CROWDSHIPPING

THE LEVEL OF TRUST TOWARDS CROWDSHIPPING FROM THE USER'S PERSPECTIVE: A STATED PREFERENCE EXPERIMENT

MERVE SEHER CEBECI

Master Thesis

Crowdshipping

The level of trust towards crowdshipping from the user's perspective: A stated preference experiment

by

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Preface

This report is the outcome of almost 7 months of hard work on the course TIL5060 TIL Thesis, completing the final requirement for the degree of the Master of Science in Transport, Infrastructure and Logistics at Delft University of Technology. The thesis is supervised by Prof. dr. ir. LA. Tavasszy (CiTG/TP), Dr. R. J. Tapia (CiTG/TP), Dr. ir. M. Kroesen (TPM/TL) and MSc. J. Amankwah (Nimber).

First and foremost, I would like to thank to Prof. Tavasszy with whom I had several discussions for finding the final topic of my research. His assistance helped me a lot to find out what interests me the most. Throughout the research, I had a great assistance from my supervisors namely, Dr. Tapia and Dr. Kroesen. I would like to sincerely thank for their great assistance and support during this study. Their guidance, criticism, feedback and constructive comments helped me tackle the challenges I faced in the research. Without their guidance and suggestions, it would not have been possible to have the same outcomes in the research.

I would like to thank my company supervisor, MSc Amankwah for being there for me whenever I need assistance from the company. His view has provided me practical side of crowdshipping and the needs which should be defined specifically in the research.

I am very thankful to Dr. Ebru Demirci who has guided me every time and has been there for me whenever I need. Also, I would like to thank my family and friends who have always supported me at every moment of my life.

Last but not least, I would like to extend my gratitude to Turkish Ministry of Education for their emotional and financial support during my master. Without their support, it would not be possible for me to take this opportunity and complete my master's at TU Delft.

I hope that this project is beneficial and explanatory enough so that it can be an important contribution to the field. I believe that this research is helpful to understand the underpinned questions about encouraging the use of crowdshipping and the importance of trust towards the system.

Merve Seher Cebeci
Delft, August 2021

Summary

Thanks to growing online shopping, last-mile logistics is becoming a more relevant problem for cities due to its negative impacts, such as congestion and environmental problems. In this research, one of the urban freight transport services aiming to tackle these externalities is analysed: crowdshipping.

Crowdshipping is a service where the package is delivered via a traveller (crowdshipper) who is already making an unrelated trip for other purposes. Thanks to this service, the package can potentially be delivered cheaper and quicker to the receiver and crowdshippers get a monetary compensation. Despite being a very promising method, the adoption of the service has still several uncertainties. The concerns that hinder the service adoption are mostly related to the situation where the package gets damaged or lost. Similarly, there might be a case that a crowdshipper keeps the package for himself instead of delivering it to its receiver. To tackle the abovementioned uncertainties and to achieve the service adoption, behavioural studies focusing on user acceptance should incorporate the factors that affect the user acceptability and preferences for the service. The factors affecting acceptability include reliability, privacy, safety and liability and they are all closely related to one essential phenomenon: trust. Although the system can only be applicable if users trust the service, this key behavioural concept is not yet researched explicitly. As also mentioned in the literature, establishing trust and understanding the impact of the level of trust towards such a system is indispensable for the service adoption. Hence, this research aims to explore the effect of trust and to examine how the adoption of the service by users can be achieved.

Based on the gaps found in the literature and the specific research purpose, the main research question addressed in this research is:

"To what extent do various attributes of crowdshipping delivery services influence the level of trust in the service and the decision to use the service?"

In this research, crowdshipping delivery is considered as a last-mile delivery option to execute the last leg of deliveries. However, there is no specific product segment of the users or specific transport mode of the crowdshippers investigated in this research. With this scope, it is aimed to explore the adoption of this novel concept and how the user's trust can be operationalised in a way to measure this psychological phenomenon.

First of all, a literature review was conducted to define trust in crowdshipping and the attributes that might impact on the level of trust. Based on the literature, six attributes were identified:

- Delivery time,
- Delivery cost,
- Tracking and tracing options,
- The delivery company's reputation,
- Insurance coverage,
- The possibility of damage.

A Stated Preference Experiment (SPE) was constructed and an online survey was distributed in order to collect the data. After the data collection process, the resulting attribute weights are deployed to a Mediation Choice Model (MCM) to analyse how the relevant attributes in the experiment would impact the level of trust and the service adoption.

The estimated MCM enabled the author to disentangle the direct, indirect and total effects of the main attributes on the service adoption. Except for the attribute track and trace, the direct effects of all the selected attributes were found to have a significant effect on the service adoption. Interestingly, the indirect effects of all the main attributes were statistically significant. This finding is remarkable to obtain as it means that all the main attributes affect trust through the service adoption. Moreover, the effect of track and trace was fully mediated by trust, meaning that trust has fully control over the effect of this attribute. Consequently, the total effects of the main attributes were significant except for the attribute

tracking and tracing. As a result, the total effects of the main attributes showed that delivery cost and the delivery company's reputation were some of the most important attributes on the service adoption, followed by the insurance coverage and the possibility of damage.

Next, choice probabilities with several hypothetical scenarios were computed. Given the below scenario I, with a 5€ delivery cost to be delivered on the next day, with a relatively bad reputation of the delivery company, the probability of a person choosing crowdshipping accounted for 64%. As the delivery cost increases to 12€ while keeping the rest fixed, the probability of opting for crowdshipping decreased to 12%. This hypothetical scenario is prominent to emphasise since it presents the vital effect of delivery cost.

Table 1: The effect of crowdshipping service choice based on the attribute levels and attitudinal profiles

Delivery features	**Hypothetical scenario (I)**	
Delivery time	Next day delivery	Next day delivery
Delivery cost	**5€**	**12€**
Delivery company's reputation	Two stars	Two stars
Tracking and tracing options	Only main steps can be seen	Only main steps can be seen
Insurance coverage	Insurance up to 500€	Insurance up to 500€
Possibility of damage	5%	5%
Choice probability	**64%**	**12%**

However, when the reputation is modified to four stars, in the same setting with 5€ delivery cost, the crowdshipping choice probability substantially changed to 89%. Keeping the same scenario with a 12€ delivery cost, the choice probability became 57% instead of 12% as in the previous scenario. From these results, it is clear that individuals are eager to pay more for a reputable delivery company.

Table 2: The effect of crowdshipping service choice based on the attribute levels and attitudinal profiles

Delivery features	**Hypothetical scenario (II)**	
Delivery time	Next day delivery	Next day delivery
Delivery cost	**5€**	**12€**
Delivery company's reputation~	**Four stars**	**Four stars**
Tracking and tracing options	Only main steps can be seen	Only main steps can be seen
Insurance coverage	Insurance up to 500€	Insurance up to 500€
Possibility of damage	5%	5%
Choice probability	**89%**	**57%**

Moreover, a Latent Class Choice Model (LCCM) was applied to further explore heterogeneity among individuals on the crowdshipping service adoption. The research showed that the 2-class latent model, named "crowdshipping sceptics" and "crowdshipping enthusiasts", is the best fit for the sample data. For both of the classes, the delivery company's reputation and delivery cost were some of the most important factors in crowdshipping service adoption.

Even though there are some research limitations, it is possible to deduce promising conclusions from this research. Firstly, the results demonstrated the importance of the market popularity for a crowdshipping service provider since the delivery company's reputation is the most important feature affecting the crowdshipping service adoption and the level of trust towards the service. Secondly, due to the cost sensitivity of the individuals, the delivery cost needs to be arranged to be able to offer affordable and cost-competitive service. Lastly, the research outcome showed that the potential market for a crowdshipping delivery service provider would be young women since they are more willing to try the service.

In order to improve the findings of this study, some future research directions were provided. Firstly, more alternatives to crowdshipping can be added in a future choice experiment. This would give the choice preference of two or more crowdshipping options in an SPE setting. Next, trust from the crowdshipper point of view needs to be studied more in depth to have a better understanding of the actors. Further research would fill the knowledge gap to understand the role of trust for all of the parties involved in crowdshipping adoption. Lastly, this research did not cover the role of the policy making process and possible interventions. However, establishing trust in crowdshipping service also requires the guarantee that the policy makers would assure. Therefore, follow-up research might cover the policy making side of the crowdshipping service adoption.

