



Nudging crowdsourced delivery - an experimental study

An experimental research on the effectiveness of incentives in crowdsourcing the last mile delivery by retail store customers

Master Thesis - Part-time Master of Business Administration

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Preface

The copyright of this Master's thesis rests with the author who is responsible for its contents. The Rotterdam School of Management and supervisors are only responsible for educational coaching and cannot be held liable for the content.

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1. Introduction

Online retailers and logistic companies face many challenges in a world of tremendous growth of online sales and growing expectations by customers. Retailers are seeking new ways to reduce delivery costs and to improve delivery time. At the same time, the consequences of environmental pollution increase more and more. As an effect of the growing e-commerce industry, it is predicted that there will be an increase of 36% in the number of delivery vehicles in the top 100 cities around the world by 2030. Because of this, there will be an increase of 32% emissions and 21% of congestion (Deloison et al., 2020). Due to COVID-19, online consumption reached disproportionate levels, reaching the 10 year forecasted level within only 2 months (McKinsey, 2020).

E-commerce deliveries are performed by standard commercial carriers (e.g., PostNL, FedEx). Traditionally, this service is built upon the concepts of home delivery and pick-up locations. Products delivered to customers' front doors is known as the last mile delivery and is mostly requested by online customers (Devari et al., 2017). Particularly in urban areas, the home delivery service is facing many obstacles as second park lane issues and "not at home" issues are causing a ping pong effect in router patterns, where packages are going back and forth between customer, store locator and distribution centers (Slabinac, 2016). These issues imply that less packages can be delivered within a specific time and also causes high emissions (Gevaers et al., 2014). The increasing volume of e-commerce purchases puts retailers and logistics companies under a considerable amount of pressure to assure quality and speedy product delivery to customers (Barclays, 2014).

Innovation, the improvement of inventory management and distribution strategies are necessary to meet customer demand (Napolitano, 2013). Companies are integrating new transportation technologies into their distributions system to keep up with the ever-growing customers' expectations. A recent innovation is crowdsourced logistics, which is a concept derived from the sharing economy that gained popularity over the past decade. It encourages peer-to-peer sharing of resources as products, transportation and accommodation (Cherry, 2018). The popularity of the sharing economy has grown tremendously during the last couple of years. One of the most successful transportation business models using the concept of crowdsourced logistics is Uber, by connecting passengers and independent vehicle owners via an online application (Schor and Attwood-Charles, 2017; Schor and Fitzmaurice, 2015). Multinationals, such as Amazon, UPS and DHL experimented and invested in this ride sharing model to optimize distributions and to perform concepts such as same-day delivery (AmazonFlex 2016; Savelsbergh and Van Woensel 2016; Supply Chain 24/7 2016). Crowdsourced delivery involves using the public crowd as an independent contractor using their own vehicle as a shipper transportation service via an online application. DHL used crowdsourced delivery in a pilot test by making use of random people to perform a part of their deliveries in exchange for a financial incentive (Morphy, 2014), whereas Walmart utilized existing routes of their employees by delivering online ordered products on their way home after work (Souza, 2017). Recent research of Devari et al. (2017) shows the potential benefits of using social networks to assist in last mile package delivery.

Considering the current volume and expected growth in volume of daily shipped parcels,

there is much to gain regarding environmental sustainability. Most studies on the environmental sustainability of e-commerce delivery focus only on the logistics service providers. However, as customers nowadays play a crucial role in choice making, as they have delivery time, price, quality and “green”/“fair” options to choose from, it is important to also involve customers as stakeholders.

In this paper, we aim to address this gap by involving retail customers in crowdsourced delivery as crowd drivers. Crowdsourcing involves people who are willing to act in favor of another person. As a result of their actions, there will be resource costs, such as time, energy or even additional costs related to their vehicle (Luo et al., 2016). Since voluntary participation cannot be assumed, an acceptable reward to compensate these costs can be given. Reward-focused incentive systems have been a powerful tool to steer people’s behavior (Deci et al., 2001). This study contributes to research from a different angle by exploiting the impact of non-financial and financial incentives to steer customer behavior in a crowdsourced delivery context. The main contribution of the research is to focus on existing routes, as former practical and theoretical literature focuses only on additional route planning and new vehicle types to make it more environmentally friendly and efficient. Previous practicalities in crowdsourced logistics were only focused on one specific crowd driver group or on financial incentives, whereas this study makes use of financial and non-financial incentives to steer customer’s behavior in general. Nevertheless, the logistics of the sharing economy is assumed to be a novel research stream (Carbone et al., 2015; Mehmman et al., 2015). Limited research has been executed around this topic, and more literature on crowd shipping is needed (Le et al., 2019). Therefore, this research is valuable for academia as well as for practical implementation in regard to creating effective and efficient planning of last mile package delivery. Given the limited amount of research on crowdsourced delivery and the vast majority of practical examples of crowdsourcing and their commercial focus, this study aims to focus on non-commercial crowdsourced delivery. The objective of this study is to gain insight on how different incentive mechanisms affect customer behavior by conducting an experiment in crowdsourced delivery. Specifically, we compare the potential of three non-financial incentives, namely environmental benefits, interpersonal relationships and support small businesses. In doing so, we respond to the main research question:

How can crowd drivers be encouraged to participate in a crowd delivery system?

This study contributes to current research on this topic in a number of significant ways. Firstly, it focuses on the impact of non-financial incentives, not just financial incentives. Secondly, this study focuses on existing routes that have a beneficial environmental and economic impact, whereas previous practices and research (e.g., DHL) focused on commercial aspects. Thirdly, while the current literature focuses on one specific group using employees (Souza, 2017) and friends (Devari et al., 2017), this study focuses on retail customers as a whole. This study is novel as it is considered more appropriate for the cost-sensitive business to consumer e-commerce industry.

The remainder of this study is organized as follows: Chapter 2 presents the related literature and the hypotheses; Chapter 3 discusses the experimental design and survey to analyze motives that can steer customer behavior when participating as crowd drivers. Chapter 4 discusses the data analyses; Chapter 5 features the results from the experimental study and Chapter 6 discusses and concludes the results of the conducted research and Chapter 7 provides the limitations of this study and the future research scope.

2. Literature review and hypotheses development

This study is based on two different theories. The first entails the logistics and supply chain area and focuses on the online retail market and the accompanying package delivery. Within this section, the growing issue of last mile delivery is discussed including theories on how to alleviate the issue. The second section then focuses more on behavioral studies and elaborates on the different customers' motives that can relate to decision making leading to a set of hypotheses.

