcoming
- Consent to the recording and use of data under anonymized and confidential conditions.
- Ensuring that there are no right or wrong answers, all opinions are relevant
- Please be honest and tell the truth

2. Warm-up

- Ask the participant to introduce themselves
    - Name
    - Age
    - Occupation
    - Nationality
    - Marital status

3. Current Smartphone

- Please name the brand, model and date of purchase of your current smartphone
- Thinking about your current Smartphone, please name three (or more) attributes you like about it - and explain why?
- Thinking about your current Smartphone, please name three (or more) attributes you dislike about it - and explain why?

4. Purchasing Behavior

- Imagine your cell phone breaks down what would you do and how would you proceed? Please tell all steps as detailed as possible.
    - What would you find most important if you were to buy a smartphone now? What functions/ features/ attributes would the smartphone have to have?
    - Do they have a brand in mind? Why?
    - Do they have a special model in mind?
    - Price sensitive?
    - Influence from peers or social environment?
- If your mobile phone broke, would you consider repairing it? Would you contact the manufacturer, or would you go to a third party? Please give reasons.

- Can you remember any smartphone advertisement? Print, Online, TV commercial, Banner? Please describe the ad. What do you remember about it?

5. CSR

- In your daily life, do you generally pay attention to the social and environmental commitment of companies when buying products? Please give concrete examples and give reasons.
- Where do you get your information that influences you here?
- What issues (ethnical, environmental) are you aware of that particularly affect the **smartphone industry**? Where do you get your information from?
- Does the knowledge you have just mentioned change your behavior? What action results from it?

APPENDIX 2: EXPERIMENT SURVEY STRUCTURE

Intro

Dear Participant,
Thank you for taking part in this survey.
The survey is part of my master thesis at Católica Lisbon SBE and will take approximately four minutes. Please answer the questions as truthfully as possible. Your participation is anonymous and data will be used for research purposes only.
If you have any questions regarding the study, feel free to contact me:
ricarda.reischl@gmx.de

Thank you for your support! Ricarda Reischl

Socio-Demographics

Q1: What is your gender?

- ○ Male
- ○ Female
- ○ Non-binary / third gender
- ○ Prefer not to say

Q2 What is your age?

_____

Skip To: End of Survey If Condition: What is your age? Is Greater Than 65. Skip To: End of Survey.; Is Less Than 18. Skip To: End of Survey.

Q3 What is your nationality?

_____

Q4 What is your average net income per month?

_____

Experiment - Preferences

When you think about your phone, what are your preferences? Please choose one of the given options for each of the following questions.

Q5 What is your preferred operating system?

- ○ iOS (Apple operative system; works only with iPhones)
- ○ Android (generic operative system; works with different brands)

Q6 Which screen size do you prefer for your smartphone?

- ○ small to medium screen size
- ○ medium to big screen size

Experiment

On the following page you will be shown an advertisement for a smartphone.
Please look at it carefully and read all the given information.
You can move to the next page only after 15 seconds.

Clicking on is only allowed after 15 seconds. Measurement of the time until clicking on.

➔ *Participants are randomly assigned to one of the four possible groups (condition repairability + condition preference). For the preferred features, the previously individually queried ones are used for individual assignment.*

Example Group 1 (high RI + preferred features (small screen, iOS)

Example Group 2 (low RI + non-preferred features (big screen, iOS)

Example Group 3 (high RI + non-preferred features (small screen, Android)

Example Group 4 (low RI + preferred features (big screen, Android)

Experiment – Dependent Variables

Q7 Above which price would you definitely not buy the shown smartphone, because you can't afford it or because you didn't think it was worth the money?

_____

Q8 Below which price would you say you would not buy the shown smartphone because you would start to suspect the quality?

_____

Q9 Please indicate how much you agree with the following statements about the smartphone shown before.

	Strongly agree (1)	Somewhat agree (2)	Neither agree nor disagree (3)	Somewhat disagree (4)	Strongly disagree (5)
The likely quality of the smartphone shown would be extremely high. (1)	○	○	○	○	○
The probability that the smartphone shown will work properly is very high. (2)	○	○	○	○	○
The likelihood that the smartphone shown is reliable is very high. (3)	○	○	○	○	○
The smartphone shown seems to be durable. (4)	○	○	○	○	○

Q10 Please indicate how much you agree with the following statements about the smartphone shown before.

	Strongly agree (1)	Somewhat agree (2)	Neither agree nor disagree (3)	Somewhat disagree (4)	Strongly disagree (5)
I would purchase this Smartphone. (Purchase Intention_1)	○	○	○	○	○
The probability that I would consider buying the Smartphone is low. (Purchase Intention_2)	○	○	○	○	○

Experiment – Attention Test

Q11 Provided Information Please select all the information that was shown to you in the smartphone advertisement before (multiple selection possible).

- ☐ Camera
- ☐ Screen Resolution
- ☐ Memory Size
- ☐ Phone Size
- ☐ Battery Capacity
- ☐ Loudspeaker
- ☐ CPU (Processor)
- ☐ SIM Card
- ☐ Repairability Index
- ☐ Brand
- ☐ Fingerprint Sensor
- ☐ Operating System

→ *Depending on the assigned group, a red or green Repairability Index icon appears*

Recall Repairability Index
This repairability icon was shown to you in the smartphone advertisement before.

Group 1 & 3

Group 2 & 4

Q12 What value was represented in the icon? Please select the correct number.

▼ 1 ... 9,5

Attitude, Awareness and Consumer Behavior

Q13 What is the average lifespan of your smartphone?

- ○ Less than a year
- ○ One year
- ○ Two years
- ○ Three years
- ○ Four years
- ○ More than four years

Q14 What is the reason for replacing your mobile phone?

- ○ Outdated style
- ○ Outdated function
- ○ Damage
- ○ Other _____

Q15 For me, repairing my smartphone when it's broken would be:

	1	2	3	4	
Useless	○	○	○	○	Beneficial
Unpleasant	○	○	○	○	Pleasant
Expensive	○	○	○	○	Cheap

Q16 Please indicate the extent to which you are knowledgeable about the following topics in the smartphone industry.

	Not known (1)	Little known (2)	Known (3)	Well known (4)
Do you know that waste mobile phone contain toxic and hazardous substances, such as lead, mercury, or arsenic? (1)	○	○	○	○
Do you know of any initiatives that have addressed the issue of electronic waste? (2)	○	○	○	○
Do you know about government regulations facilitating the repair of electrical appliances? (3)	○	○	○	○

Attitude towards the RI

France has introduced a new index that provides consumers with clearer information about the repairability of electronic devices.
The aim of the index is to encourage consumers to choose more repairable products and manufacturers to improve the repairability o f their products through easier accessibility and better prices for spare parts.

Q17 Please indicate the extent to which you agree with the following statements about the Reparability Index.

	Strongly agree (1)	Somewhat agree (2)	Neither agree nor disagree (3)	Somewhat disagree (4)	Strongly disagree (5)
Considering price, I would prefer Smartphones with a high Repairability Index. (1)	○	○	○	○	○
The Repairability Index is generally beneficial to the consumer. (2)	○	○	○	○	○
In general, buying smartphones with a high Repairability Index is a better choice. (3)	○	○	○	○	○