Contents

Nomenclature

Abbreviations

Abbreviation	Definition
UN	United Nations
SP	Stated Preference
SPE	Stated Preference Experiment
SEM	Structural Equation Modelling
LCCM	Latent Class Choice Model
MCM	Mediation Choice Model
AMOS	Analysis Moment of Structure
SAS	Statistical Analysis System
B2C	Business to Consumer
C2C	Consumer to Consumer
DOSPERT	Domain-specific risk-taking
KMO	Kaiser-Meyer-Olkin test
SPSS	Statistical Package for the Social Sciences
BVRs	Bivariate Residuals
BIC	Bayesian Information Criteria
AIC	Akaike Information Criterion
CBS	Central Bureau of Statistics

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INTRODUCTION

In this chapter, the brief introduction concerning crowdshipping service and the problem definition are given. Besides that, the research gap and the motivation of the research are described. After explaining the research objectives and related research questions, the relevance of the research is also explained. This section is concluded by representing the layout of the thesis.

1.1. Background

In today's world, more people prefer to maintain their life in urban cities instead of rural areas. According to United Nations' (UN) report, while in 1950, only 30% of the world's population resided in urban areas, the same value reached 55% in 2018 [1]. Based on their projection, 68% of the world's population is expected to be urban by 2050. Regarding the people in Europe, almost 75% of the population live in urban areas, and it is estimated to reach 80% urban in 2040 and nearly 85% by 2050 [1].

Together with business to consumer (B2C) and consumer to consumer (C2C) e-commerce, this living pattern brings several changes to the cities. First of all, the demand for last-mile delivery has grown rapidly since consumers would rather shop online instead of physically being in the shopping place. Additionally, final customers seek more customised on-demand deliveries, leading to an increase in parcel shipments in urban areas by couriers. Moreover, these more customised last-mile delivery requests from B2C and C2C markets also lead to negative externalities in urban areas, such as congestion and pollution.

Specifically, from a B2C point of view, most retailers provide a home delivery option to their customers, and they provide specific time windows so that the service can be customised. Concerning C2C deliveries, the market expands day by day. According to Weltevreden and Rotem-Mindali [2], C2C e-commerce is more likely to increase in passenger and freight transportation when it is compared to the B2C market in the near future.

In the context of this research, last-mile delivery refers to delivery of the parcel to final customers' predetermined locations. In a study, it is stated that the cost of the last-mile deliveries between the range of 13% to 75% of the total logistics cost [3]. Due to the fact that these delivery operations have a relatively big impact on logistics cost, logistics service providers focus on alternative ways to diminish their cost of transportation.

As an innovative solution to tackle these issues, shared mobility services such as crowdshipping are also proposed in which on-demand delivery requests are taken into account. Crowdshipping can be considered an effective way of delivering goods to end-users by enabling environmentally friendly vehicle options [4], [5]. In this delivery system, a package is delivered via crowd who are making their regular travel and are willing to take the package and drop it off at the intended location. From the last-mile logistics perspective, the main idea behind crowdshipping is that the package or parcel is transported with the help of another passenger who is intended to make their trip for other purposes.

In traditional last-mile delivery, items are delivered from a depot or hub to a short distance destination. Additionally, transport service providers re-assign the deliveries based on the parcel destination during the process. However, crowdshipping allows delivering parcels with the help of ordinary people. Wicaksono [6] points out that this method arises a new way of last-mile delivery option to the inner city by utilising the capacity of existing vehicles. Moreover, crowdshipping creates personalised delivery conditions such as flexible pick up times and locations [7]. Since the vehicle density use will be diminished, it is expected to have a positive impact on both congestion and pollution. For instance, a person, who makes their trip by public transport, carries someone else's package and drops it off at the planned location. In this case, the number of the trip made by the carrier is reduced and also the delivery process is executed by public transport, which is eco-friendlier.

1.2. Problem Definition

Currently, there are several types of research engaged in the topic of on-demand delivery crowdshipping. Based on the literature analysis about crowdshipping, some studies are conducted to determine the system's outcomes and how crowdshipping can be modelled from the perspective of crowdshipper (occasional drivers) [1]. According to Archetti et al. [8], crowdshippers, who are willing to deliver the package using their vehicle, can be considered a new variation of capacitated vehicle routing problem. They investigate that crowdshippers help reducing the delivery cost for companies if last-mile delivery companies involved in the system. Besides that, the system can diminish the negative impacts of last-mile delivery on the environment, as crowdshipping uses existing and fewer vehicles. Another optimisation related study shows that crowdshippers can be preferred to perform last-mile deliveries with a large scale mobile crowd-tasking model [9]. In line with this approach, some simulation models are created to model crowdshipping operations with occasional and dedicated crowdshippers [8], [10]. Some research provides useful insights to evaluate possible impacts of the system, such as delivery cost and reduction of emissions. However, they are based on the assumption that behavioural acceptance is ensured from both the demand and supply sides. To the best of the author's knowledge, the current study's contributions to behavioural crowdshipping research are still limited concerning the user's preference. Punel and Stathopoulos [7] also mention a need to develop and contextualise a behavioural concept of crowdshipping from the user perspective.

As can also be seen from the literature, crowdshipping relies on its perceived service quality on crowd resources (supply-side). Some studies are conducted to find out occasional travellers' willingness to work as crowdshipper. The study discusses the potentiality of using a traveller as a crowdshipper in the context of a Stated Preference Experiment (SPE) [11]. Another study showing the behavioural aspect of crowdshippers concludes that willingness to work as a crowdshipper and maximum tolerance of travel time examine crowdshipping service success [12]. However, it is essential to point out that these behavioural studies concentrate on only crowdshippers (supply-side) and they should incorporate with user acceptance (demand side) [2]. An example found in the literature highlights the factors that have an impact on the acceptability and preferences for crowdshipping depending on different distance categories [7]. However, so far, not enough virtual averment has mentioned user's perceived trust towards crowdshipping and behavioural concerns originated from the new system.

Crowdshipping provides potentially faster and cheaper parcel deliveries for users since the system uses existing infrastructure and the crowd who are eager to deliver the parcel [4], [10], [13]. Moreover, the carrier uses fewer vehicles and makes fewer vehicle kilometres in total, which reduces the negative impact of the last-mile on the environment. Additionally, crowdshippers get paid, which might be seen as a source of income for them [12].

Besides the advantages of crowdshipping stated in the literature, there are also some concerns about the concept. First of all, trust, reliability, and liability issues of the parcel are some of the important drawbacks in crowdshipping service adoption. [7], [9], [14]. There is a possibility that a crowdshipper keeps the package for himself instead of delivering it to the receiver. Although the communication between crowdshipper and sender is conducted via mobile smartphone apps with a certain degree of insurance coverage, there is a possibility that damage and loss of the delivery can occur. Privacy-related concerns can be seen as another obstacle that can raise questions about the system. The parcel label can have private information about the receiver, and the receiver may not prefer to share it with strangers. Addition to that, user's might have a doubt about the crowdshipping platform since the service is not yet used extensively. This issue brings concerns regarding the market popularity and reputation of the crowdshipping service provider.

Moreover, trust is considered one of the key factors of crowdshipping service [13], [15], [16]. Even though the system can only be applicable if users trust the service, this key behavioural concept is not yet researched explicitly. According to Rougès and Montreuil, in the crowdshipping context, building trust is a key performance indicator, and the main question is how the level of trust can be achieved in the user's mind [17]. In the operational and behavioural studies about crowdshipping, the importance of establishing trust has been highlighted. However, to the best of the author's knowledge, there is no scientific study regarding a specific focus on operationalising trust in crowdshipping setting.

[1] Hereinafter the term crowdshipper will be used to define a citizen who is not a professional delivery person in other words, an occasional driver

[2] Throughout the research, the term user acceptance will be used to define the demand side of crowdshipping service, which represents the party who chooses the service

All in all, it is important to realise that user acceptability of the system can only be possible if trust-related concerns, as mentioned above, are taken into account. In that way, the continuity of crowdshipping can be obtained.

1.3. Research Gap and Motivation

As it is also explained in Section 1.2 and described in Figure 1.1 , there are several knowledge gaps that have been found in the literature. First of all, the research done about the behavioural aspect of crowdshipping is still limited to investigate users' preferences in the system. Secondly, there is a necessity to study user's perception towards crowdshipping and behavioural concerns originated from the new system, as stated in Section 1.2. These concerns bring an important question into place: how user's trust would be operationalised so that the level of trust can be measured in order to achieve the adoption of the service. Therefore, a specific focus on conceptualisation of trust also needs to be studied explicitly.