2.1 Crowdsourced logistics and last mile delivery

Crowdsourced delivery is a great solution for organizing the last mile distribution (Castillo, 2018). Research on crowdsourcing as a solution to resolving logistics issues in urban areas is upcoming but so far limited. Transportation logistics for people and freight are traditionally organized separately. To create efficient mobility for people and goods, especially in urban areas, Li et al. (2016) investigated this problem. This study examined the use of existing routes, by using passenger transport such as taxis and buses, to deliver packages during passenger journeys (Li, 2014; Li, 2016). Another study by Devari et al. (2017) shows the solution of exploiting one's own social network of friends in crowdsourced delivery. The study contains a scenario-based analysis of using friendship networks for package delivery by store pick-ups. It is found that 60% of people are willing to deliver their friends' package for free and most of them are willing to spend 15 minutes extra to deliver the package (Devari et al., 2017). Crowdsourced delivery has proven to reduce last mile delivery costs and daily emissions in urban areas (Devari et al., 2017). Another recent study of Arslan et al. (2016) analyzed the concept of using private ad-hoc drivers aiming to use excess capacity on existing routes. This concept shows promising results in regard to making last mile delivery more cost efficient and reducing vehicle miles instead of using traditional delivery services (Arslan et al., 2016). A trial study in crowdsourced logistics for a library in Finland gave insight on the perspective of the participants. Surprisingly, legal and other possible issues related to home delivery by strangers, such as lost or damaged goods, were not considered inconvenient by participants who made use of the crowdsourced delivery service. Several motivations were found, such as "support public services" and "support the environment." Besides the proven economic benefits and the reduction on the carbon footprint, the study also showed that social cohesion is sustainable (Paloheimo et al., 2016). Current research mainly focuses on benefits of crowdsourced delivery given certain actions and behavior; however, some papers explicitly focus on empirically studying the behavior of crowd drivers in this context.

2.2 Motives

2.2.1 Environmental awareness

An increase in online shopping has a great impact on the amount of transportation that is used and their polluting gas emissions. Transportation is a growing issue regarding the environmental impact, especially in Western countries (Lanzini et al., 2017). These concerns alongside climate change have resulted in sustainable transportation alternatives and strategies, such as clean fuels, vehicle technologies, transportation demand management and sharing concepts (i.e., bike/car sharing; Shaheen, 2007). Decision makers and policy experts are forced to incorporate more sustainable restrictions in their strategies. However, not only policy decision makers but also the general public has a great impact on the amount of transportation used for online shopping. The general public is the key actor whose involvement is necessary for any sustainable mobility strategy to be successful (Donald, Cooper & Conchie, 2014). Therefore, it is important to gain insight into the thoughts and behavior of individuals regarding transportation. Stern (2000) states that the importance of general environmental beliefs for a pro-environmental readiness is specified within the value-belief-norm theory (VBN) of environmentalism. The VBN theory is seen as the normative base for acting pro-environmentally. It explains that the willingness to minimize negative environmental effects of, for example, car use is activated by a norm activation process through personal values and problem awareness (Eriksson, 2008). The human behavior is activated by a personal norm (e.g., reduce polluting transport emissions). The personal norm to act pro-environmentally according to the VBN theory is activated through personal values, pro-environmental orientation, awareness of the consequences of human actions for the environment and the responsibility to act for oneself (Stern, 2000). The stronger the norm, the more willingness a person has to act in a more environmentally friendly way. Other studies show evidence of the importance of problem awareness in accepting transport policies (e.g., Loukopoulos et al., 2005; Poortinga et al., 2004).

The motivation to act for oneself can be created through intrinsic and extrinsic motivation (Ryan, 2000). Intrinsic motivation is considered as motivation to exercise an activity for the enjoyment, pleasure or satisfaction of the activity itself. Extrinsic motivation is understood as acting to receive separable outcomes, such as approval or rewards, avoiding sanctions or instrumental value. For example, a person may choose a green label because they care for the environment, and they believe that this action will help the environment. The last one consists of personal endorsement and a feeling of choice, but avoiding sanctions is more a compliance with an external control (Ryan and Deci, 2000).

Sustainable supply chains have gained much interest during the past years. Environmental sustainability within the supply chain became one of the most important facets for the success of supply chain management, including logistics (Hong et al., 2019). This is mainly due to regulations and customer demand, which have forced companies to use environmentally friendly strategies (Wu, 2011). Hong et al. (2019) states that the environmental consciousness of consumers is an important market-driven factor for achieving environmental sustainability in the supply chain. Therefore, it is important to have a closer look at the environmental awareness of customers.

Even though the environment is currently an important subject, research shows that the environment is not prioritized when it comes to online shopping. Customers are aware of the environmental impact of online shopping and the logistics that come with it (Sendcloud, 2019) –

54% of European customers find that online shopping is an issue for the environment. However, Dutch consumers are less worried about the environmental impact, and only 38% consider the environment to be an important factor in package delivery (Sendcloud, 2019).

Even though the environment is not yet a high priority for customers, companies are increasingly focusing on green delivery. Especially the supermarket industry is using innovative ideas such as green time slots. Recent research by Agatz et al. (2021) show that eco-conscious customers are more responsive to green labels, and green time slots do not specifically synergize with discounts. Buldeo Rai et al. (2021) demonstrate in their recent research that non-financial incentives can encourage consumers to choose a more sustainable delivery option.

Based on the above mentioned literature, the following hypotheses are set:

(H1a) People are more likely to participate in crowdsourced delivery if the environmental benefits are highlighted.

(H1b) The effect of highlighting the environmental benefits of crowdsourced delivery participation will be stronger for people with higher eco-consciousness.

2.2.2 Social exchange theory

One of the most popular and influential theories for understanding behavior is social exchange theory (Cropanzano & Mitchell, 2005). Social exchange theory consists of interactions that generate obligations (Emersen, 1976). These interactions are contingent on the rewarding reactions of another person, which provides mutually and rewarding transactions and relationships (Blau, 1964). The social behavior of that action is motivated by making a trade-off between costs and benefits (Homans, 1961). It is assumed that customers participate to receive intrinsic or extrinsic rewards. Customers will engage in co-creation if they receive a higher value in use feeling compared to their participation and used sources (Jiang, Henneberg, & Naudé, 2011). Hence, customers are willing to participate in crowdsourced delivery only if they become satisfied through the trade-offs between perceived reciprocity, benefits, acts of kindness and costs. Several studies state that increased levels of co-production are related to customer satisfaction (Buonincontri, Morvillo, Okumus, & van Niekerk, 2017; Haumann, Güntürkün, Schons, & Wieseke, 2015). However, customers that have spent resources (e.g., energy, time, skills) in co-producing a service but do not receive the expected value in return will be less willing to engage in customer co-creation behavior (Dang & Arndt, 2017; Prebensen & Xie, 2017).

Based on the above mentioned literature, the following hypothesis is set:

H2: People who have a personal relationship with the sender are more likely to participate as a crowd driver for package delivery.

2.2.3 Local support

Several studies have attempted to understand the underlying aspects of customers' choice for buying local (Lombardi et al., 2015). Research by Brown et al., (2009) showed that the main motivations for buying local were for altruistic reasons: reducing miles in favor of the environment and supporting the local economy (Carpio and Isengildina-Massa, 2009). A new form of collective action can be described as the solidarity purchasing groups movement. These groups promote better social and environmental sustainability (Graziano and Forno, 2012). However, social and environmental sustainability is negatively impacted by big retailers. Small retailers are affected by the popular big retailers called "big-box stores," such as Walmart, who offer low-priced goods by maintaining mass production, distribution and supply-chain ownership (Boarnet et al., 2005). The big-box stores dominate in every sector by driving small businesses out of competition through a wider array of products and lower prices (Pan, 2003). However, the popularity of the big retailers has become a point of discussion lately. Many people, including environmentalists and grassroots organizations, state that the negative impacts of big-box retailers on the economy, environment and society outweigh the benefits to consumers (Freedman et al., 2016). Moreover, the presence of small businesses is important to the overall economy and a good indicator of economic vitality in communities (Deller and McConnon, 2009; Goetz et al., 2010). Hence, consumer buying behavior has been recently shifting from rational to more emotional levels.

