

Article

The Endowment Effect in the Circular Economy: Do Broken Products Face Less of a Trading Barrier Than Intact or Repaired Ones?

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Abstract: Repairers may play a substantial role in the shift from a linear (make, use, dispose) to a more circular economy, where resources are continually reused and waste is minimized, which is therefore by definition more sustainable. Repaired defective products are usually reused by their owners or may be traded in a second-hand market. A barrier commonly associated with trading is the endowment effect, which is caused by the difference between the maximum amount buyers are willing to pay for a product and the minimum amount sellers are willing to accept for a product. The present study examined whether second-hand market exchanges face an endowment effect, including in situations where the products are broken and repairers are recruited to repair possible defects in the product. An online survey that randomly assigns participants to one of eight experimental conditions (four product types × two buyer/seller statuses) was used for this study. The results show significant endowment effects for intact products and defective products with a repairer involved, but not for defective products. Furthermore, endowment effects occur for different product types. This suggests that sellers may be reluctant to sell their products in terms of the value that buyers would want to pay for them when repairers are easily accessible, which may impede transactions from taking place. The transaction of broken products may be facilitated by designing a system whereby sellers sell broken products to repairers and buyers buy repaired products from repairers.

Keywords: circular economy; endowment effect; second-hand market; repairs



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1. Introduction

In the current transition from a linear economy (make, use, and dispose) to a more circular economy, resources are continually reused to minimize waste. Circular economies are, by definition, more sustainable than linear economic systems [1]. Defective products and repair services are essential aspects of circular models because repairing extends the product's life, which helps reduce the pressure that waste has on the environment (<https://www.europarl.europa.eu/thinktank/infographics/circulareconomy/public/index.html> accessed on 11 July 2023). Repairing comes in many forms, but in this paper, we focus on individual repairers, often locally organized in repair movement communities. The extant product transaction literature typically deals with intact products [2]. Very little is known about transaction dynamics when defective second-hand products are involved, either with or without easy access to repair services. This paper fills that gap in the literature and, in this way, aims to contribute to our understanding of the transition from linear to circular economies and possible barriers. Removing the barriers will be essential to increasing the sustainability of the economic system.

To tackle this question, we zoom in on how buyers and sellers value a second-hand product, which is linked to the endowment effect. The endowment effect is the tendency for people who own a good (potential sellers) to value it more than people who do not (potential buyers) [3,4]. This difference in valuation between buyers and sellers may cause a reluctance to trade and, therefore, give rise to market inefficiencies [5].

1.1. The Endowment Effect

Even though research on its causes and underlying cognitive and neural processes is still ongoing, the endowment effect is empirically well established [5]. Kahneman and Tversky [6] explained the endowment effect in the context of prospect theory, whereby buyers first evaluate the potential change in a situation as either a gain or a loss, and that changes that are framed as losses are weighed more heavily than changes that are framed as gains. In effect, sellers who view selling an object as a loss place a higher value on the object than buyers who see buying an object as a gain. In particular, one behavioral process that is believed to cause an endowment effect in the market is loss aversion. This account comes into play on the seller's side because when an individual owns an object, forgoing that object feels like a loss. The negative experience of losing is believed to exceed the pleasure experienced by acquiring the same object [6]. However, other studies have argued that the endowment effect is mainly caused by ownership but not loss aversion [7]. For instance, it has been argued that product ownership creates an association between the item and the self, and this possession-self link increases the value of the product [8]. In addition, psychological ownership of objects has been shown to increase the value owners place on them [9,10]. Also, Park and Armstrong [3] found that consumers with a high sense of ownership perceive engaging in utility-based non-ownership collaborative consumption for apparel to be risky.

The psychological law of inertia, which indicates that neither buyers nor sellers have a precise valuation of the object for sale, has also been used to substantiate the endowment effect. It is argued that, in every transaction, there is a range of prices over which neither buyers nor sellers have much incentive to trade. A classic example is in Kahneman et al.'s [11] paper, where sellers demanded about USD 7 to part with their mug and buyers were only willing to pay approximately USD 3 to acquire the mug. This created a range of prices between USD 3 and USD 7 where there was no incentive for buyers and sellers to trade, creating a situation whereby buyers and sellers maintained the status quo.

The presence of an endowment effect has also been explained by the fact that buyers and sellers focus on different aspects of the product in a transaction. According to Nayakankuppam and Mishra [12], the endowment effect can be attributed to the characteristics of the product used to determine the price by buyers and sellers. They argue that buyers are more focused on the negative characteristics of the products, whereas sellers are more fixated on the positive characteristics of the products, thus resulting in sellers having more negative reactions toward losing the product and buyers feeling reluctant to lose money to gain a product they feel has more negative characteristics than sellers (A few more concepts have been used to explain the endowment effect in trade [5]). This gap is called "attribute sampling bias" [12].

The second-hand market has been gaining importance and is even booming with the advent of the internet, the development of peer-to-peer e-commerce platforms like Amazon, the proliferation of social networks like Facebook groups [2], and the growing focus on the circular economy. Most behavioral research into second-hand consumption has focused on identifying the underlying motivations of second-hand buyers [13–15] and barriers to the purchase of second-hand products [16]. Examples of these buyer motivations are critical motivations (e.g., distancing from the dominant linear economic system), economic motivations (e.g., search for a low price), hedonic/recreational motivations (e.g., treasure hunting), the uniqueness of the product, and how fashionable the product is. Nevertheless, next to the motivations of buyers, second-hand sellers' potential reluctance to trade because

of the endowment effect should be considered if we want to understand the behavioral dynamics of second-hand markets.

In addition, while the endowment effect and its economic impact are well established in the literature, more research must be conducted to verify this phenomenon in the context of to-be-repaired products in the second-hand market. The scant research conducted in the second-hand market is also limited to identifying the interactions between buyers and sellers, with an implicit focus on intact (non-defective) products. For example, preliminary evidence suggests there is no endowment effect when people transact secondhand goods [17]. However, such results may not be all that relevant when we take the transition to a circular economic system seriously because products in second-hand markets often contain deficiencies and thus require the services of repairers. Buying and selling of to-be-repaired second-hand goods abound (e.g., the used car market often involves repairs), and the involvement of a repairer may have a significant impact on willingness-to-pay and willingness-to-accept discrepancies.

1.2. The Present Study

The present study aims to investigate the endowment effect in the second-hand market when the product under consideration is defective and when there is or is not an opportunity to involve a repairer to fix it. Specifically, four different kinds of second-hand exchange situations were explored in this study, covering four different product state categories. These include products that are not defective (i.e., baseline), defective products, and defective products when a repairer is either recruited by the buyer or the seller. In a first step to go beyond one specific product category, we considered four diverse products because the endowment effect has been shown to vary across entitlements (products, time, and safety) and items [18–20].