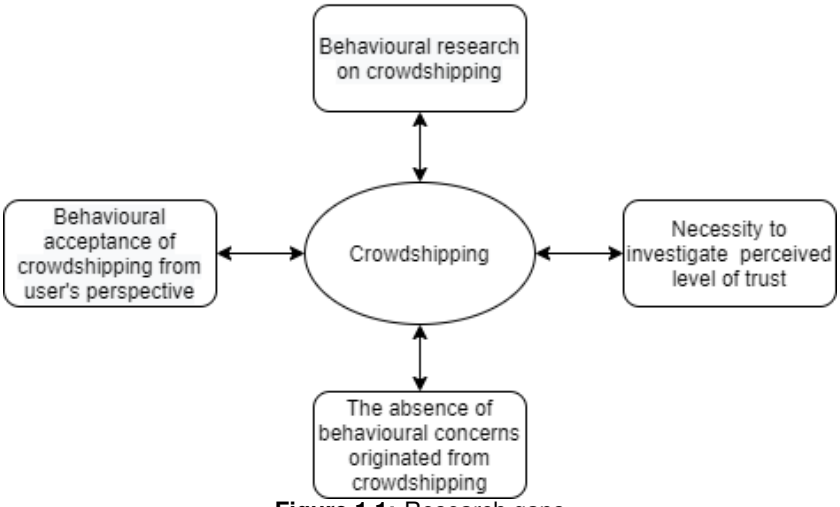

Figure 1.1: Research gaps

This thesis topic has been selected by the student of the master of science in Transport, Infrastructure and Logistics at the Delft University of Technology (TU Delft/The Netherlands). The author's motivation has originated from her own interest in the last-mile logistics operations, on-demand economy applications and innovative and customised logistics services.

This research is also carried out in order to support the LEAD project, which aims to develop a range of logistics solutions for shared, connected and low-emission logistics services [18]. Within the LEAD project, the new and innovative last-mile solutions and services will be validated in the six intervention living labs: Budapest, Lyon, Madrid, Oslo, Porto and The Hague. In these living labs, cost, environmental and operational efficiencies will be measured [18].

Thanks to this research, it will be possible to gain a fundamental understanding of the level of trust towards crowdshipping operations in the Netherlands. The outcomes of the research is expected to provide valuable insights for The Hague living lab, where one of the aims is to create integrated last-mile logistics operations with crowdshipping services. It is important to point out that Nimber, one of the LEAD stakeholders, is a partner in this research. The company has a crowdshipping platform in which crowdshippers and senders are matched in order to carry out the package delivery. As stated during the discussions with the company, there are several concerns behind a successful crowdshipping operation. According to Nimber, reliability, liability and trust issues are considered some of obstacles in the system. The company believes that the operation's liability and security are ensured via their insurance system. However, the company is questioning how to measure the level of trust from users' perspective. From their point of view, it is indispensable to gain users' trust towards the system to have a competitive operation. Consequently, when the level of trust in the system is understood from user's perspective, the success of the system can be obtained. As a result of this research, it is aimed to investigate the importance of trust and willingness to send the parcel with a crowdshipper to provide valuable insights for the company.

1.4. Research Objectives and Questions

This research aims to fill the gap on acceptance of crowdshipping from the users' point of view with a specific focus on trust. As stated in Section 1.2, one of the main obstacles of crowdshipping service is trust-related concerns. Thereby, this research can be seen as the first step to gain understanding of the users' perception towards crowdshipping with an exclusive focus on the level of trust. Thanks to this research, it would be possible to have a clearer understanding on the acceptability of the service from the users' perspective.

Consequently, the main objective of this research is to investigate the users' perception towards crowdshipping while operationalising trust. Firstly, a literature review is conducted to define trust in crowdshipping and the attributes that might impact on the level of trust. An SPE is constructed for data collection. The attribute weights are estimated by a Mediation Choice Model (MCM) which is used to analyse the impact of the level of trust on choice for crowdshipping service. The estimated MCM also enables the authors to disentangle the direct, indirect through trust and total effects of the main attributes on the service adoption. Next, a Latent Class Choice Model (LCCM) is applied. Thanks to LCCM, the heterogeneity in preferences is explored and the class membership function is included to characterise the classes with sociodemographic profile and attitudinal variables.

To meet these research objectives, the main research question for this study would be as follows:

"To what extent do various attributes of crowdshipping delivery services influence the level of trust in the service and the decision to use the service?"

In order to answer the main research question in a decent order, sub-questions are designed and listed below.

1. What is the definition of trust in the context of crowdshipping?

   The first sub-question aims to understand how trust can be defined in the crowdshipping context. With the help of this question, it is possible to conceptualise trust and fill the knowledge gap in behavioural acceptance of crowdshipping from users' perspective. Answering this question enables the author to figure out essential factors that might be important while operationalising trust.

2. What are the attributes that play an important role in user acceptance towards crowdshipping?

   The second sub-question is important to find out relevant attributes that are taken into account in the service. This question is also essential to figure out trust-related concerns from the user perspective in crowdshipping service. With the help of this research question, it is possible to understand the system barriers that users would like to avoid. Moreover, it is possible to define users' trade-offs when they have a choice between traditional delivery and crowdshipping. The attributes are used to construct an experiment and also to assess users' choice preference. Answering this question provides a classification of relevant attributes in crowdshipping.

3. What is the level of trust in crowdshipping depending on the relevant attributes?

4. To what extent does the level of trust mediate the choice of the crowdshipping system?

   The third and fourth sub-questions are asked to investigate the perceived level of trust from users' perspective and attractiveness to send the package. Additionally, these questions fill the knowledge gap if trust plays a mediatory role in service adoption.

5. To what extent does heterogeneity in choice preference exists for the type of delivery method?

   The aim of this question is to answer if there is a heterogeneity in preferences. Thanks to this question, it is possible to identify the groups or classes where respondents tend to have a higher probability of accepting crowdshipping as a last-mile delivery service.

1.5. Scientific and Societal Relevance

As seen from the literature review and interviews with the company, crowdshipping operations can only be successful if the users trust the system. Due to this study's specific focus on trust and related behavioural trade-offs such as reliability and liability concerns, this research has both scientific and societal contributions.

From a scientific point of view, the research investigates the level of trust in last-mile crowdshipping from the user's perspective. In the literature, some studies are conducted to explain how crowdshippers' actions can be modelled, how their performance can be assured or what kind of environmental or economic impacts are expected when the system is preferred. However, one of the expected outcomes of this research is to show how user acceptance of the system can be achieved by operationalising trust in the system. It is also expected to improve current crowdshipping operations since this research would give a better understanding of the important attributes that can affect users' trust in the system. Further research would focus on making more explicit experiments and adding more alternatives to a constructed analysis by using the outcomes of this research.

This study's societal relevance sets in the fact that the recommendation can be useful not only for the logistics service providers but also for the government as a policymaker. The research is expected to give a better understanding to transport service providers that might consider adapting crowdshipping in their business model. Since one of the main obstacles in crowdshipping service is trust-related concerns, this research can be an important step in understanding the users' perception of crowdshipping service provided by a specific company, Nimber, for the value case in The Hague. In future research, more elaborative-unobserved alternatives can be found by starting from this research discoveries. This research can be seen not only pursuing the current problem but also creating it as a milestone to pursue investigation regarding the applicability of this research in the Netherlands with the collaboration of other crowdshipping companies.

1.6. Thesis Layout

The figure below shows the structure of the thesis and sub-research questions, which are covered in each chapter. In Chapter 2, the sub-questions 1 and 2 are answered by conducting a literature review. Thanks to this review, the research framework is created, and the attributes which are the subject of this research are determined. The methodologies explained in Chapter 3 are used to analyse the sample data. In Chapter 4, the descriptive statistics is provided. Whilst the processed data is analysed, the rest of the sub-questions are covered in Chapter 5. The research conclusion and recommendations are discussed in Chapter 6.