Based on these points, the following hypothesis is given below:

H3: People are more likely to participate in crowdsourced delivery when it is highlighted that their help supports the small business.

3. Research Methodology

This chapter elaborates on the how the research was conducted. The type of research undertaken and the conceptual model is discussed, followed by the research design, population and sampling.

3.1 Type of research

This thesis is an empirical theory-oriented study in which scientific crowdsourced theory is tested based on current literature through experimental research using a survey. Hence, this is a theory-testing study based on the typology of social transportation research and hypotheses discerned from the literature review findings (Van Raaij, 2020; Dul & Hak, 2008). To our knowledge, the specific question addressed in this research “How can crowd drivers be encouraged to participate in a crowd delivery system?” has not yet been examined. By making use of experimental research, quantitative data was collected. The quantitative approach was used to test the strength of incentives that influence the choice of participating in crowdsourced delivery as a crowd driver.

3.2 Conceptual model

The conceptual model is based on what is currently known in academic literature and on potential gaps to further examine. As shown in Figure 1, the conceptual model visualizes the main concepts of this research. The dependent variable of the study is the “willingness of the customer to participate as crowd driver” accompanied by the independent variables; environmental benefits, interpersonal relationship and supporting a small business. Eco-consciousness was used as a moderator to test if this has an additional effect between the relationship of highlighting the environmental benefits and willingness to participate as crowd driver. Although solid literature is available on the independent variables, there is little empirical research that relate to crowdsourced logistics.

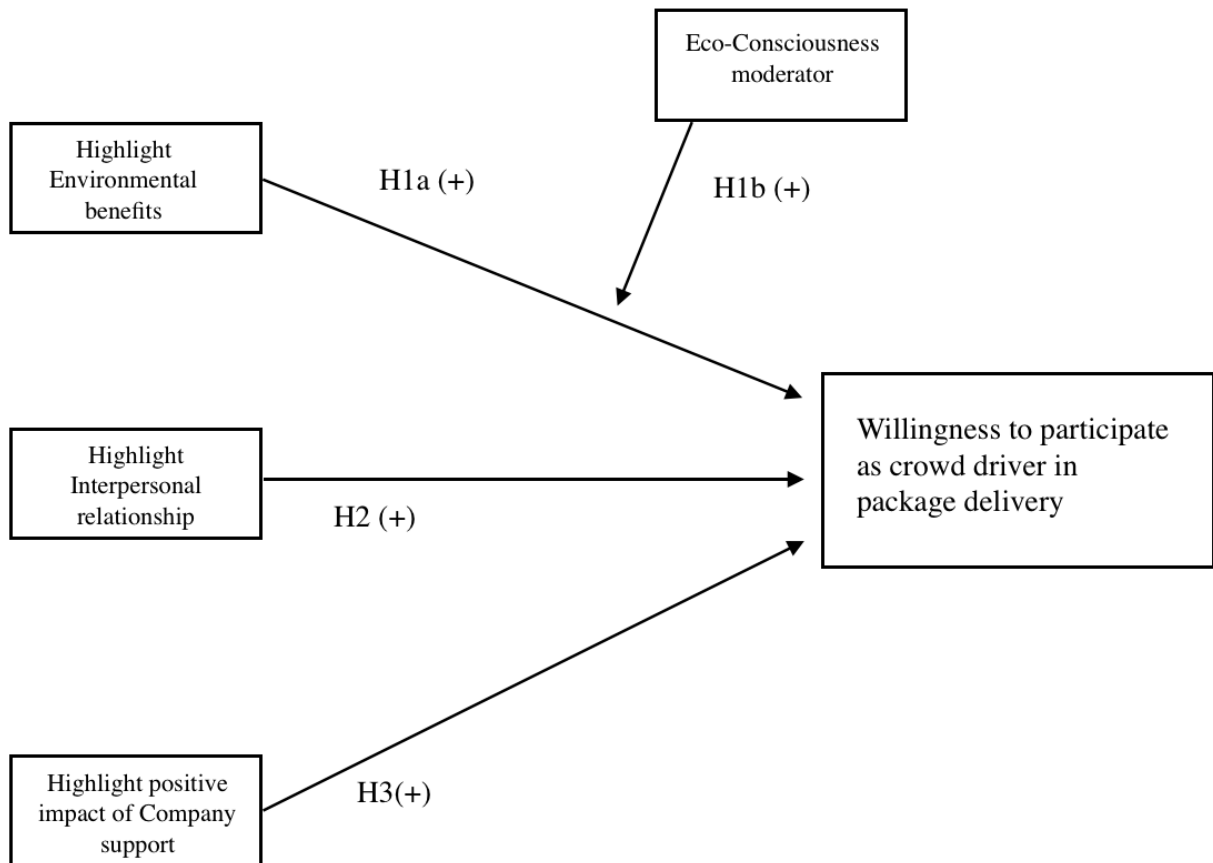


Fig.1 Conceptual model

3.3 Research Design

In this study, we tested four hypotheses: (H1a) People are more likely to participate in crowdsourced delivery if the environmental benefits are highlighted. (H1b) The effect of highlighting the environmental benefits of crowdsourced delivery participation will be stronger for people with higher eco-consciousness. H2: People who have a personal relationship with the sender are more likely to participate as a crowd driver for package delivery. H3: People are more likely to participate in crowdsourced delivery when it is highlighted that their help supports small businesses.

In order to conduct this research and respond to the set hypotheses, we designed an experimental research method as this research aims to investigate causal propositions with interventions. To collect detailed data on the customers view and characteristics that influence their behavior in social transportation, the most appropriate research method to use for this thesis was a survey. Quantitative questions was used to receive as much valuable data as possible and was designed to aim minimally limiting the respondents to certain answers. The use of questionnaires was also beneficial for reaching a great amount of people effectively and efficiently.

We set up the experiment based on a control group and three experimental groups. The experiment is designed with between-subjects to avoid carryover effects from one experimental condition to another. Each experimental group received another incentive in accordance with the pre-defined hypotheses, namely: environmental benefits (H1a/H1b), interpersonal relationship (H2) and supporting a small business (H3). The outcomes of the experimental groups are then separately compared to the control group. See Figure 2 for the experimental design.