The attribute sampling bias predicts that because the attributes of a good are most accessible to owners, the magnitude of the endowment effect would increase as the positive attributes of a good increased in extremity [5]. On the other hand, owners put lower values on goods that have predominantly negative attributes (e.g., parking tickets) [21–23]. Since defective products signal negative attributes, we expect that the value sellers will place on defective products will be lower compared to when the products are not defective. Thus, we expect that:

H1: *The difference in valuation between sellers and buyers (the endowment effect) is higher for intact products than for defective products.*

As described above, the psychological processes causing the endowment effect may emerge again when a repairer is available to repair the defective product. The availability of a repairer could be on the side of the seller or the buyer, but we do not see clear reasons to expect systematic differences due to this factor. In effect, we hypothesize that:

H2: *The availability of a repairer (either on the side of the seller or the buyer) will result in a difference in the valuation between sellers and buyers (the endowment effect) compared to no difference in the situation where the product is defective.*

2. Materials and Methods

2.1. Design

We used the established valuation paradigm to investigate whether second-hand market exchanges face an endowment effect, including in situations where the products are defective and where there is the possibility of recruiting repairers to repair possible defects in the product. This was conducted by using an online survey experiment that randomly assigned participants to 8 different experimental conditions, which consist of 4 product conditions and 2 conditions of either being a buyer or a seller. The four product conditions were: The baseline products (second-hand products that are not defective); defective products; defective products with a repairer employed by the buyer; or defective

products with a repairer employed by the seller. In addition, four different products were also used (mugs, figurines, chairs, and speakers) to generalize the results of the study. The valuation paradigm was preferred in this study because it explicitly distinguishes the valuation of products by buyers and sellers, whereas the exchange paradigm does not. Experimental designs to investigate the endowment effect are usually based on one of two types of paradigms: an exchange paradigm or a valuation paradigm [5,24]. In the exchange paradigm, participants who are randomly endowed with one of two goods are more reluctant to exchange it for the other good than would be expected by chance [25]. In the valuation paradigm, the maximum amount of money that buyers are willing to pay to acquire the good (i.e., Willingness To Pay, or WTP) is lower than the minimum amount of money that sellers of the good are willing to accept to relinquish it (i.e., Willingness To Accept, or WTA), creating a WTP–WTA gap [5,11,26].

2.2. Participants

The participants for this study were drawn from the United States and recruited via the Amazon Technical Turk platform. Possible workers see the opportunities and freely agree to join or not. Participants were paid a participation fee of \$1.80 after the completion of the study. Based on the main endowment effect in the classic valuation paradigm, we determined the number of people needed to detect an effect of this size in the baseline condition. A power analysis was thus performed using prior literature measuring the endowment effect by using G*Power [27] to establish how many participants were needed for the survey. A total of 458 participants were needed for the analysis. In effect, 458 participants were contacted to fill out the online survey used for the study, of which about 36 responses had to be removed because no valid valuation could be drawn for at least one of the products, resulting in a dataset of 422 participants. Table 1 represents the distribution of participants in each of the 8 experimental conditions (4 product conditions \times 2, either a buyer or a seller) obtained from the 422 valid responses. The lowest number of participants in an experimental condition was 45, and the highest number was 59, indicating that the dataset was slightly unbalanced for an unknown reason.

Table 1. Distribution of participants into buyer-seller condition by product conditions.

Buyer_Seller Condition	Product Condition				Total
	Baseline	Defective	Defective, Repairer with Buyer	Defective, Repairer with Seller	
Seller	52	47	45	49	193
Buyer	57	56	57	59	229

The average age of the participants was 36.9 years, with male participants slightly overrepresented (59% of the participants). About 58% of the respondents indicated that they have a university degree or a higher degree; 23% are in the university; and the remaining 19% stated that their highest level of education is secondary education. In terms of the annual level of income, the majority of the respondents (42%) reported that their annual income is between USD 30,000 and USD 60,000; 21% reported that their annual income is between USD 60,000 and USD 90,000; 17% reported that their annual income is more than USD 90,000; and about 19% of the participants also stated that their annual income is less than USD 30,000. About 1% of the participants preferred not to state their annual level of income.

2.3. Procedure

2.3.1. Endowment Effect Measurement

Each participant read hypothetical scenarios, as is frequently conducted in endowment effect studies [28,29]. The scenarios were explicitly tailored to the experimental group the participant belonged to (see Appendix A for more details). Each participant read

four different scenarios, depicting four different products: “a mug with the logo of the city you are currently living in”—if defective with a broken off ear; “an outdoor plastic chair”—if defective with a broken off leg; “an authentic figurine”—if defective with a broken off arm; and “a home speaker”—if defective with a broken off power cable. These products were all included to ensure that the effects found generalize to different products. The products were presented to the participants randomly to alleviate the order effect. A pretest with 50 participants from the same participant pool was conducted before the main study to determine acceptable price ranges for our products.

After reading each scenario, participants were asked to choose a valuation for the product they read about using a yes/no format answer sheet depicting a list of several possible—increasing—valuations. A list of valuations is a response method that has been regularly used (e.g., Kahneman, Knetsch, and Thaler [11]) and is sometimes referred to as a “multiple price list” [30]. This study’s valuation was conducted in a two-step multiple price list procedure analogous to Brebner and Sonnemans [30]. Participants were first presented with an answering sheet containing a list of broader product valuation categories. Secondly, they were presented with an answering sheet that contained more detailed product valuations based on their choices from the first sheet. The second list was given based on the switch from yes to no (buyers) or no to yes (sellers) in the first list when going down the list of amounts in increasing order. When participants behaved inconsistently in step 1 by switching more than once, the second sheet was given based on the first switching point on the first sheet. In the original Brebner and Sonnemans [30] study, participants saw both lists on the same screen, whereas in our study, the lists were shown after each other. Also, their computer program did not allow for multiple switches, but ours did, leading to the constructed set of rules associated with multiple switches.

The values included in the lists were calculated based on the short pretest before the main experiment. In the pretest, participants answered open-ended questions about how much they thought each of the four products (i.e., the city mug, outdoor plastic chair, authentic figurine, and home speaker) were worth (see Appendix A). The deciles of the gathered values were calculated, and for each product, the 10% decile was taken as the lowest value and the 90% as the highest. In order to have a broad list of values that participants can choose from in step 1, the values were turned into a list of 11 values using the deciles. In addition, to obtain a detailed valuation of the products, the second step had a list of nine values between the values of the first list (see Appendix A for an example). Furthermore, values below (above) the minimum (maximum) value of step 1 were added in case there was no switch in step 1. The ultimate valuations that were drawn from this procedure were, for buyers, the highest price they would want to pay to buy the product in step 2, and for sellers, the lowest price they would want to accept for the product in step 2. When participants switched multiple times in step 2, the mean of the highest and lowest values chosen was taken as the valuation. Participants that did not follow the expected switch pattern in step 1 (i.e., buyers that switched from no to yes or sellers that switched from yes to no) did not get a second list. When that happens, those participants cannot draw a valid valuation and are, thus, dropped from the analyses.