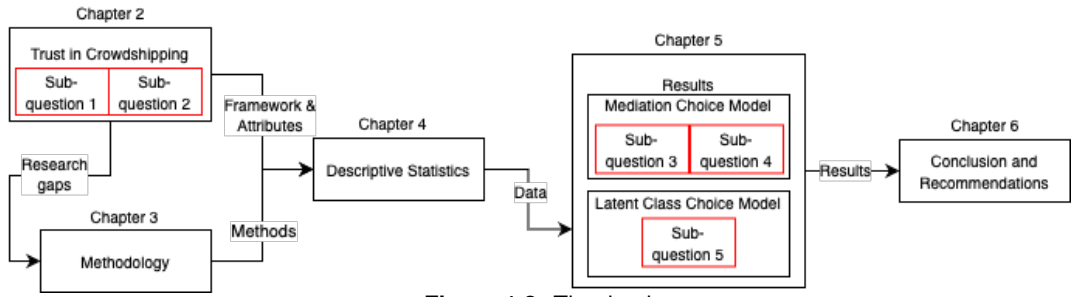

Figure 1.2: The thesis structure

2

TRUST IN CROWDSHIPPING

This chapter aims to find possible conceptual connections between consumer trust and the adoption of crowdshipping, as well as the attributes highlighted in the literature to measure level of trust. An extensive literature review is conducted to be able to have a better understanding of both trust and crowdshipping service. While performing the literature review, the approach which is suggested in the paper by Van Wee and Banister [19] is preferred. Therefore, in Section 2.1, the overview of the literature selection process is given, followed by the content-related clustering where concept of trust and background information about crowdshipping are discussed. Moreover, building the trust in crowdshipping service is described in which the research hypotheses are formulated.

2.1. Literature Review Methodology

Especially in social sciences and transportation domain, there are various variables influencing the independent variable [19]. This leads to complexity in causal relationships. According to Van Wee and Banister [19], conceptual model provides elaborate visual on how dependent and independent variables are linked as well as adding value to the review. By following this rationale, the literature review is conducted.

In order to determine the current state of the art in the concept of trust and crowdshipping service, the literature is thoroughly explored. Various databases, articles and journals are used to find out the most relevant literature. The journals that are found the most useful are listed below:

- Transportation Research Part C and E,
- Journal of Trust Research,
- Travel Behaviour and Society.

While the snowballing approach is used to detect the references of the abovementioned sources, the following keywords are used to search relevant articles: “crowdshipping”, “trust”, and “user perspective”.

2.2. Background

In this section general overview of the concept of trust and crowdshipping are given in order to identify the key concepts. Firstly, the crowdshipping service is introduced followed by the concept of trust.

2.2.1. Crowdshipping as a New Delivery System

Crowdshipping is an expanding contender in the logistics industry, cooperating with technology firms and retailers [7]. This new delivery service emerged as an alternative for urban freight distribution by utilising existing travellers’ capacity to perform goods transportation [6]. According to Gdowska et al. [20], crowdshipping involves ordinary people in the package delivery to other customers. From this point, this service is defined as a platform that links customers to a crowd of travellers that are willing to pick up and deliver packages to the other ends.

There are several examples of crowdshipping services that have been operating in many countries. In the US and Australia, the crowdshipping start-ups (UberRush, PostMates, PostRopes) have grown exponentially since they successfully maintain their users’ trust by enhancing the service reliability [17]. In the Netherlands, Trunkrs engages car commuters to pick up parcels in the service station and deliver them to the recipients along the way home [21]. In this research, service stations are taken into account by considering the existing instance network of Trunkrs. The study concludes that the distribution network can be only reliable if there is a sufficient number of private drivers. While performing the optimisation model, it is assumed that there is enough demand to execute a cost-efficient crowdsourced

delivery platform. However, it is not still clear how to investigate the customer's acceptance towards the system in order to create profitable demand.

Crowdshipping service consists of mainly three components. On the one side, sender creates a request for the package to be delivered (demand side), on the other side crowdshipper (supply side) takes a part to deliver the package. Among the sender and crowdshipper, the crowdshipping platform takes a part so that the system actors can be matched. Business models which are used in crowdshipping can vary. For instance, the crowdshipping service can appear in B2C or C2C industry models.

The Figure 2.1 shows the abovementioned industry models of crowdshipping service. Regarding B2C deliveries, international retail stores such as Walmart and Amazon have already started several trials to investigate crowdsourced deliveries [10]. In this way, retail stores make use of the customers at the store to deliver an online order for another customer. In these cases, the customer who shops at the physical store becomes a crowdshipper and delivers someone else's package on his/her own way. Similarly, C2C deliveries become a potential market for crowdshipping. In the end, ordinary people execute the parcel deliveries for someone while their own way.

Consequently, last-mile delivery is carried out in a cost-efficient and eco-friendly way with the help of this new delivery method.

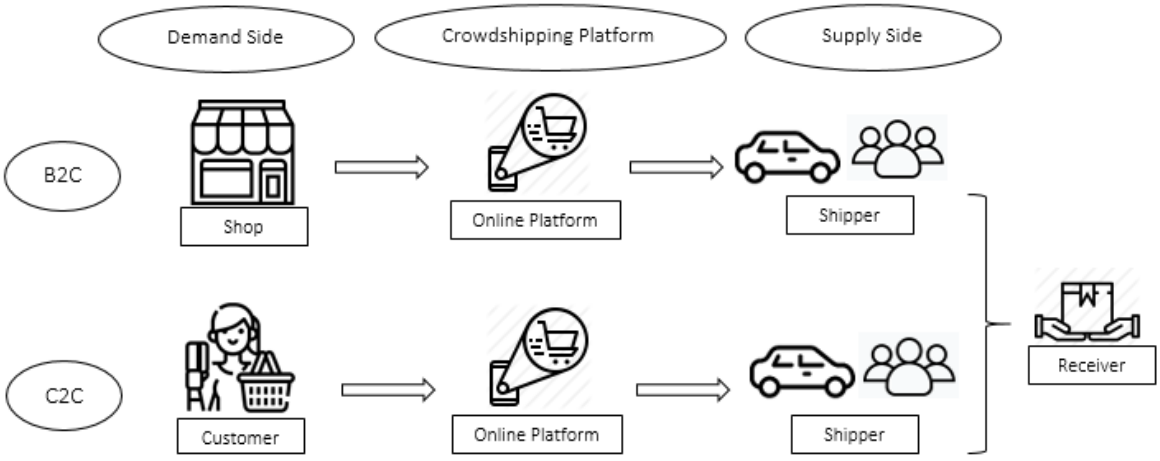

Figure 2.1: Crowdshipping operation process

As a novel last-mile delivery method, crowdshipping has several advantages. First of all, in this delivery method, while crowdshippers get monetary compensation, the package is potentially delivered more cheaply and quickly to the receiver [4], [12], [13]. Due to the fact that existing infrastructure (crowd) is used, the delivery cost decreases. Similarly, instead of using traditional delivery with professional drivers, occasional drivers deliver the package, which is in principle directly diminishes the labour costs and indirectly the cost of the delivery. Concerning the speed of the delivery, crowdshipping offers a more customised and flexible delivery time for the users since the delivery time is determined based on the availability of the crowdshipper and the receiver.

Traditional features offered by the crowdshipping service can be considered an important aspect that drives the success of crowdshipping [22]. Firstly, the delivery speed that further translated into lead time needs to be determined within hours, such as 1-2 hour, 3-hour, same day, or next day delivery. Next is the delivery cost. Delivery cost can be in several forms depends on how the package is delivered, hourly-based or parcel-based [17]. Punel and Stathoupulous [7] find that customers are willing to pay for the reduction in delivery lead time. Similarly, Arslan et al. [10] state that crowdshipping can reduce the transportation cost for transport service providers as the system allows making payment to crowdshippers which is in principle less than general transportation cost. Based on the crowdshipping studies in the literature, one of the main merits of this new concept is its positive impact on the environment. Gatta et al. [23] assert that crowdshipping is a promising way to diminish pollution originated from last-mile deliveries in the city. They focus on making use of transit network and smart lockers inside or outside of the station. In this research, travellers who use the train station would be

considered as crowdshippers. They conclude that annually 239 kg of particulates can be saved in Rome, Italy with this setting.

Moreover, there is more flexibility in terms of package delivery. According to Rougès and Montreuil [17], the matching app enables users to connect with the commuters who are possibly willing to deliver the package along their daily routes. Additionally, the delivery process cannot necessarily be in between working hours as the final delivery time is decided with crowdshipper.

While the abovementioned reasons make crowdshipping an attractive delivery option, the service has some unknowns that need to be considered explicitly. As it is also briefly explained in Section 1.2, there are several concerns that can obstruct the adoption of the service. From the demand point of view, challenges mainly originate from the uncertainty regarding the package delivery. In the literature, studies focusing on the behavioural acceptance of crowdshipping state that reliability, privacy, safety and liability are some of the concerns from users' point of view [15], [17], [24], [25]. However, these concerns are all closely related to one essential phenomenon: trust.