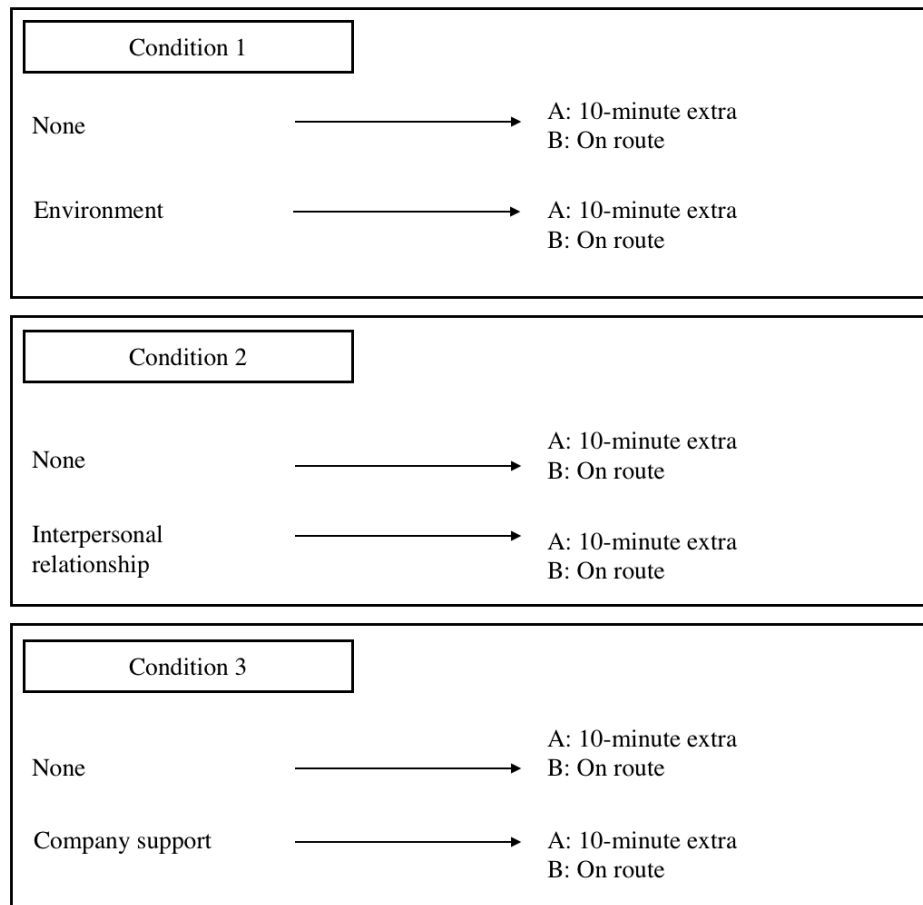


Fig.2 Experimental design

The experimental survey was designed with two different sections. The first section contained a general introduction that elaborated on the research context and gave assurance of respondent anonymity. This was followed by a set of general questions regarding socio-demographical aspects (e.g., age, gender, employment, country of residence) (see Appendix 1). Thereafter, another block was added to indicate the eco-consciousness based on seven different statements using the 5-point Likert scale: ‘strongly agree’ (5) to ‘strongly disagree’ (1). The Likert 5-scale type was used because it is less confusing for respondents to choose for an answer than 7-scale type and it appears to increase response rate (Revilla, 2013). The environmental awareness questions were used to rate the eco-consciousness of each participant in order to report the final outcome on hypothesis H1(B). The environmental questions are created on similar measurement methods based on Becerra and Lin (1999) and Alsmadi (2007).

This first section of the survey was identical to all participants. The second section of the survey was based on the experimental conditions and designed with between-subjects to avoid carryover effects from one experimental condition to another. Hence, all participants were randomly assigned to one of the conditions. Randomization is important to create equal groups so that bias and differences beyond the experiment set-up are avoided (Sekaran and Bougie, 2016).

During the experiment, each group was presented with the same context and questions followed by a different additional stimulus depending on the allocated condition (see Appendix 2). The experimental context, which was identical in each group, is defined below:

Experiment: *“You are in a retail shop where you purchase a product. Another person purchased a product online in this same store and chose home delivery service. The delivery address of this person is on the same route as your way home. The cashier asks whether you can deliver this package on your way home. The package is portable and can be taken on all types of transport. Your transportation costs remain the same.”*

The additional stimulus of the three conditions are described as follows:

Environmental benefits (1): *If you deliver the package, you will contribute to the environment as emissions will reduce by eliminating package delivery companies.*

Interpersonal relationship (2): *Charlie is your friend and currently works behind the cashier desk. Charlie asks whether you can deliver the package on your way home as this minimizes time, effort and delivery costs.*

Support small business (3): *The company where you purchase a product is a small retail business. You will support the owner by delivering the package on your way home as this minimizes time, effort and delivery costs of the owner.*

After the participants were assigned to the experimental group or control group, the survey was divided into two blocks: “on route” and “10 minute detour distance” (See Appendix 3 for an overview of both blocks). Both blocks follow the same survey questionnaire. To analyze behavior from different angles, three questions were asked per block depending on the answers selected by the participant.

The first question aimed to investigate whether participants would bring the package *for free* if the delivery address is on route, and the second question asks if the participant would bring the package *for free* if a 10-minute detour distance is required. In case participants selected “no” for an answer, the subsequent questions were incentivized by an X amount of money. The amount of money was not specified to avoid bias in our collected data. The respondent was asked an open

question to specify *what amount of money he/she is willing to deliver the package for as financial compensation* or could respond to *not willing to deliver the package for a financial compensation either*. By collecting this data, a realistic analysis could be made regarding behavioral motives. Incentivized questions were added because reward-focused incentive systems have been a powerful tool to steer people's behavior (Deci et al., 2001). Crowdsourcing involves people who are willing to act in favor of another person. As a result of their actions, there will be resource costs, such as time, energy or even additional costs related to their vehicle (Luo et. al., 2016). Since voluntary participation cannot be assumed, a financial reward to compensate those costs is given as an option.

In the scenario that respondents are willing to deliver the package *for free* "on route" and with a '10-minute detour distance' the participant is asked a third question in order to distinguish the different behavioral levels of delivery time. This question concerns the minimum amount of minutes a participant is willing to take to deliver the package for free.

3.4 Participants

The experiment is designed through online software named 'Qualtrics Research Suite' of the Erasmus Survey centre. All questions were designed to have a 'forced answer' for every question. Every condition has been equally and randomized assigned to a participant. The online survey is distributed among family, friends and colleagues who live in The Netherlands via linked-in, social media and email. All respondents are asked to share the survey within their network to stimulate the snowball technique. We encouraged participation to this experiment by organizing a raffle.

4. Data analysis

4.1 Sample composition

There is a validity threshold of 30 questionnaires per group, resulting in a minimum of 120 respondents required for valid research. The experiment was held among consumers in the Netherlands. The target group was men and women between the ages of 20 and 90 years old. In total, 214 questionnaires were collected, of which 27 respondents left prematurely. The survey contained “forced answer” settings for every question. Every condition was equally and randomly assigned to a participant. Accordingly, a total of 187 valid questionnaires were considered for analysis. Therefore, the validity threshold of 30 questionnaires per condition was surpassed. See distribution of assigned groups in Figure 3.