2.3.2. Measurement of Control Variables

The existing literature identifies three general dimensions of second-hand shoppers’ motivations: economic motivations, critical motivations (like environmental concerns), and hedonic/recreational motivations developed through experience [15,31]. Also, the need for uniqueness, the fashionable nature of second-hand products, and respondents’ experiences with the second-hand markets have been identified as factors that influence second-hand shopping motivations, which can influence the valuation of second-hand products by buyers [14,15,32]. In effect, as control checks, we measured these variables and investigated their effects on the endowment effect in the second-hand market.

In particular, participants’ second-hand shopping motivations were measured with Guiot and Roux’s [15] second-hand shopping motivations scale on 24 statements

(1 = strongly disagree, 5 = strongly agree). The answers can be divided into three subscales, which reflect one's critical motivations (i.e., negative attitudes towards the regular consumption system, also including ethical and environmental concerns), economic motivations (i.e., enjoying low prices and looking for fair prices), and hedonic/recreational motivations (i.e., "treasure hunting"; enjoying original products and/or nostalgic ones) associated with shopping second-hand. A Cronbach's alpha of 0.83, 0.82, and 0.92 indicated that the three measures of motivation have high internal consistency.

In addition, the participants' need for uniqueness scale from Snyder and Fromkin [32] of eight statements was measured (1 = strongly disagree; 7 = strongly agree), with a Cronbach's alpha of 0.65, suggesting that the internal validity of this measurement is quite questionable in our sample. The fashionable nature of second-hand products was also measured [14] (1 = strongly disagree; 7 = strongly agree). Finally, based on Guiot and Roux [15], the frequency of different types of products that were ever bought second-hand was questioned: "How often did you buy used products in the following product categories? (1 = never; 5 = more than ten times), with twenty product categories (including cars, books, records/cassettes/CDs/DVDs, furniture, collectables, decorative household items, knick-knacks, crockery/glassware, children's clothing, adult clothing, jewelry, video games, children's games and toys, cell phones, TVs, hi-fi, bikes, video-game consoles, computers, and printers) included in the survey. This question was used as a proxy to measure respondents' experience in the second-hand market. The Cronbach's alpha of 0.92 shows the high internal consistency of all the 20 second-hand products considered. In effect, scoring was conducted by adding each Likert-scale point answer and dividing it by 20 to get a measure of experience with buying different products second-hand, with 1 representing not ever buying a second-hand product. Only 8% of the respondents reported that they needed to gain experience buying second-hand products.

3. Results

3.1. The Endowment Effect and Defective Products, with or without a Repairer

In order to obtain valuations that are comparable across the four different product types, we transformed the valuations of the four different product types into standardized z-scores. Then we used the average of the z-scores in the analysis to neutralize the intrinsic value differences between products. Next, we performed four standard normal tests of equality of means to investigate whether there are differences in the amount of money buyers are willing to pay for the products and the amount sellers are willing to accept to let go of the product (see Figure 1). For the baseline (non-defective) products, the average product value (in z-scores) was significantly higher for sellers than for buyers ($|t| = 3.17$; $p = 0.002$). This result was comparable when a repairer was involved. More specifically, defective products with a repairer involved in repairing them for the buyer received a significantly higher valuation by the sellers than by the buyers ($|t| = 3.46$; $p < 0.001$). Similarly, product valuations for defective products with a repairer involved in repairing them for the seller were significantly higher for sellers than for buyers ($|t| = 4.07$; $p < 0.001$). However, the results showed that, even though sellers value their defective products more than what buyers are willing to offer, this difference was not significant ($|t| = 1.28$; $p = 0.204$). This result is consistent with the first hypothesis, which states that sellers significantly value non-defective second-hand products more than buyers, whereas, in contrast, there is no such endowment effect when considering second-hand defective products.

We test the specific hypothesis with an interaction contrast where we zoom in on intact and defective products only (see Table 2). The results revealed a highly significant effect of being either a buyer or seller ($M_{buyer} = -0.109$, $SD = 0.77$, $M_{seller} = 0.231$, $SD = 0.88$; $F(1208) = 10.42$, $p < 0.001$) and the condition of the product ($M_{non-defective} = 0.452$, $SD = 0.80$, $M_{defective} = -0.376$, $SD = 0.65$; $F(1208) = 71.06$, $p < 0.001$) on the valuation of the products. However, we observed an insignificant interaction between being either a buyer or a seller and the product condition (non-defective versus defective) on the valuation of the products ($F(1208) = 2.28$; $p = 0.132$).

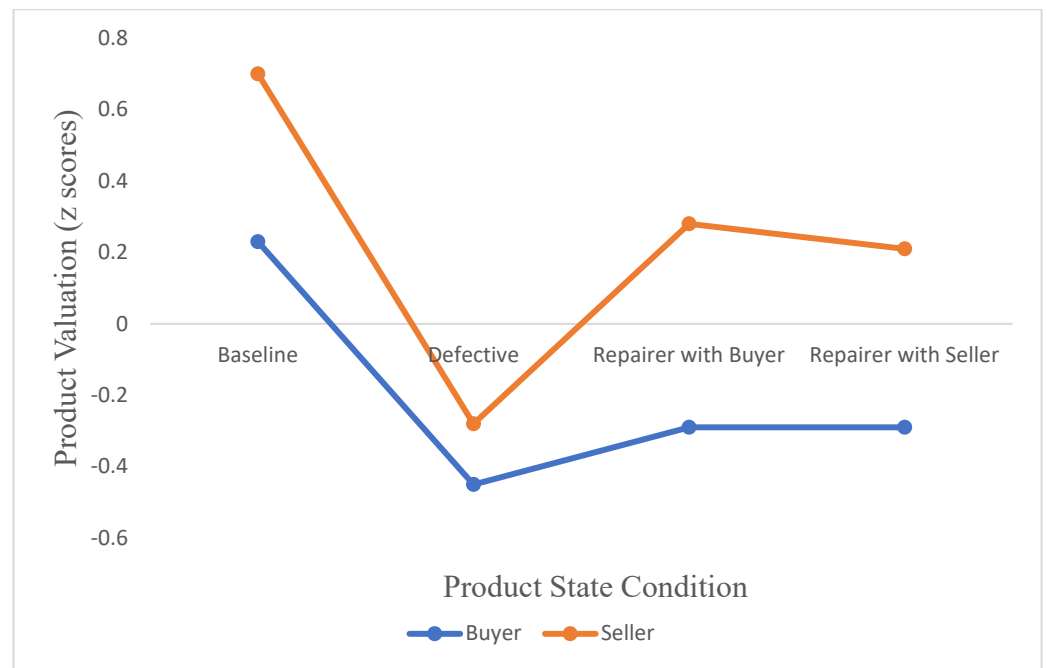


Figure 1. Product valuations are in terms of mean z-scores.

Table 2. ANOVA results of the interaction contrast between buyer–seller condition and product condition.