Building user trust is a key factor for the adoption of a crowdshipping system. Thereby, user trust should be ensured towards the service to be able to adapt such a delivery option [17], [26]. More supporting attributes derived by the user's preference, namely, driver performance, courier expertise, and experience, also affect the trustworthiness of the crowdshipping service [7]. The ability to define pickup time is found to be a significant factor in the research by Punel and Stathopoulos [7]. To ensure those trustworthiness Rouges and Montreuil [17] propose that crowdshipping service providers can ensure tracking and tracing features to build user's trust towards the service. Moreover, another attribute that also affects the trustworthiness is insurance provision to solve any liability issues caused by damage or stolen packages [17]

All in all, when the level of trust is operationalised in a way to explain the main concerns which are mentioned above, it would be possible to have a better understanding of the barriers of behavioural acceptance.

2.2.2. The Concept of Trust

Trust is an extensive concept and has also been the subject of different disciplines of social sciences such as psychology, political science, sociology, economics, anthropology, history, and management. Each discipline explains the role of trust in social processes from different perspectives. There are various categorisations that can be found in the literature such as characteristic trust, rational trust, and institutional trust and these perspectives are explained in Section 2.3.1. In the literature, it is agreed that trust is necessary for organizational success, but requires effort and process that cannot be created in a short time [27]. Building the customers' trust towards the organization provides an effective operation and continuity of the business.

Trust is a key concept in both interpersonal and group relationships as well as in businesses. Although level of trust cannot be understood directly, it can be inferred with other relevant attributes. For instance, some of the studies concerning trust show that trust is related to perceived risk that one might eager to take [27]. From this aspect, level of trust needs to be considered as context dependent variable. Besides that, there are some other factors that have impact on the level of trust such as credibility and reliability. Finally, these aspects of trust are discussed in Section 2.3.2 explicitly by considering the crowdshipping context.

From a conceptual point of view, there are different definitions of trust, however, the literature extensively cites two of them. First, trust can be seen as one person's willingness to act on another person's action or decision [28], [29]. Based on this definition, trust is a credence and positive expectation of the individual towards a person, situation or service. In crowdshipping, expectations that delivery will be carried out in a safely manner can improve trust levels. Secondly, trust is defined as one party's willingness to be vulnerable to another party's action [29]. Thus, one party's willingness to be involved in crowdshipping service plays a pivotal role in trust building process.

Based on the different definitions above, trust incorporates with two important aspects namely, trustee and trustor. While trustee is defined as the party on whom trust is being placed, trustor is the person placing himself in a vulnerable and uncertain situation [27]. Due to the nature of the concept of trust, the relation between both sides are dyadic. Thereby, a certain level of trust is needed to execute the service from both sides. According to Elliott and Yannopulou [30], trust is an essential component for both trustee and trustor in order to eliminate the perceived risk and uncertainty that affect consumers' buying behaviour. For the crowdshipping service, it can be translated into the fact that users' willingness

to use the system highly depend on the trust that they have towards the service.

Even though the literature converges into common definitions and concepts of trust, it is still not clear if there is a common view for the measures that can be used to operationalise trust [31]. Literature review emphasizes that the measurements of trust highly depend on the domain which is studied. Therefore, in the crowdshipping context, it is important to consider observable attributes to operationalise such an abstract concept. In order to find out what specific attributes exist for measuring trust in crowdshipping and to what extent these attributes affect the service adoption, a more detailed review is conducted and represented in Section 2.3.

In the context of transportation, establishing trust is challenging as technology evolves and transportation methods vary. The high level of trust is considered a positive perception where the expected delivery quality is obtained in the service. Building and improving this perception is not only a challenge for transportation service providers but also service users. For instance, in autonomous transportation systems, establishing users' trust is still problematic since there is not enough clarification regarding the division of the responsibilities in case of an accident or system failure [32]. Similarly, in crowdsourced deliveries, the level of trust towards the system is still in limited number of studies.

The concepts discussed are summarized in Table 2.1.

Table 2.1: Aspects of trust

Concept	Description
Trust	A complex psychological factor comprised of a positive expectation that the other person will not act in self-interest.
Trustee	The party who is being trusted.
Trustor	The party who puts himself in an uncertain situation.
Dyadic trust relation	The participation where trustor and trustee are involved.

2.3. Building Trust in Crowdshipping Service

In order to operationalise the level of trust in a crowdshipping platform, it is essential to reconsider the definition of trust, which is explained in Section 2.2.2. Based on these definitions, a certain level of trust among parties is needed to ensure that the crowdshipping system's adoption can be obtained. In case of a crowdshipping operation, trustee is not only the crowdshipper but also the online platform which matches sender and crowdshipper. For the same instance, trustor is the party that is willing to send the package or to use the platform. From the conceptualisation point of view, there are a plethora of studies that assess antecedents of trust, and the literature converges defining trust as a complex psychological phenomenon [27], [31]. However, it is still not yet clear how this concept could be measured.

To be able to identify essential aspects to measure trust, this section is divided into two parts where firstly, the widely used approaches to measure trust based on the review papers are represented followed by the trust measurements derived from research papers.

2.3.1. Review Papers

To be able to realise different approaches to measure trust and to figure out the best fit for operationalising trust in crowdshipping context, two review articles are used [27], [31]. However, it is important to point out that no recent review paper has been found about trust measurements. McEvily and Tortoriello, [31] point out that there is a consistency in the approaches when conceptualising trust; nevertheless, it is questionable to what extent the trust measurements can be determined. Thereby, the categorisation studied in the literature about measuring trust needs to be presented and the possible connections with the crowdshipping service need to be found. Based on the detailed analysis, it is concluded that interpretation of the trust measurements varies depending on the focused disciplines. For instance, from the economic point of view, trust towards the product, service or system is calculated based on the possible negative or positive outcomes.

On the other hand, in the seller-buyer transactions, trust is considered a concept that the buyer builds upon the seller's service quality, reliability, and trustworthiness [33]. Similarly, in shared economy applications such as ride-sharing, ride-hailing or crowdshipping, trust is seen as a complex phenomenon. It can be indirectly measured by the users' risk-taking threshold, perceived uncertainty of the service and reliability related concerns.

After reviewing 40 papers from different fields, Laeequddin et al. [27], conclude that trust measurement can be categorised in three perspectives as it is also defined by Zucker [34]: characteristic trust, rational trust, and institutional trust. Characteristics trust is preferred to express important factors affecting the level of trust such as reliability, disposition to trust, goodwill, reputation and credibility. In the crowdshipping context, building trust can be only possible if the perception of the service quality is ensured with the help of the abovementioned factors [27]. As for rational trust, it depends on the field that the trust measurements are defined. While rational trust measurements can be based on the system's reward and costs, they also directly depend on the positive or negative expectations that trustee, and trustor might have. This type of trust is categorised as rational trust in which the outcomes are calculated depending on the economic predictions. Lastly, institutional trust takes into account control mechanisms in the system. According to Laeequddin et al. [27], these mechanisms can be represented with the provided insurance level, agreements and contracts, and bank guarantees.

The second review paper aims at finding out important trust measurements and their validity in other research papers. The research provides a framework to identify trust measurements in several research papers and an overview of dimensions of trust such as reliability, predictability, and goodwill. According to the authors, it is essential to determine the perspective of trust, which will be looked upon due to the versatility of trust. The authors conclude that trust measurements will vary from a particular study area to another; however, trustworthiness can be measured depending on the theoretical model. For instance, trust can be conceptualised as a willingness to take a risk (behavioural) or possible expectations that the trustee can provide (perceptual). In the scope of this research, adoption of the crowdshipping is explored from the user (trustor) point of view, which means that behavioural expectations have a vital role. Even though there is no research specifically focusing on crowdshipping and trust measurements, the reviewed papers are vital to understand essential factors that could impact crowdshipping users' trust. The summary of findings from review papers is given in Table 2.2.

Table 2.2: Review Papers Summary

Review Papers	Common Findings
Measuring trust in supply chain partners' relationships [27] Measuring trust in organisational research: Review and recommendations [31]	Trust can be measured indirectly from different perspectives based on the targeted field. The conceptualisation of trust can be found in various studies. However, there is a lack of knowledge regarding operationalising it. Trust can be measured with the risk-taking ability and various factors such as reliability, reputation and goodwill. Most of the studies focus on only one side of the trust due to several research limitations.

2.3.2. Research Papers

After exploring the abovementioned review papers, it is concluded that there is a knowledge gap on how to operationalise trust. Future directions gathered from review papers indicate that trust measurements highly depend on the area focused on for a specific research. Thereby, it is beneficial to analyse research papers where crowdshipping and trust literature are studied recently. Reviewing the current research papers is also important to capture novel developments in the field of crowdshipping and to have a better understanding of trust indicators. The analysis of research papers is described based on the relevant aspect of trust measurements.