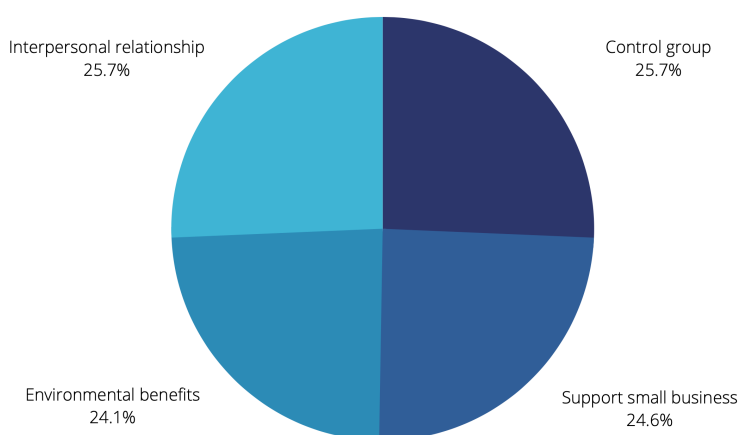


Figure 3 - Rate of assigned groups

4.2 Sample characteristics

The following sections describe a detailed analyses of demographic data. All participants have answered general demographic questions in order to understand and compare the behavior per person. In addition, a set of statements were asked to rate to test for environmental consciousness.

4.2.1 Gender & Age

In total, 94 woman and 92 man participated in this research. Only one participant did not want to share his/her gender. Only adults were allowed to participate in this research. Figure 5 demonstrates the age range of all participants. The abscissa represents the different age groups ranged per 5 years. The vertical axis represents the frequency per age group ranged per 10 counts. The chart is skewed to younger participants between the age of 25 and 35 years old. There is an overall age varying between 20 and 65 years old, with a few outliers between 75 and 80 years old. See figure 4 for the bar chart distribution and Table 1 for distribution per condition.

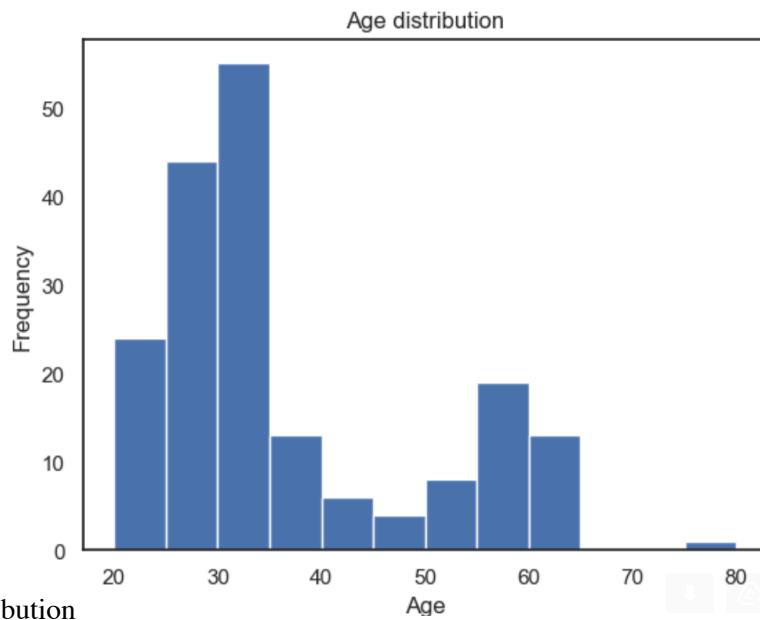


Figure 4 - Age distribution

Age	Condition Environment	Condition company support	Condition Interpersonal relationship	Control group
20-29	21	17	12	18
30-39	16	12	21	18
40-49	1	1	6	2
50-59	7	9	4	7
60-69	1	5	3	3
70+	0	1	0	0

Table 1 - Conditional Age distribution

4.2.2 Occupation

Most of the participants are full-time employed, followed by part-time employees and students. The participants who have a different occupation are entrepreneurs, retirees, unfit for work or people who combine a part-time job and study. We will not go deeper into these variables as they are not considered for the final analysis. These variables might be useful for further analysis in the future. Distribution of occupation is presented in Figure 5.

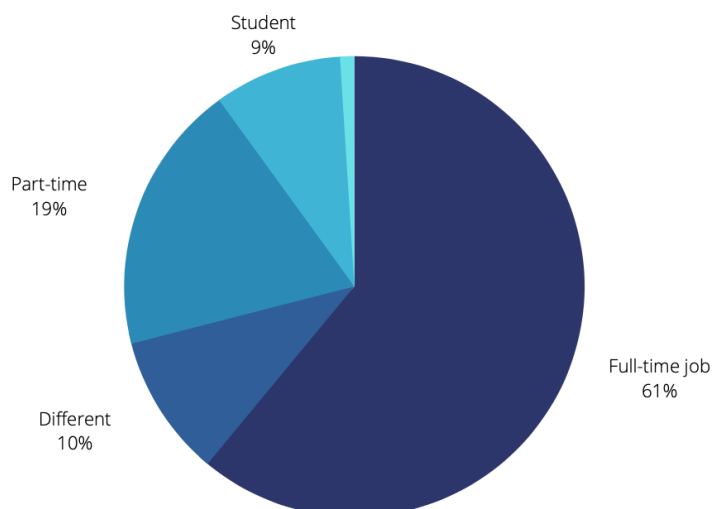


Figure 5 - Occupation distribution

4.2.3 Eco-consciousness

To test for environmental consciousness as moderating effect all participants were confronted with different statements concerning the environment in the survey. Almost half of the entire participants contain high environmental awareness. A five-point Likert scale is used to yield data of high quality. (Revilla et al.,2013) Most of the participants don't find the CO-2 emissions of production and transportation of a product important to know before they purchase a product. Still, most participants care about the environment and try their utmost best to prevent environmental pollution. Most participants think that people in general should adjust their behavior if this is more environmental friendly. Please see Table 2 for a detailed overview of the eco-consciousness rate for the environmental benefits experimental group and control group.

ECO CONSCIOUSNESS		
	Control group	Environmental benefits condition
	Average (N%)	Average (N%)
I try my utmost best to prevent environmental pollution	2,6 (52%)	2,4 (48%)
I think the type of transport is important for environmental sustainability	2,35 (47%)	2,4 (48%)
People in general should adjust their behavior if it is more environmental friendly	2,37 (47%)	2,5 (50%)
I care about the environment	1,9 (38%)	1,96 (39%)
Environmental pollution has an effect on my personal healthy and quality of life	2,3 (46%)	2,39 (48%)
The amount of CO-2 emissions of production and transportation of a product is important to know before I purchase the product	3 (60%)	3,13 (63%)
Note: 5: Strongly disagree, 4: Disagree, 3: Not agreed or disagreed, 2: Agree, 1: Strongly agree		
Environmental awareness :	2,4 (48%)	2,5 (49%)

Table 2 - Eco-consciousness rate

5. Results

5.1 Distribution of sample

In order to analyze and test for reliable relationships between experimental groups and the control group it is necessary to have equal amounts of respondents in each experiment and similar respondent characteristics to avoid bias. There were 94 woman and 92 man who participated in this research. Only one participant did not want to share their gender. Since all participants were randomly assigned to each condition, it was important to analyze the sample size, gender distribution and average age per condition. Table 3 shows the distribution related to each condition and the control group. It was concluded that man and woman were equally divided within all conditions that will exclude bias of gender while analyzing data. The sample size is equally divided and no significant difference of average age between experimental groups was identified.