Buyer_Seller Condition		Buyer-Seller Condition	Product Condition	Interaction between Buyer-Seller Condition and Product Condition
Baseline and Defective	F	10.42	71.06	2.28
	<i>p</i> -value	0.001	0.000	0.132
Baseline and Defective with repairer involved with Buyer	F	22.80	18.20	0.24
	<i>p</i> -value	0.000	0.000	0.627
Baseline and Defective with repairer involved with Seller	F	25.44	27.26	0.04
	<i>p</i> -value	0.000	0.000	0.847
Defective and Defective with repairer involved with Buyer	F	13.06	12.70	3.87
	<i>p</i> -value	0.000	0.001	0.051
Defective and Defective with repairer involved with Seller	F	14.32	13.58	3.55
	<i>p</i> -value	0.000	0.000	0.061
Defective with repairer involved with Buyer and Defective and Defective with repairer involved with Seller	F	28.68	0.119	0.118
	<i>p</i> -value	0.000	0.730	0.732

In order to test the second hypothesis, two interaction contrasts were also performed with two two-way independent ANOVA designs, one zooming in on defective versus defective products to be repaired by the buyer and one zooming in on defective versus defective products to be repaired by the seller (see Table 1 and Figure 2). The results revealed a highly significant effect of being either a buyer or seller ($M_{buyer} = -0.371$, $SD = 0.63$, $M_{seller} = -0.006$, $SD = 0.88$; $F(1201) = 12.58$, $p < 0.001$) and the condition of the product ($M_{defective} = -0.376$, $SD = 0.65$, $M_{defective\ products\ to\ be\ repaired\ by\ the\ buyer} = -0.036$, $SD = 0.85$; $F(1201) = 11.43$, $p < 0.001$) on the valuation of the products.

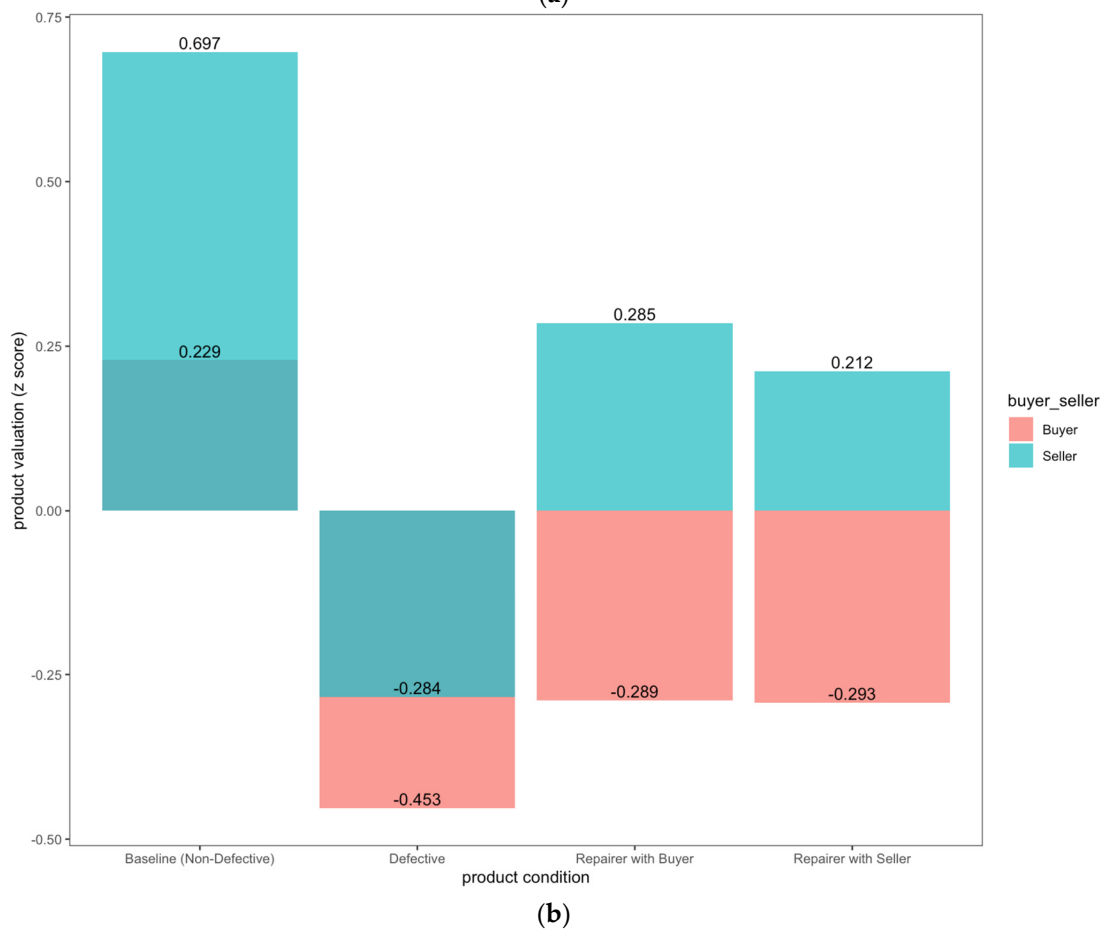
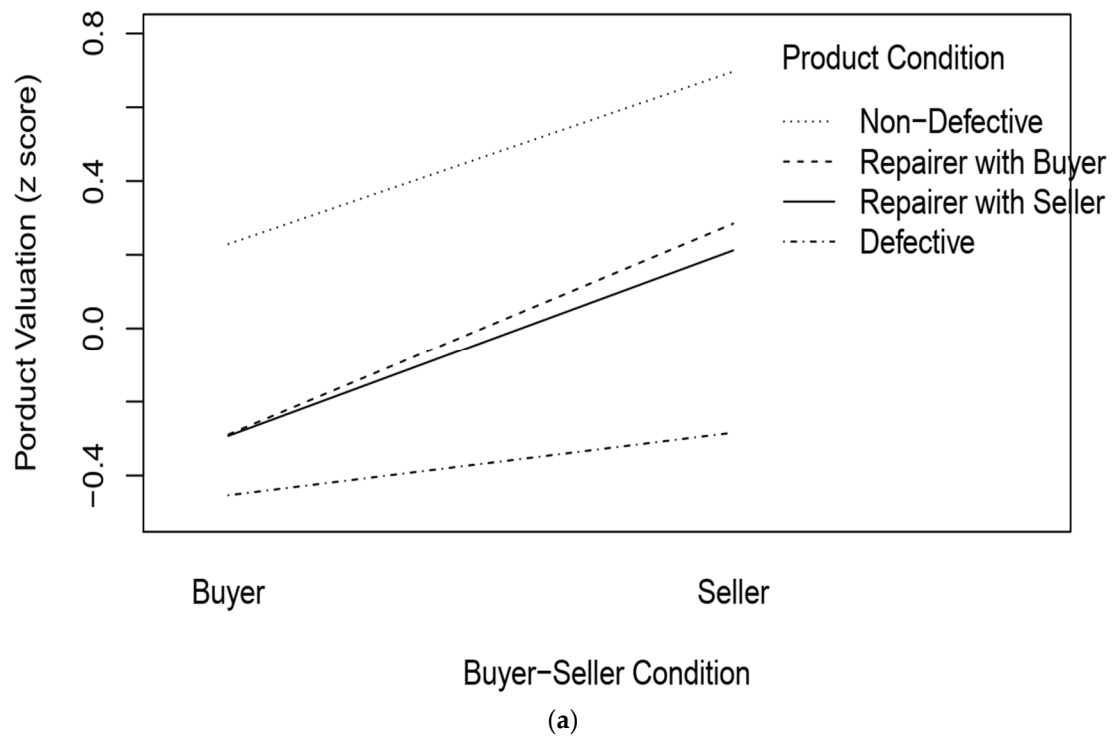


Figure 2. (a) The interaction effect of being a buyer or seller and the product condition. (b) Valuation of buyers and sellers per product condition.