Individual characteristics- Sociodemographics

Literature shows that there is a relation between the sociodemographic characteristics and the adoption of the service. Working as a crowdshipper and willingness to pay for the service is found directly linked to sociodemographics [11], [12]. Similarly, several papers researching the crowdshipping concept show that men are more likely to become crowdshippers and users are expected to be the ones who are younger than 44 years of age [35]. Thereby, it is wise to cover sociodemographics to assess the relationship between personal characteristics and the adoption of the service. Although there is no specific study done in the scope of the user's level of trust in crowdshipping and the relation between the sociodemographic characteristics, the relation among these items is assumed to be related, resulting in

the hypotheses below.

Hypothesis 1a: Sociodemographic characteristics (gender, age, occupation, education level and income) are associated with the adoption of the crowdshipping service.

Additionally, establishing trust between different sociodemographic segments would differ. Therefore, sociodemographic characteristics are considered another important parameter for the service adoption mediated by trust.

Hypothesis 1b: The level of trust partially mediates the effect of sociodemographic characteristics in the crowdshipping service adoption.

Individual characteristics- Attitudinal Profile

Attitudinal profile is divided into three different categories, namely, risk-taking behaviour, expectations of online shopping and expectations of crowdshipping. In this part these three aspects are explained.

Trust is a vital concept that entails success or failure in the service when there is a risky or uncertain situation [36]. In the case of crowdshipping delivery, there might be a risk that the crowdshipper can keep the package for himself instead of delivering it to the receiver, or the package might get damaged during the delivery process. For such circumstances, it is also essential to figure out how much people are willing to take risk while using the service as the service demand originates from the users. Thereby, willingness to take risks needs to be considered to model trust towards an action, behaviour, or service. Although the role of risk-taking behaviour to build trust is disregarded in prior trust literature [37], recently, this indicator of trust is extensively explored in customer research [38]–[40].

From the conceptualisation point of view, being risk-seeking and risk-averse are connected to trust [38], [39]. In a crowdshipping setting, one might have a higher risk-taking threshold than the other, which might be correlated to her/his trust in the service. In line with this thought, Colquitt et al. [41] represent a moderate to a strong positive relationship among the level of trust and risk-taking by using a meta-analysis approach.

Similar to risk-taking behaviour, expectations regarding online shopping or crowdshipping might have an impact on service adoption. In the case that individual perceptions of the delivery quality are met, the possibility of choosing crowdshipping might be higher. For this reason, it is worth investigating if there is a relation between these factors and the adoption of the crowdshipping service and if the level of trust plays a mediating role in the service adoption.

As it can also be derived from the literature, attitudinal profile can be associated with the adoption of crowdshipping service, which brings the following hypothesis for this research.

Hypothesis 2a: Attitudinal profile is associated with the adoption of the crowdshipping service.

Additionally, the adoption of the crowdshipping service may have its impact on the level of trust through its effect on the personal attitudinal profile. In the scope of this research, attitudinal profile is assumed to have an impact on crowdshipping service adoption mediated by the level of trust. Thereby, the following hypothesis is proposed to investigate the stated relationship.

Hypothesis 2b: The level of trust partially mediates the effect of the attitudinal profile in the crowdshipping service adoption.

Other trust indicators- Delivery time and Delivery cost

Even though the crowdshipping concept has been discussed recently in the literature, some studies are available to evaluate the impact of the concept from both operational and economic perspectives. Regarding the operational perspective, one of the key features of this system is that workers are self-scheduled as they determine how often and when they work [10]. This means that the system flexibility of deliveries depends on the communication between the crowdshipper and the system user. The attractiveness of the crowdshipping service is that the customer (person or shop) is able to send the package incidentally in relatively giving more flexibility in the time [42]. Since crowdshipping allows

deliveries to be executed in a more customised way, possible delivery time appears as one of the other essential features in the system. Thanks to the hypotheses shown below, the relationship between delivery time and adoption of the service and the mediating effect of the level of trust can be examined.

Hypothesis 3a: Delivery time of the service is negatively associated with the adoption of the crowdshipping service.
Hypothesis 3b: The level of trust partially mediates the effect of delivery time in the crowdshipping service adoption.

In the literature, the studies focusing on the economic impacts of crowdshipping show that this new delivery concept can have several advantages from an economic point of view. Arslan et al. [10], for instance, state that crowdshipping can reduce the transportation cost for transport service providers since the system allows making payment to crowdshippers which would be in principle less than general transportation cost. Moreover, last-mile delivery can bring major economic benefit for all stakeholders when crowdshipping is preferred as outsourcing logistics [4]. Devari et. al., [4] find out that retailers can reduce delivery costs by 8600$ per day which is equivalent to diminishing their total truck mileage by 57% when the last-mile delivery is crowdsourced. Thereby, it is expected that the delivery cost in crowdshipping is less than traditional delivery options which is in line with the literature review [4], [10], [13]. As explained in Section 2.3.1, rational trust is directly connected to the system's perceived outcomes, such as reward and costs. For this reason, the delivery cost can be seen as a vital aspect from the trusting behaviour perspective [43]. While the lower delivery cost can lead to a positive impact on the crowdshipping service adaption, it can be mediated by the level of trust. Therefore, the corresponding hypotheses are postulated below.

Hypothesis 4a: The delivery cost of the service is negatively associated with the adoption of the crowdshipping service.
Hypothesis 4b: The level of trust partially mediates the effect of delivery cost in the crowdshipping service adoption.

Reliability

In the crowdshipping service like in traditional deliveries, one of the most important concerns is reliability issues. Thereby, reliability concerns in crowdshipping appear to be an indispensable part of the successful crowdshipping operation [14], [15], [17]. Some studies state a strong relation between reliability and level of trust [44], [45]. In other words, when the service is perceived as reliable, then the user's trust would be higher for that specific service. In the US and Australia, the crowdshipping start-ups (UberRush, PostMates, PostRopes) have grown exponentially since they successfully maintain their users' trust enhancing their service reliability [17]. Therefore, perceived reliability remains important feature to the customers in order to build trust among the customers and to let the unknown crowd deliver the package [6].

As can also be concluded from the literature, the system acceptance can be assured if the users believe that the service is reliable. Although reliability is a complex feature to be measured, in the crowdshipping context, it is believed that some features can indirectly measure the reliability of the service, such as traceability of the delivery operation, insurance policy of the crowdshipping company and the possibility of a damaged delivery. These features would give users tangible insights to assess the service's reliability and enable users to trust the crowdshipping service. Moreover, it would be possible to represent how the adoption of this new delivery system can be carried out. With this measurement, the below hypotheses are proposed.

Hypothesis 5a: The existence of tracking and tracing options of the service is positively associated with the adoption of the crowdshipping service.
Hypothesis 5b: The level of trust partially mediates the effect of tracking and tracing options in the crowdshipping service adoption.

Hypothesis 6a: Insurance coverage of the service is positively associated with the adoption of the crowdshipping service.
Hypothesis 6b: The level of trust partially mediates the effect of insurance coverage in the crowdshipping service adoption.

Hypothesis 7a: The possibility of damaged delivery in the service is negatively associated with the adoption of the crowdshipping service.
Hypothesis 7b: The level of trust partially mediates the effect of possible damaged delivery in the crowdshipping service adoption.

Reputation

As an essential component in the service adoption, reputation is directly linked to trustworthiness [46]. The delivery company's reputation can be evaluated based on the satisfied customer reviews or app ratings. Additionally, the reputation of the crowdshipping company would be more influential than the cost of the delivery and the delivery time [15]. In the scope of this research, the delivery company's reputation considered the credibility of the company and the rating of the company's app.

During the delivery process in crowdshipping, there might be unwanted consequences such as misdelivery, damaged or wrong delivery. In those circumstances, users exposed to risky service or poor service quality. As the company's reputation provides information about the service, this knowledge can diminish unwanted service outcomes [47]. Reputation enables the user to envision the service quality as it provides other user's reviews and comments which result in the service adoption. For this reason, the following hypotheses are tested to evaluate if reputation has a direct impact on the service adoption or if the level of trust mediates it.

Hypothesis 8a: The delivery company's reputation is positively associated with the adoption of the crowdshipping service.
Hypothesis 8b: The level of trust partially mediates the delivery company's reputation in the crowdshipping service adoption.