Conditions	Sample	Female	Avg. Age
Environmental benefits	46	50%	34
Interpersonal relationship	48	50%	36
Company support	45	53%	39
Control group	47	49%	35

Table 3 - Gender & Age profile

5.2 Findings

The objective of this research was to identify how non-financial and financial incentives can steer customer behavior towards participating in crowdsourced package delivery. Table 4 demonstrates the differences of choice to participate as crowd driver between the control group and the three experimental groups. The table shows that people were more willing to bring the package for free when on route if a non-financial incentive was highlighted compared to the control group. Financial incentives seems to be not effective for steering behavior towards participating as a crowd driver. There was no statistical test executed on financial incentives due to results insufficient results (see Appendix 6). The impact of the three experimental conditions was tested by comparing each experimental group separately with the control group. The Chi-square test for independence was used for testing any difference between the experimental values and the control value at a 5% significance level. To measure the strength of association between two nominal variables, we used the Phi and Cramer's V test. Values that are close to 0 indicate a weak association, and values close to 1 indicate a strong association (Baarda et al., 2012). To test for a moderation effect of eco-consciousness, we used regression analysis. Please see Appendix 4 for Chi-square test results and appendix 5 for Regression analysis results.

The results suggest that a non-financial incentive (H2) interpersonal relationship and (H3) a willingness to support small businesses can influence consumer behavior in choosing to participate as a crowd driver. The following section further elaborates on the results.

Condition interpersonal relationship				Control group		
Free delivery	Yes	No		Free delivery	Yes	No
On Route	38 (79,2%)	10 (20,8%)		On route	29 (60,4%)	19 (39,6%)
10- min Detour distance	25 (52,1%)	23 (47,9%)		10- min Detour distance	15 (31,3%)	33 (68,7%)
Condition small business				Condition Environmental benefits		
Free delivery	Yes	No		Free delivery	Yes	No
On route	34 (75,6%)	11 (24,4%)		On route	34 (73,9%)	12 (26,1%)
10- min Detour distance	18 (45%)	27 (60%)		10- min Detour distance	16 (34,8%)	30 (65,2%)

Table 4 - Willingness to participate as crowd driver

5.2.1 Findings on route

(H 1A) People are more likely to participate in crowdsourced delivery if we highlight the environmental benefits.

To investigate the impact of highlighting the environmental benefits, we added an information message clarifying the positive benefits to the environment when choosing to deliver the package. In response to this non-financial incentive, 73,9% of the respondents opted for delivering the package for free when on route, compared to 60,4% in the control group. Although the majority of respondents chose for free delivery on route, the results show that the difference is not statistically significant at a 5% level with a p-value of 0.0699. $\Phi=0.74$, which indicated that the relationship is strongly associated. As a result, it was concluded that highlighting the environmental benefits is not an effective method to encourage customers to choose for delivering a package in crowdsourced delivery. Therefore the hypothesis H 1A is not supported.

(H 1B) The effect of highlighting the environmental benefits on crowdsourced delivery participation will be stronger for people with higher eco consciousness.

To investigate the moderation effect, a regression analysis is conducted with an added interaction term (dummy for env group * env score). Since the regression coefficient (0.4377) for the interaction term is not significant at the 5% level ($p=0.519$), there exist no significant moderation effect. In other words, people who are more eco-conscious do not respond stronger when environmental benefits are highlighted. However, the general environmental awareness coefficient

(0.7973) with a p-value= 0.019 is significant. Thus, people who are more eco-conscious are more willing to deliver a package for free in general. Based on the results, the hypothesis H 1B is not supported.

H2: People who have a personal relationship with the sender are more likely to participate as crowd driver for package delivery.

To investigate the impact of interpersonal relationships in steering customer behavior towards participating as crowd driver in crowdsourced delivery we added a message ‘the person asking you to participate in crowdsourced delivery is your friend’. In response to this experiment, the majority of respondents (79,2%) are willing to bring the package for free when on route. This experimental group scores the highest in regard to the amount of people willing bring the package for free on route compared to other experimental groups and the control group. Our analysis shows that the use of interpersonal relationship as stimulus is highly effective and statistically significant with a p-value of 0.0079 at a 5% level. Phi= 0.38, which indicates that the relationship between willingness to participate as crowd driver and interpersonal relationship is only moderately strong. Based on the results, the hypothesis H2 is supported.

H3: People are more likely to participate in crowdsourced delivery when their help is highlighted as supporting the small business.

To investigate the impact of supporting small businesses by participating as a crowd driver for package delivery, we added the message “By delivering the package, you will support the small business by lowering their delivery costs.” In response to this non-financial incentive, the results show that most of the customers chose to deliver the package for free on route (75.6%). The analysis shows that the difference between the results of the experimental group and control group to deliver the package for free on route is considered to be statistically significant with a p-value of 0.0332 at a 5% level. Phi= 0.31, stating that the relationship is moderately associated. As a result we can conclude that highlighting a positive contribution to a small business while participating in crowdsourcing can steer customer behavior in participating as crowd driver. Therefore, the hypothesis H3 is supported.

5.2.2 Findings 10-minute detour distance

(H 1A) People are more likely to participate in crowdsourced delivery if we highlight the environmental benefits.

The second level of analysis was conducted for delivering the package with a 10-minute detour distance. The results show that the difference compared to the control group is not significant and contains a weak relationship (p-value = 0.5216; Phi=0.09) at a 5% level. The results show an immediate decrease of willingness to participate as crowd driver compared to the same incentive used for on route crowdsourcing. As a result, we can conclude that highlighting the environmental benefits is not an effective method to encourage customers to participate as crowd driver while using a detour distance of 10 minutes. Therefore the hypothesis H 1A is not supported.

(H 1B) The effect of highlighting the environmental benefits on crowdsourced delivery participation will be stronger for people with higher eco consciousness.

To investigate the moderation effect, a regression analysis was conducted with an added interaction term (dummy for env group * env score). Since the regression coefficient (-0.1718) for the interaction term is not significant at the 5% level (p-value= 0.770), there exist no significant moderation effect. In other words, people who are more eco-conscious do not respond stronger when environmental benefits are highlighted when a 10-minute detour distance is required. In addition, the general environmental awareness coefficient (0.2918) with a p-value= 0.336 at 5% level is not significant as well. Thus, people who are more eco-conscious are not triggered by the environmental benefit stimulus and are not willing to deliver a package for free in general when a detour distance is required. Therefore, the hypothesis H 1B is not supported.

H2: People who have a personal relationship with the sender are more likely to participate as crowd driver for package delivery.