More importantly, we observed a marginally significant interaction between being either a buyer or a seller and the product condition (defective versus defective products

to be repaired by the buyer) on the valuation of the products ($F(1201) = 3.87; p = 0.051$). In addition, the results revealed a highly significant effect of being either a buyer or seller ($M_{buyer} = -0.371, SD = 0.59, M_{seller} = -0.031, SD = 0.75; F(1207) = 14.59, p < 0.001$) and the condition of the product (defective versus defective products to be repaired by the seller) ($M_{defective} = -0.376, SD = 0.65, M_{defective\ products\ to\ be\ repaired\ by\ the\ seller} = -0.064, SD = 0.68; F(1207) = 12.46, p < 0.001$) on the valuation of the products.

We also observed a marginally significant interaction between being either a buyer or a seller and the product condition on the valuation of the products ($F(1207) = 3.55; p = 0.061$). This implies that there is no significant endowment effect when buyers and sellers value defective products. However, once there is an opportunity for the product to be repaired, sellers significantly value the product more than buyers, irrespective of who is recruiting the repairer. This set of findings supports the idea that the endowment effect for second-hand defective products reappears once there is the possibility for the product to be repaired.

For completeness, we tested the interaction contrast by zooming in on both conditions with defective products and a repairer involved. The results again revealed a significant effect of either being a seller or a buyer ($M_{buyer} = -0.371, SD = 0.63, M_{seller} = -0.006, SD = 0.88; F(1206) = 28.68, p < 0.001$), but no condition of product effect ($F(1206) = 0.12, p = 0.730$), on the valuation of the products. Moreover, we also observed an insignificant interaction between either being a buyer or a seller and the condition of the product (defective products to be repaired by the buyer versus defective products to be repaired by the seller) ($F(1206) = 0.12, p = 0.732$). This result implies that whoever recruits the repairer does not significantly impact the valuation of the products by the buyers and sellers.

3.2. Robustness Checks

As a form of robustness check, we also investigated whether an endowment effect existed for each product separately and for the different product states (see Table 3). A Mann–Whitney test was used to compare the differences in values buyers and sellers placed on each of the four products for the four different product states because the variables were not normally distributed. In the non-defective (baseline) product condition, we observed a highly significant endowment effect for figurines ($|z| = 3.35; p < 0.001$), speakers ($|z| = 2.65; p < 0.01$), and chairs ($|z| = 2.21; p < 0.05$).

In addition, the results show that sellers marginally significantly value non-defective mugs higher than buyers ($|z| = 1.74; p = 0.082$). However, these endowment effects for non-defective products vanish when the products are in a defective state. In particular, the results showed no significant endowment effect when the products are defective for all products except figurines, which had a significant endowment effect at a 5% significant level ($|z| = 2.02; p = 0.044$). The endowment effect reappears when the defective products are repaired by the repairer, either employed by the buyer or the seller (see Table 3).

The results revealed that sellers significantly value second-hand products more than buyers, thereby replicating the endowment effect. The results also show that once the products are defective, their value reduces drastically for both buyers and sellers, with sellers reducing their value even more than buyers, making the endowment effect insignificant. However, when buyers and sellers realize there is a possibility for the product to be repaired, they increase their product valuation, with sellers having a higher valuation irrespective of who bears the cost of the repairs. In other words, the endowment effect reappears when there is an opportunity for the defective product to be repaired by a repairer.

3.3. Explorative Analyses

A two-way ANOVA was run on the four subsamples of product conditions to examine the effect of demographics on how buyers and sellers value these products using the standardized values. The results show that age, gender, level of education, and income had

no significant effect on how buyers and sellers value non-defective and defective products (see Table 4). However, respondents' education level and their age had a marginally significant positive effect on how buyers and sellers value defective products to be repaired by buyers and defective products to be repaired by sellers, respectively. The respondent's income was also found to significantly affect how buyers and sellers value defective products that the buyer would have to bear the cost of repair ($F = 1.32$; $p = 0.016$).

Table 3. Descriptive statistics concerning production valuation by buyers and sellers.

	Buyer	Seller	Z	p-Value
	Baseline			
Mug	3.20 (2.36)	4.18 (2.92)	−1.74	0.0817
Chair	9.69 (6.20)	11.82 (5.60)	−2.21	0.0274
Figurine	25.12 (23.08)	40.14 (23.54)	−3.35	0.0008
Speaker	58.05 (43.83)	74.93 (45.77)	−2.65	0.0080
Obs.	57	52		
	Defective			
Mug	1.60 (1.88)	2.41 (2.80)	−1.49	0.1355
Chair	5.23 (3.75)	5.47 (4.42)	−1.00	0.3166
Figurine	10.94 (13.09)	14.41 (13.81)	−2.02	0.0439
Speaker	30.61 (29.05)	37.81 (44.48)	−0.68	0.4986
Obs.	56	47		
	Defective with repairer involved with Buyer			
Mug	2.12 (2.36)	3.59 (3.28)	−2.45	0.0143
Chair	6.25 (4.85)	9.14 (6.16)	−3.10	0.0020
Figurine	12.7 (15.39)	28.6 (21.94)	−4.17	<0.0001
Speaker	38.9 (36.87)	58.58 (47.39)	−2.48	0.0133
Obs.	57	45		
	Defective with repairer involved with Seller			
Mug	2.37 (2.56)	3.58 (2.68)	−2.95	0.0032
Chair	6.80 (3.88)	9.39 (5.35)	−2.89	0.0039
Figurine	14.34 (15.64)	23.87 (20.33)	−3.10	0.0020
Speaker	26.82 (28.75)	54.11 (39.93)	−4.40	<0.0001
Obs.	59	49		

Table 4. ANOVA results of interaction contrast between buyer–seller condition and demographics.