3

RESEARCH METHODOLOGY

This chapter explains the conceptual framework derived from the literature review as well as the data collection and analysis method to answer the research questions in Section 1.4. In order for the conceptual model to be quantified, it is needed to provide a statistically rigorous method where the analysis of correlations between psychological constructs also takes place. The following, the methodology used in this research to collect the data; a SPE is explained in Section 3.2. Then, the method used to research the effects of the level of trust on adopting the crowdshipping service, namely MCM is discussed in Section 3.3. Finally, a LCCM is described in Section 3.4 where the focus is to identify the number of classes that incline to have a higher probability of adopting the crowdshipping service. It is important to mention that the used research approach is based on a working paper [48], where the authors investigate the effect of safety perception and support for policy measures while travelling by train during the pandemic.

3.1. Conceptual Model

With the help of the literature review, various measurements to operationalise trust are represented. The review provides useful insights of trust measurements on crowdshipping service. However, it is vital to point out that not many studies have been done to show the relationship between trust and crowdshipping in particular. Therefore, it is not clear how this relationship between trust towards crowdshipping and the adoption of the service works.

In this section conceptual model which is framed for this research is given. Besides that, the relations among trust measurements and adoption of the service are provided based on the hypotheses explained in Section 2.3.

The focus of the conceptual model is to understand how various features affect the adoption of the crowdshipping service and whether trust plays a mediatory role in this adoption. The causal paths are used to explain the relations between various features and adoption of the service and the effect of trust in this context. Based on the discussions in Chapter 2, the conceptual framework is visualised in Figure 3.1.

To show the heterogeneity in preferences, LCCM is also needed to be mentioned in the conceptualisation. Due to the fact that MCM and LCCM are two separate models applied to the research, it is not directly possible to visualise both the models in the same framework. To estimate LCCM, the total effect of the variables is used, that the effect of trust is not included as it is already explored thoroughly in MCM.

It's worth mentioning that the proposed model is only used in this research. Although it does not present entire possible measurements and relations, the model provides main features for the adoption of the service.

Since one of the important aims of this research is to understand if the level of trust has a mediating role in adopting the service, conceptual design should be in line with this consideration. Two paths need to be created in order to examine this relationship. First of all, the measurements, namely individual characteristics, traditional features, reliability measurements, and reputation, can directly impact the adoption of the service (the paths represented with the subindex-a). In other words, trust does not have an indirect impact on the adoption. Secondly, the level of trust might have an indirect effect towards the adoption of the crowdshipping service. Hence, the measurements can be mediated by the level of trust, revealing the second path in the conceptual design (the paths represented with the subindex-b).

As the concept of trust contains multiple factors, the causal paths might become quite complex. For this reason, it is not possible to examine all interactions in the scope of this research such as the link between traditional features and reliability or personal risk-taking attitude and reliability. What is preferred is to show possible relations in the conceptual design. Thereby, the final version of the

conceptual model, shown in Figure 3.1, can be considered a simplified version of reality. The used paths and corresponding reasons and arguments behind the choice are discussed in detail in the Section 2.3.

At this point, it is essential to describe the role of trust in the conceptual design. It is believed that the level of trust towards the crowdshipping system affects the adoption of the service. For this reason, it is wise to examine whether this characteristic of trust can be captured via the design. Additionally, individual characteristics such as age, gender and education level are considered some variables that can be related to directly adoption of the crowdshipping service and can be indirectly mediated by the level of trust.

All in all, the hypotheses which are tested in the scope of this research are represented in the conceptual model below.

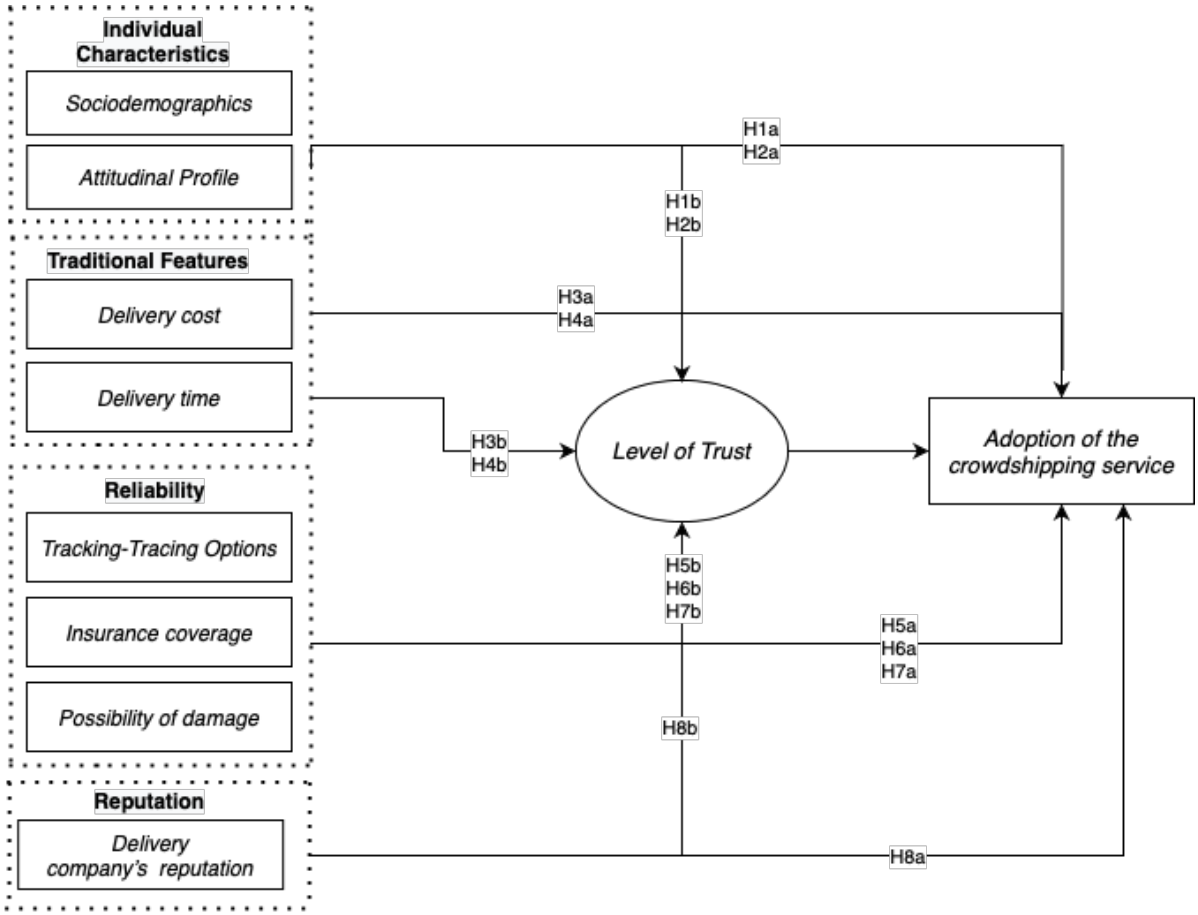

Figure 3.1: Conceptual model

3.2. Stated Preference Experiment

The used data for answering the research questions can come from revealed preference data or stated preference (SP) surveys. In this research, an SP survey is designed since crowdshipping service has not been applied in the Netherlands, and there is no revealed data available in this context. Moreover, this experiment technique enables the author to capture the decision to use the crowdshipping service. In the experiment, the respondents are asked to make choices based on a set of hypothetical situations. Since SP surveys use hypothetical scenarios, these experiments are ideal for testing future situations [49]. With this method, the experiment in general is easier to control and more flexible to be applied [50]. Another substantial advantage of this method is that the author can collect multiple observations from the same individual, which makes the sample size larger in the end.

Besides the advantages of SP, applying this method has some limitations. Firstly, designing these experiments may involve bias from the researcher side since the researcher specifies the important attributes incorporated in the design and has control over which alternatives are provided in the

experiment [51]. Secondly, the experiment has hypothetical scenarios where the respondents opt for their best preference. However, it is not clear if the person would choose the same alternative in the real life setting. Furthermore, the decision about the attributes and the attribute levels need to be thoroughly described in order to minimise hypothetical bias. Therefore, the context of the experiment and the selection of the attributes for the experimental construct are given in the following.

3.2.1. Context

As the crowdshipping service in the Netherlands can be seen as a relatively new concept, there are not many different alternatives that one respondent can assess. For this reason, in the choice experiment, people are asked to make the selection between two different unlabeled alternatives, namely crowdshipping delivery and traditional delivery options. Moreover, there is a need to create a context for respondents to make them consider the same assumptions in choice sets. To this end, respondents are asked to consider the last item that they bought and the value of that item while choosing their preferences. Moreover, the statements given below are provided in the choice experiment so that every respondent can imagine a similar context.