The second analysis on delivering the package for free when a 10-minute detour distance is required is shown to be statistically significant, with a p-value of 0.0018 at a 5% level. Phi=0.45, which indicates a moderate relationship between having a personal relationship with the sender and the willingness to participate as crowd driver. As a result, customers are more willing to participate as crowd driver when they have a personal relationship with the sender. Therefore, the hypothesis H2 is supported.

H3: People are more likely to participate in crowdsourced delivery when their help is highlighted as supporting the small business.

The second level of analysis of delivering the package for free with a 10-minute detour distance can also be considered as statistically significant, with a p-value of 0.1977 at a 5% level. Phi=0.31, which demonstrates that the relationship between willingness to participate as crowd driver and supporting the small business is moderately strong. Although the results show a slight decrease in willingness to participate compared to on-route crowdsourcing, we can conclude that highlighting

to participate as crowd driver will support the small business can steer customer behavior in participating as a crowd driver. Therefore, the hypothesis H3 is supported.

6. Discussion and conclusions

In an attempt to involve people in crowdsourced delivery, this study evaluated and compared the impact of non-financial and financial incentives to steer behavior on choosing to participate as a crowd driver. We specifically focused on e-commerce delivery service by involving consumers in retail stores to deliver online-ordered packages on their way home or with a 10-minute detour distance. We believe that the findings can be generalized to other aspects of e-commerce delivery, such as the grocery industry, as consumers are willing to alter their decisions of delivery choice for environmental reasons (Agatz et al., 2021).

The non-financial incentives used in this thesis are based on customer motives that can steer behavior and are applied in accordance with the research context by providing an information message highlighting (1) the environmental benefits, (2) highlighting interpersonal relationship and (3) by highlighting the positive contribution to small businesses. To further analyze behavior a financial incentive was added as this reward focused incentive systems have been a powerful tool to steer people's behavior (Deci et al., 2001)

Our study provides five main findings. First, customers who are willing to participate as a crowd driver are more willing to deliver the package for free when the delivery address is on their route compared to when a detour distance is applicable. Respondents who were in the environmental group show the highest decrease of 52% regarding a willingness to deliver the package for free when a 10-minute detour is required compared to on route. Respondents might consider the detour not to be environmentally friendly anymore as an additional route is required. An overall reason for the remarkable decrease between willingness to deliver the package for free on route and detour distance may be spent energy, time or the discomfort of not knowing the exact route while needing to make a detour.

Second, environmental benefits seem to be less effective as incentive mechanism at steering customer behavior in participating as a crowd driver. This result seems to be the consequence of the experimental set up in which respondents were framed in an environmental scenario as questions were asked concerning their environmental awareness beforehand. However, customers who were more eco-conscious were more likely to participate as a crowd driver when the delivery address is on their route if environmental benefits were highlighted. This finding is in line with Agatz et al. (2021), who explored that the rate of eco-consciousness is sensitive to green labels.

Third, our study demonstrate the power of interpersonal relationships. Interpersonal relationships are most effective to steer customer behavior in participating as crowd driver, followed by the non-financial incentive of supporting a small business. This suggests that customers who have a personal relationship with the sender are more willing to deliver the package for free when the delivery address is on their route. We can assume this is the result of triggered intrinsic motivation that can relate to the study of Ryan and Deci (2000) in which intrinsic motivation is considered as motivation to exercise an activity for the enjoyment and satisfaction of the activity. However, relationships cannot be considered a highlighted incentive mechanism to apply in retail stores. In practice, retail stores can contribute to perceived relationships by maintaining goals and manners to interact with customers. Customer satisfaction is the main basis for a perceived relationship quality (Moliner et al., 2007). Retail stores can contribute to a perceived relationship by

creating a personal contact between a customer and a sender by, for example, using personal names and building a customer loyalty strategy within the retail company.

A fourth finding demonstrated that customers have high willingness to participate as a crowd driver when this had a positive effect on supporting a small business by lowering their delivery costs. The results show that this is a highly effective incentive mechanism and easy to implement for retail stores.

Lastly, our study shows that customers are less responsive to financial incentives. Respondents might feel that it is unethical to receive a financial reward, or they might believe that financial rewards do not create a lasting commitment while non-financial incentives do. Therefore, our study suggests that alternative incentives are more effective than financial incentives.

The potential of implementing non-financial incentive mechanisms in crowdsourced delivery is high considering the rising volume of e-commerce delivery as well as the environmental gains. It is concluded that highlighting the positive contribution to a small business by participating as crowd driver is mostly effective followed by the use of interpersonal relationships. These non-financial incentives imply low-cost modifications for retailers to implement and contain low consequences for retail customers.

7. Limitations and Future research

There may be limitations in our research due to the design of the experiment. The specific order of questions might have resulted in bias. Questions that were constructed to test the level of eco-consciousness were asked before the scenario in the experiment was explained. Participants could therefore have been influenced before participating in the experiment and results may contain bias.

Another limitation can be that the experiment was conducted online, which favors internal validity and over external validity. Scenarios as described in the experimental design were hypothetical and artificial, which means that findings cannot necessarily be applied to a real-world scenario in the same way as in the field experiment. This is because people may not behave the same way in a real-world scenario compared to how they behaved in this survey.

This research could be extended by undertaking a field experiment. Only a few respondents were willing to participate as a crowd driver in favor of a financial incentive. This might be the result of the experimental set up in which people were framed directly to the question to perform crowdsourced delivery for free. Both options were not directly shared at the beginning of the experiment. The financial incentive option became visible after people did not want to participate for free. Therefore, respondents may have been influenced to participate for free without knowing another option was available. However, the experiment did not yield enough evidence to execute a statistical test to research the financial incentive mechanism to steer consumer behavior in participating as a crowd driver. Future research could further investigate the use of financial incentive mechanisms in crowdsourced delivery.

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9. Appendices

Appendix 1 - Social demographic questions

Survey Questions

1) What is your Gender?

- Male
- Female
- I don't want to share

2) What is your Age?

3) What is your Nationality?

4) What is your occupation?

- Unemployed
- Part-time job
- Full-time job
- Student
- Different, namely:

5) What is your city of residence?

6) How often do you visit a retail store?

- 1-2 times a week
- 1-2 times a month
- 4 times a month
- Different, namely:

7) What type of transportation do you use to visit retail shops?

- Car
- Public transport
- Bicycle
- By foot

8) Eco consciousness Likert scale question

Followed by the experiment

Appendix 2 - Experimental conditions

Block Interpersonal relationship: The following questions concern shopping in a retail store where you purchase a product. To collect realistic data is it important to situate yourself in the following scenario:

“You are in a retail shop where you purchase a product. Another person purchased a product online in this same store and chose home delivery service. The delivery address of this person is on the same route as your way home. The cashier asks whether you can deliver this package on your way home. The package is portable and can be taken on all types of transport. Your transportation costs remain the same.”

Charlie is your friend and currently works behind the cashier desk. Charlie asks whether you can deliver the package on your way home as this minimizes time, effort and delivery costs.