		Baseline		Defective		Defective with Repairer Involved with Buyer		Defective with Repairer Involved with Seller	
		F	<i>p</i> -Value	F	<i>p</i> -Value	F	<i>p</i> -Value	F	<i>p</i> -Value
Gender	Buyer Seller	9.64	0.0024	2.04	0.1567	13.23	0.0004	17.15	0.0001
	Gender	0.30	0.5842	0.61	0.5429	0.32	0.7261	0.35	0.5552
	BS#Gender	0.07	0.7908	0.01	0.9223	1.69	0.1966	0.45	0.5041
Education	Buyer Seller	10.91	0.0013	1.39	0.2420	3.51	0.0639	9.20	0.0031
	Education	0.22	0.8042	0.18	0.8341	2.40	0.0960	1.55	0.2162
	BS#Education	1.21	0.3016	0.63	0.5329	2.92	0.0586	1.72	0.1839
Income	Buyer Seller	6.62	0.0118	0.83	0.3652	20.55	0.0000	13.59	0.0004
	Income	0.98	0.4704	0.83	0.6111	1.41	0.1842	1.76	0.0807
	BS#Income	0.40	0.9431	0.60	0.7925	1.32	0.0158	0.77	0.6616
Age	Buyer Seller	10.06	0.0225	0.63	0.4326	10.28	0.0023	18.07	0.0001
	Age	1.88	0.0193	0.81	0.7511	0.96	0.5436	1.52	0.0847
	BS#Age	1.06	0.4142	1.08	0.3969	0.57	0.8897	1.62	0.0942

Participants' second-hand market experience, their perception of how fashionable second-hand products are, and their perception of the uniqueness of second-hand products, as well as their motivation for patronizing second-hand markets, were also analyzed to investigate whether these traits affect endowment effects in each of the product conditions (see Table 5).

Table 5. ANOVA results of the interaction contrast between buyer–seller condition and second-hand shopping experience.

		Baseline		Defective		Defective with Repairer Involved with Buyer		Defective with Repairer Involved with Seller	
		F	<i>p</i> -Value	F	<i>p</i> -Value	F	<i>p</i> -Value	F	<i>p</i> -Value
Fashion	Buyer Seller	2.94	0.0894	0.10	0.7514	10.91	0.0014	12.02	0.0008
	Fashion	2.33	0.0382	0.40	0.8776	2.71	0.0182	1.38	0.2311
	BS#Fashion	1.29	0.2706	1.28	0.2799	7.01	0.0000	0.54	0.7729
Uniqueness	Buyer Seller	0.00	0.9614	0.10	0.7490	7.98	0.0058	7.50	0.0073
	Uniqueness	5.72	0.0012	2.54	0.0610	3.64	0.0085	2.88	0.0397
	BS#Unique	5.25	0.0021	0.78	0.5107	0.70	0.5520	0.54	0.6587
Product Experience	Buyer Seller	2.73	0.1016	0.01	0.9320	1.90	0.1717	5.77	0.0182
	Experience	0.49	0.7421	1.16	0.3334	0.68	0.6051	0.14	0.9653
	BS#Exp.	3.66	0.008	3.05	0.0206	2.09	0.0889	0.07	0.9775
Critical Motivation	Buyer Seller	2.33	0.1304	3.23	0.0754	17.11	0.0001	9.35	0.0029
	Critical Motivation	1.01	0.4086	1.56	0.1926	3.90	0.0057	2.79	0.0303
	BS#Critical	1.54	0.1951	1.42	0.2338	2.68	0.0362	0.74	0.5640
Hedonic Motivation	Buyer Seller	0.71	0.4007	1.06	0.3056	4.33	0.0402	4.45	0.0374
	Hedonic Motivation	2.38	0.0565	2.68	0.0361	5.44	0.0006	0.85	0.4992
	BS#Hedonic	1.32	0.2663	1.46	0.2315	0.61	0.6586	0.25	0.9102
Economic Motivation	Buyer Seller	5.17	0.0251	0.09	0.7612	1.27	0.2630	2.73	0.1015
	Economic Motivation	2.20	0.0744	0.59	0.6231	0.71	0.5884	2.23	0.0712
	BS#Economic	0.25	0.8607	0.53	0.6634	0.72	0.5416	0.49	0.7447

Participants' experience with second-hand products was found to significantly affect how buyers and sellers value the products in all conditions, except when a repairer is employed by the seller when the product is defective. In particular, sellers in the second-hand market who have more experience with how the second-hand market works place a higher value on second-hand products than buyers who have more experience in the second-hand market. The critical motivation of participants in patronizing second-hand products and respondents' perception of how fashionable second-hand products are were also found to have significant interaction with how buyers and sellers value defective products when a repairer is employed by the buyer, with the seller placing a higher value on the product than the buyer.

4. Discussion

4.1. Main Findings

This research explored the endowment effect in second-hand market situations for defective goods. Our results reveal that the endowment effect depends on the state of the traded product. A strong endowment effect was replicated for used but intact products, which contradicts the results by Da Silva et al. [17]. This endowment effect, however, disappears when the product is defective. Furthermore, we show that the endowment effect reappears once a repairer is recruited, irrespective of who the buyer or seller is. This suggests that, within repair communities, sellers may be reluctant to sell their products in terms of the value buyers would want to pay for them, which may impede transactions. We did several robustness tests and verified several control variables, but in addition to a few main effects, the general pattern that constitutes the main contribution of this work remained in place.

As expected (hypothesis 1), the endowment effect largely disappears in the case of defective products. The defective state may instantaneously reduce the value to the owner, as proposed by the attribute sampling bias [12]. In particular, sellers who know the negative attributes of the defective product may reduce their valuation. Intuitively, for most products, the user value of such products is close to zero because they do not function anymore. Objectively, however, the difference between a music box with a cord and a broken cord is only the fixing of the cord. The buyer may evaluate this difference better, which may reduce the discrepancy between the willingness to accept and the willingness to pay. The fact that the emergence of a repairer in the picture erases this suppression of the endowment effect (hypothesis 2) is consistent with such an account, with the figurine being an exception. Moreover, the fact that the figurine, whose primary function is sentimental, does not show this pattern is consistent with this account because the figurine may keep its sentimental value to the seller even when broken, leading to a persistently higher WTA [3,8,24]. Further research is called for to explore the nature of the lost utility (and the impact of the defect on it) for the WTA.

4.2. Practical, Environmental, and Economic Implications

From a broader environmental and sustainability perspective, understanding the conditions under which consumers start valuing defective (repaired) products enables us to design ways to curb polluting behavior more efficiently and reduce waste pressure on the environment. This is because one method of avoiding the purchase of single-use products is to extend the lifespan of products through maintenance and repairs [33]. As a result, for environmental policymakers, we provide an additional psychological explanation that can help extend the product's life cycle by changing behaviors. In particular, to design effective consumer policies, the factors shaping consumer behavior must be adequately understood so that those policies may be implemented successfully [34]. This was the goal of our research. For instance, our findings suggest that the trading barriers may be diminished by inviting sellers of broken products directly to be the repairer's trading partner rather than the end user (buyer). In this case, the product is defective during the transaction, which may result in a lower valuation by the sellers than when they exchange repaired products

with the buyers, effectively removing the trading barrier and hence stimulating the influx of broken products back into the market.