Block Environmental benefits: The following questions concern shopping in a retail store where you purchase a product. To collect realistic data is it important to situate yourself in the following scenario:

“You are in a retail shop where you purchase a product. Another person purchased a product online in this same store and chose home delivery service. The delivery address of this person is on the same route as your way home. The cashier asks whether you can deliver this package on your way home. The package is portable and can be taken on all types of transport. Your transportation costs remain the same.”

If you deliver the package, you will contribute to the environment as emissions will reduce by eliminating package delivery companies.

Block Control group: The following questions concern shopping in a retail store where you purchase a product. To collect realistic data is it important to situate yourself in the following scenario:

“You are in a retail shop where you purchase a product. Another person purchased a product online in this same store and chose home delivery service. The delivery address of this person is on the same route as your way home. The cashier asks whether you can deliver this package on your way home. The package is portable and can be taken on all types of transport. Your transportation costs remain the same.”

Block: Support small business

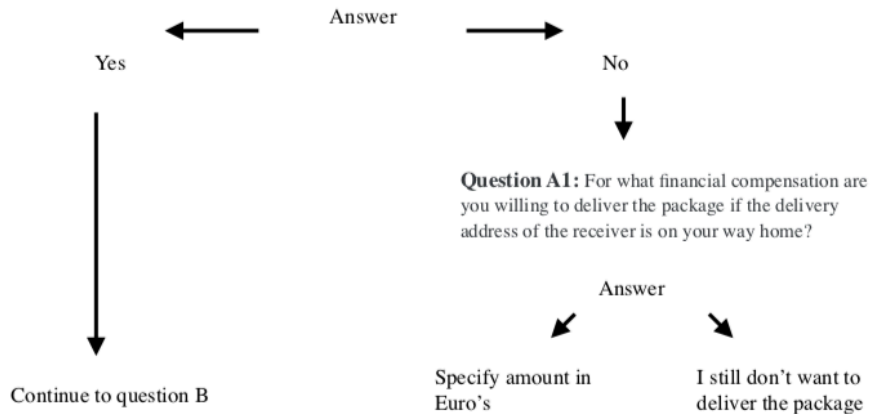
The following questions concern shopping in a retail store where you purchase a product. To collect realistic data is it important to situate yourself in the following scenario:

“You are in a retail shop where you purchase a product. Another person purchased a product online in this same store and chose home delivery service. The delivery address of this person is on the same route as your way home. The cashier asks whether you can deliver this package on your way home. The package is portable and can be taken on all types of transport. Your transportation costs remain the same.”

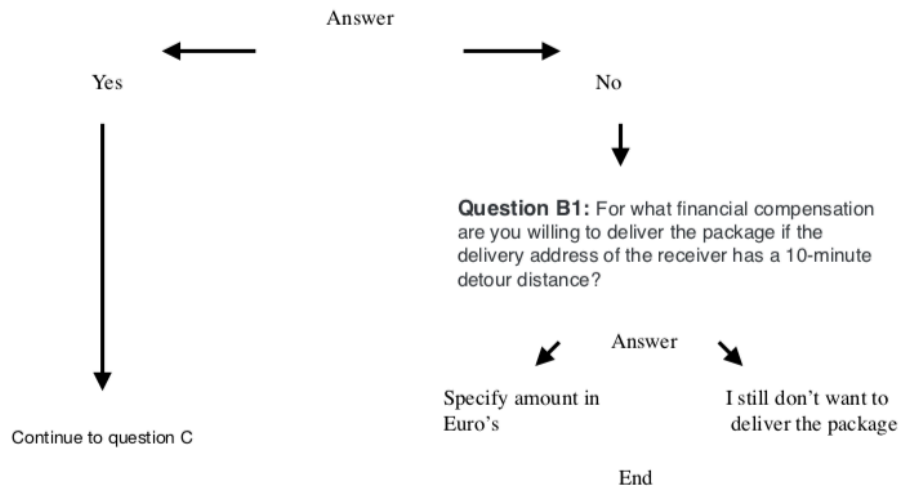
The company where you purchase a product is a small retail business. You will support the owner by delivering the package on your way home as this minimizes time, effort and delivery costs of the owner.

Appendix 3 - Experimental questions

Question A: Would you deliver the package for free if the delivery address of the receiver is on your way home?



Question A: Would you deliver the package for free if the delivery address of the receiver has a 10-minute detour distance?



Question C: What is the maximum amount of minutes you would like to spend to deliver the package?

End

Appendix 4 - Chi-square analysis

Environmental benefits on route: P value and statistical significance:

Chi squared equals 3.286 with 1 degrees of freedom.

The two-tailed P value equals 0.0699

V= 0.0699

Environmental benefits 10-minute detour distance: P value and statistical significance:

Chi squared equals 0.411 with 1 degrees of freedom.

The two-tailed P value equals 0.5216

V=0.0945

Interpersonal Relationship on route: P value and statistical significance:

Chi squared equals 7.056 with 1 degrees of freedom.

The two-tailed P value equals 0.0079

V=0.3834

Interpersonal Relationship 10-minute detour distance: P value and statistical significance:

Chi squared equals 9.697 with 1 degrees of freedom.

The two-tailed P value equals 0.0018

V=0.4495

Support local business on route: P value and statistical significance:

Chi squared equals 4.537 with 1 degrees of freedom.

The two-tailed P value equals 0.0332

V=0.3175

Support local business 10-minute detour distance: P value and statistical significance:

Chi squared equals 1.659 with 1 degrees of freedom.

The two-tailed P value equals 0.1977

V=0.1920

Appendix 5 - Regression analysis

On route - Regression analyse

	coef	std err	z	P> z	[0.025	0.975]
Intercept	-0.0173	352	-49	961	-707	672
Average eco-consciousness score	0.7973	340	2.346	19	131	1.463
Environmental benefits	0.5070	540	939	348	-551	1.565
Support local business	0.5755	470	1.225	221	-345	1.496
Interpersonal relationship	0.8179	472	1.734	83	-107	1.742
Interaction Environmental benefits vs. Eco-consciousness score	0.4377	679	645	519	-893	1.768

10-minute Detour distance - Regression analyse

	coef	std err	z	P> z	[0.025	0.975]
Intercept	-0.9602	362	-2.652	8	-1.670	-251
Average eco-consciousness score	0.2918	303	962	336	-303	886
Environmental benefits	0.3020	548	551	582	-773	1.377
Support local business	0.3229	444	727	467	-548	1.194
Interpersonal relationship	0.7961	429	1.855	64	-45	1.637
Interaction Environmental benefits vs. Eco-consciousness score	-0.1718	587	-292	770	-1.323	979

Appendix 6 - Financial incentive distribution

Control group		
10 minute extra	Compensation	Not even for compensation
Total respondents	14 (42,4%)	19 (57,6%)
Condition interpersonal relationship		
10 minute extra	Compensation	Not even for compensation
Total respondents	10 (43,8%)	13 (56,2%)
Condition small business		
10 minute extra	Compensation	Not even for compensation
Total respondents	11 (40,7%)	16 (59,3%)
Condition Environment		
10 minute extra	Compensation	Not even for compensation
Total respondents	19 (63,3%)	11 (36,7%)