Our findings are also relevant for companies working with defective and repaired products. Seeking to increase the valuation of defective products, sellers and buyers should consider cooperating with repairers. In addition, when marketing such defective products, communication messages highlighting the fact that reparation is performed or guaranteed can increase the value of the original product. Overall, our research signals that understanding the behavioral motivations behind the value of defective and repaired products has the potential to help with the transition from a linear economy to a more circular economy.

4.3. Theoretical Contributions

The endowment effect is a well-established phenomenon in the behavioral sciences, having been replicated dozens of times in different situations [11,25] (perhaps one from above [17]). Our findings add an aspect that has hitherto not been studied, probably also because the economic literature has traditionally been more interested in linear processes (selling by producers or owners and buying by consumers) than in circular processes (which involve reusing and repairing broken products). The endowment effect is very relevant in the transition to a circular economy because it reflects a trading barrier. Our findings provide a first view of what happens to this robust phenomenon when the product is broken and to what extent the presence of repairers plays a mitigating role. Our findings point to a couple of open questions. One remarkable finding that calls for further research is that the presence of a repairer kind of erases the effect of the product defect as far as the endowment effect is concerned. This is not good news for the transition because it suggests that the trading barrier (endowment effect) is easily reestablished, attesting to its robustness. Further research may be needed to find out how this easy reestablishment could be suppressed and, hence, how the influx of defect products on the repair market may be stimulated.

Another implication of our findings is that the patterns that we observed are remarkably robust across a varied product set. Although a broken figurine and a plastic chair have very little in common, the pattern is similar. Yet there are some differences. For the figurine, the endowment effect seems to be more robust, even in the face of damage, so the question arises as to why that is and how this effect may block the return of raw material to the market. As suggested above, it may be the emotional attachment that keeps the selling value artificially high, but the difference may also follow from the fact that artwork comes with a different notion of functionality. A figurine with a broken arm is not as dysfunctional as a chair with a broken leg or a radio with a broken cord. The latter simply do not function anymore. Further research is needed to elaborate on these relevant questions.

4.4. Limitations

This study has several limitations. First of all, the stated prices were hypothetical. This is common practice in this literature [22,35,36], and it seems not to have a significant impact on the endowment effect [36], but we are not sure if the suppressive role of a defect would be insensitive to real transactions. Further research is needed to address this question. Furthermore, our design did not consider the possibility that owners might value defective products lower than zero (i.e., more concretely, that they would pay to get rid of them) due to the negative attribute of being defective. If so, this would entail not only the disappearance of the endowment effect but even a reversal [21–23]. However, this would only undermine our key finding of defectiveness, with the repairer lowering the commonly induced transaction barrier. On the contrary, such a reversed endowment effect could stimulate transactions in circular second-hand markets.

In addition, we only relied on American participants, who are not necessarily representative of traders in other parts of the world. A final limitation pertains to the specific products we used: the results seem robust across our four quite different product categories,

but the finding that the endowment effect is still present for broken figurines suggests that there may be moderators. We speculate that defective figurines may still have some sentimental value to the sellers, but this needs further research.

5. Conclusions

The present study examined whether second-hand market exchanges face an endowment effect, including in situations where the products are broken and repairers are recruited to repair possible defects in the product. This was conducted by using experimental methods through an online survey that randomly assigned participants to one of eight different experimental conditions, which consisted of four product conditions and two conditions of either being a buyer or a seller. The four product conditions used include: baseline products (non-defective second-hand products), defective products, defective products with a repairer employed by the buyer, and defective products with a repairer employed by the seller. In addition, because the endowment effect has been shown to vary across entitlements (products, time, and safety) and items, we considered four diverse products (mugs, figurines, chairs, and speakers). Therefore, each participant read four different scenarios depicting the four different products.

The results show significant endowment effects for non-defective products. This was not the case for defective products, as the results show no significant endowment effect for defective products. However, the market for defective products with a repairer involved, irrespective of who bears the cost of repairs, exhibited a significant endowment effect. This endowment effect in the market for defective products that can be repaired was mainly caused by the significant increase in the valuation of the products by sellers compared to the market for defective products. For instance, once sellers notice that defective products can be repaired, irrespective of who bears the cost of the repairs (buyers or sellers), they increase the valuation of their product significantly, while buyers only increase their valuation of the products by a small margin, creating a significant trade barrier in this market. In effect, transactions in the second-hand market can be facilitated by designing a system whereby sellers deal with repairers. In this case, the seller sells a defective product at a lower valuation to the repairer, and the buyer buys a repaired product from the repairer at a slightly higher valuation than the value they place on defective products.

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

Appendix A

Appendix A.1. Pretest

Hi there, thanks for your interest in this short consumer behavior study.

The purpose of this study is to have an idea of average consumer evaluations for certain types of products. Therefore, this study consists of short product evaluation questions, which will appear right after you click on the arrow.

Thank you very much for your participation!

- Please indicate what amount of money you would be willing to pay for a mug on which the logo of the city you are currently living in is printed: [text box]
- Please indicate what amount of money you would be willing to pay for an outdoor plastic chair: [text box]
- Please indicate what amount of money you would be willing to pay for an authentic figurine: [text box]
- Please indicate what amount of money you would be willing to pay for a home speaker: [text box]

Appendix A.2. Scenarios

In the following survey, please imagine what you would do in real life, and choose your answers accordingly. More precisely, first, imagine that you are in the particular situation depicted in the text. Second, for each statement, indicate if you would buy [sell] the product or not at the particular price depicted in the statement.

- Buyer and Baseline products
 - Imagine that someone owns a mug on which the logo of the city you are currently living in is printed. The owner is willing to sell it to you. What amount of money would you be willing to pay for it?
 - Imagine that someone owns an outdoor plastic chair on his or her terrace. The owner is willing to sell it to you. What amount of money would you be willing to pay for it?
 - Imagine that someone owns an authentic figurine. The owner is willing to sell it to you. What amount of money would you be willing to pay for it?
 - Imagine that someone owns a home speaker. The owner is willing to sell it to you. What amount of money would you be willing to pay for it?
- Buyer and Defective products
 - Imagine that someone owns a mug on which the logo of the city you are currently living in is printed. However, its ear has broken off. The owner is willing to sell it to you. What amount of money would you be willing to pay for it?
 - Imagine that someone owns an outdoor plastic chair on his or her terrace. However, one of its legs has broken off. The owner is willing to sell it to you. What amount of money would you be willing to pay for it?
 - Imagine that someone owns an authentic figurine. However, its arm has broken off. The owner is willing to sell it to you. What amount of money would you be willing to pay for it?
 - Imagine that someone owns a home speaker in his or her current living space. However, its cable has broken off. The owner is willing to sell it to you. What amount of money would you be willing to pay for it?
- Buyer and Defective products but with a maker repairing for the seller
 - Imagine that someone owns a mug on which the logo of the city you are currently living in is printed. Its ear had broken off, but a handyman (m/f/x) the owner knew repaired it. The owner is willing to sell it to you. What amount of money would you be willing to pay for it?
 - Imagine that someone owns an outdoor plastic chair on his or her terrace. One of its legs had broken off, but a handyman (m/f/x) the owner knew repaired it. The owner is willing to sell it to you. What amount of money would you be willing to pay for it?

- Imagine that someone owns an authentic figurine. One of its arms had broken off, but a handyman (m/f/x) the owner knew repaired it. The owner is willing to sell it to you. What amount of money would you be willing to pay for it?
- Imagine that someone owns a home speaker in his or her current living space. Its cable had broken off, but a handyman (m/f/x) the owner knew repaired it. The owner is willing to sell it to you. What amount of money would you be willing to pay for it?
- Buyer and Defective products but with a maker repairing for the buyer
 - Imagine that someone owns a mug on which the logo of the city you are currently living in is printed. The owner is willing to sell it to you. However, its ear has broken off. What amount of money would you be willing to pay for it, given that you know a handyman (m/f/x) who is willing to repair it?
 - Imagine that someone owns an outdoor plastic chair on his or her terrace. The owner is willing to sell it to you. However, its leg has broken off. What amount of money would you be willing to pay for it, given that you know a handyman (m/f/x) who is willing to repair it?
 - Imagine that someone owns an authentic figurine. The owner is willing to sell it to you. However, its arm has broken off. What amount of money would you be willing to pay for it, given that you know a handyman (m/f/x) who is willing to repair it?
 - Imagine that someone owns a home speaker in his or her current living space. The owner is willing to sell it to you. However, its cable has broken off. What amount of money would you be willing to pay for it, given that you know a handyman (m/f/x) who is willing to repair it?
- Seller and Baseline products
 - Imagine that you own a mug on which the logo of the city you are currently living in is printed. What amount of money would you be willing to sell it for?
 - Imagine that you own an outdoor plastic chair on your terrace. What amount of money would you be willing to sell it for?
 - Imagine that you own an authentic figurine. What amount of money would you be willing to sell it for?
 - Imagine that you own a home speaker in your current living space. What amount of money would you be willing to sell it for?
- Seller and Defective products
 - Imagine that you own a mug on which the logo of the city you are currently living in is printed. However, its ear has broken off. What amount of money would you be willing to sell it for?
 - Imagine that you own an outdoor plastic chair on your terrace. However, one of its legs has broken off. What amount of money would you be willing to sell it for?
 - Imagine that you own an authentic figurine. However, its arm has broken off. What amount of money would you be willing to sell it for?
 - Imagine that you own a home speaker in your current living space. However, its cable has broken off. What amount of money would you be willing to sell it for?
- Seller and Defective products but with a maker repairing for the seller
 - Imagine that you own a mug on which the logo of the city you are currently living in is printed. Its ear had broken off, but a handyman (m/f/x) you knew repaired it. What amount of money would you be willing to sell it for?
 - Imagine that you own an outdoor plastic chair on your terrace. One of its legs had broken off, but a handyman (m/f/x) you knew repaired it. What amount of money would you be willing to sell it for?

- Imagine that you own an authentic figurine. Its arm had broken off, but a handyman (m/f/x) you knew repaired it. What amount of money would you be willing to sell it for?
- Imagine that you own a home speaker in your current living space. Its cable had broken off, but a handyman (m/f/x) you knew repaired it. What amount of money would you be willing to sell it for?
- Seller and Defective products but with a maker repairing for the buyer
 - Imagine that you own a mug on which the logo of the city you are currently living in is printed. However, its ear has broken off. What amount of money would you be willing to sell it for, knowing that the buyer will have a handyman (m/f/x) repair it?
 - Imagine that you own an outdoor plastic chair on your terrace. However, one of its legs has broken off. What amount of money would you be willing to sell it for, knowing that the buyer will have a handyman (m/f/x) repair it?
 - Imagine that you own an authentic figurine. However, its arm has broken off. What amount of money would you be willing to sell it for, knowing that the buyer will have a handyman (m/f/x) repair it?
 - Imagine that you own a home speaker in your current living space. However, its cable has broken off. What amount of money would you be willing to sell it for, knowing that the buyer will have a handyman (m/f/x) repair it?

Appendix A.3. Multiple Price List Valuation Example

For each row, indicate if you would buy [sell] this product at that price.

- | | | |
|--|---------------------------|--------------------------|
| - Pay [Receive] €[0] to buy [sell] this product: | <input type="radio"/> yes | <input type="radio"/> no |
| - Pay [Receive] €[1] to buy [sell] this product: | <input type="radio"/> yes | <input type="radio"/> no |
| - Pay [Receive] €[2] to buy [sell] this product: | <input type="radio"/> yes | <input type="radio"/> no |
| - Pay [Receive] €[3] to buy [sell] this product: | <input type="radio"/> yes | <input type="radio"/> no |
| - Pay [Receive] €[4] to buy [sell] this product: | <input type="radio"/> yes | <input type="radio"/> no |
| - Pay [Receive] €[5] to buy [sell] this product: | <input type="radio"/> yes | <input type="radio"/> no |
| - Pay [Receive] €[6] to buy [sell] this product: | <input type="radio"/> yes | <input type="radio"/> no |
| - Pay [Receive] €[7] to buy [sell] this product: | <input type="radio"/> yes | <input type="radio"/> no |
| - Pay [Receive] €[8] to buy [sell] this product: | <input type="radio"/> yes | <input type="radio"/> no |

Please elaborate your choice by answering the following statements, keeping the scenario in mind (This is shown if the participant switched from yes to no for buyer or no to yes for sellers at row in the previous question (Pay [Receive] €[6] to buy [sell] this product: o yes o no)):

- | | | |
|--|---------------------------|--------------------------|
| - Pay [Receive] €[6.1] to buy [sell] this product: | <input type="radio"/> yes | <input type="radio"/> no |
| - Pay [Receive] €[6.2] to buy [sell] this product: | <input type="radio"/> yes | <input type="radio"/> no |
| - Pay [Receive] €[6.3] to buy [sell] this product: | <input type="radio"/> yes | <input type="radio"/> no |
| - Pay [Receive] €[6.4] to buy [sell] this product: | <input type="radio"/> yes | <input type="radio"/> no |
| - Pay [Receive] €[6.5] to buy [sell] this product: | <input type="radio"/> yes | <input type="radio"/> no |
| - Pay [Receive] €[6.6] to buy [sell] this product: | <input type="radio"/> yes | <input type="radio"/> no |
| - Pay [Receive] €[6.7] to buy [sell] this product: | <input type="radio"/> yes | <input type="radio"/> no |
| - Pay [Receive] €[6.8] to buy [sell] this product: | <input type="radio"/> yes | <input type="radio"/> no |
| - Pay [Receive] €[6.9] to buy [sell] this product: | <input type="radio"/> yes | <input type="radio"/> no |

Note. Actual values depended on the pretest and were different for each product. Format based on Brebner and Sonnemans (2018) [30], but slightly edited.

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