- The product is not needed urgently.
- As a receiver, you have to be at your predefined location to collect the package.
- In case of a damaged or wrong delivery, you can only reach out the transportation company for your claims.

After defining the general context and assumptions of the experiment, respondents encounter two questions. In the first part, they are asked to choose if they prefer to select crowdshipping delivery option or not. Secondly, they are asked to rank their level of trust towards crowdshipping even if they do not select the crowdshipping option in the first question. This question is formulated to be in line with the conceptual model and to analyse how much people trust crowdshipping based on the given hypothetical scenario.

The example shown below represents these two questions.

Example: Imagine the last item that you bought online, the shop (website) provides two alternatives to deliver your package to your intended location.From the available delivery options below, select the one that fits your preference most

1. Would you consider making use of this crowdshipping service?

- Yes
- No (I would use traditional delivery)

2. Based on the above mentioned scenario, how much would you trust crowdshipping?

- Strongly distrustful
- Distrustful
- Neutral
- Trustful
- Strongly trustful

Throughout the experiment, while the attribute levels of crowdshipping alternative vary, the traditional delivery option values are fixed. There are several reasons behind this choice. First of all, the traditional delivery option is considered a base alternative in order for respondents to compare with the crowdshipping option. Next, individuals are more familiar with the traditional delivery; therefore, it is expected to make the selection between alternatives more imaginable for respondents when it comes to crowdshipping. Lastly, treating traditional delivery as a base alternative allows the author to analyse the direct and indirect effect of trust towards the service adoption with the used mediation model, explained in Section 3.3.

3.2.2. Attributes and Attribute Levels

In this part, the important attributes and attribute levels are introduced which are related to trust and crowdshipping concept.

In the SPE, selection of the attributes is a vital process in order to meet the research objectives. However, most of the time the research cannot cover all the features that might have an impact on the research focus. Consequently, essential features to capture the choice behaviour should be included in the experiment [52]. Another point that needs to be considered is the number of attributes in the experiment. It is believed that as the number of attributes increases, there is a high chance that a respondent cannot consider provided information [50]. The attributes can be qualitative (e.g. reputation of the company) and quantitative (e.g. delivery cost). They should be formulated to deduce similar context from the choice set. Relevant academic and grey literature, expert interviews and discussions can be used to decide the most prominent attributes in the research [53].

To avoid respondents missing out on essential information and achieving good survey quality, not all the attributes explained in Section 2.2.1 are considered in the experiment. In this way, it is believed that the selection of the attribute levels is closer to reality with a more practical approach.

The selected attributes, namely delivery time, delivery cost, reliability (tracing and tracking options, insurance coverage, the possibility of damage) and the delivery company's reputation, are described below.

Delivery time and delivery cost

Since crowdshipping delivery is a relatively new concept, the system's adoption depends on the possible advantages deduced from the service. Thanks to the idea of sharing economy and more customised last-mile deliveries, the delivery time becomes an important component that one might seek for. Thereby, delivery time needs to be taken into account in the choice set. Moreover, to survive the competition in the transportation industry, service providers need to find the competitive price for the service. Due to the fact that price is directly linked to the customer's choice behaviour, low delivery cost enables customers to use the system. These attributes are considered traditional features in the study regarding the relation between trust and delivery time and cost. They are expected to have a strong relationship with or through the level of trust.

Regarding the attribute levels for delivery time, same day or next day delivery options are defined. These attribute levels aim to assess the importance of delivery speed for the respondents. As the main goal of the research is to understand how trust is affected by the provided crowdshipping service features, delivery time is not needed to be represented with hours specifically. Hence, only generic information (either same day or next day) is provided . In this way it would also be possible to examine how much elasticity can occur on the delivery time. Next, the cost of the service is assumed to be 5-7-10 and 12€. Although the crowdshipping service cost is calculated based on the distance travelled, respondents are provided with pre-specified cost values. The reason for this is to investigate to what extent people are conscious regarding the cost. Also, in the experimental design, there is no specification regarding the travel distance which makes stated cost values more relevant for this research. Thanks to this specification, respondents have also a chance to compare different cost levels with the traditional delivery, which has intermediate attribute levels in the experiment.

Reliability

This feature is indirectly measured with three different attributes. The reason for this is an abstract nature of reliability. It is believed that the effect of reliability can be investigated with specific features, namely, tracking and tracing, insurance coverage and the possibility of damage.

Tracking and tracing options

To what extent the delivery company can track the delivery process is considered one of the other essential components that can be linked to users' trust and the adoption of the service. This feature provides information to the users so that they can have supervision over the conditions of the delivery. Tracking of the crowdshipper is seen as a unique advantage of the crowdshipping service [7], [12]. In local delivery, real time tracking is found significant in users' behaviours on choosing crowdsourced deliveries [12]. Therefore, the option of tracking and tracing facility is included in the choice set.

As for the level of the attribute, the availability of real time tracking for the alternative is considered. Due to the novelty of the platform, it is assumed that having a real time tracking of the crowdshipper might impact the reliability of the service and users' level of trust.

Insurance coverage

To indirectly refer to reliability feature, insurance coverage is also included in the research. Since the delivery company covers the insurance, in the choice sets, the representative values are provided. In

case of damaged delivery, insurance coverage becomes an essential indicator tested in the scope of this research.

Insurance coverage is represented with an upper bound value in the choice set with two levels. These values are used to describe the limit of the insurance since this is also the way insurance coverage is represented in real life setting.

The possibility of damage

Regarding the possibility of damage, this feature is also considered one of the vital attributes to assess the service adoption and the level of trust. According to the research conducted by Le and Ukkusuri [54], delivery of the packages on time without any damage is essential for the sender when opting for the service. The research done in the US and Vietnam shows that 85% of potential users are concerned about the damaged delivery. Due to the fact that possibility of damaged delivery impact users' perception, this research takes into account different values for the possibility of a product getting damaged.

The attribute is shown with the percentages representing the possibility that the item can get damaged or lost. The values are given to measure if the possibility of damage affects the service adoption and the level of trust in crowdshipping.

Delivery company's reputation

The reputation of the company is provided as another feature in the choice set. It is believed that this feature might impact the choice of the service and can be linked to the level of trust. Although there is no research found including the crowdshipping company's reputation, a study takes into account the reputation of the courier specifically [15]. In the scope of this research, the company's reputation based on their app rating is considered and given in the choice set.

To show the delivery company's reputation, the number of stars is provided concerning the app rating, and the aim is to show the credibility of the delivery company, which is directly related to the concept of trust. Although the level of reputation is considered as low, medium or high in some studies [54], [55], as far as the research concerns, this is the first time that the number of stars in the app is considered in users' service adoption. With respect to the attribute levels, providing one or five stars might lead to bias in the attribute since they are both extreme values in app rating. Hence, two and four stars are preferred in the experimental design.

Table 3.1 below shows the summary of the concepts mentioned above for crowdshipping alternative and Table 3.2 represents the given fixed intermediate values for the traditional delivery option.

Table 3.1: Summary of the attribute levels for crowdshipping delivery

Attribute	Number of attribute levels	Levels	Coding
Delivery time	2	Next day delivery Same day delivery	0 1
Delivery cost	4	5€ 7€ 10€ 12€	5 7 10 12
Tracking tracing options	2	Only main steps can be seen in the app/website Real time driver tracking by the app/website	0 1
Delivery company's reputation	2	★★ ★★★★	0 1
Insurance coverage	2	Up to 500€ Up to 1000€	0 1
Possibility of damage	2	1 in 20 damaged delivery (5%) 1 in 30 damaged delivery (3%)	0 1

Table 3.2: Summary of the attribute levels for traditional delivery

Attribute	Levels
Delivery time	Next day delivery
Delivery cost	10€
Tracking tracing options	Only main steps can be seen in the app/website
Delivery company's reputation	★★★
Insurance coverage	Up to 750€
Possibility of damage	1 in 25 damaged delivery (4%)

3.2.3. Experiment design

After clarifying the context of the SPE, related attributes and the attribute levels, the choice sets used in the survey need to be explained. To be able to combine defined attribute levels into a choice set, an orthogonal fractional factorial design with one 4-level and five 2-level attributes is chosen, which results in 16 unique profiles. Ngene software package is used to generate the choice tasks [56] and dummy coding is used to code binary level attributes. The syntax used to create the choice tasks and the experimental design can be found in Appendix- B. The design is divided into two blocks in order to limit the load faced by respondents. Consequently, respondents are randomly assigned to one of the blocks, and they are asked to fill in 8 choice tasks. The Figure 3.2 below shows an example choice task which is asked in the experiment.

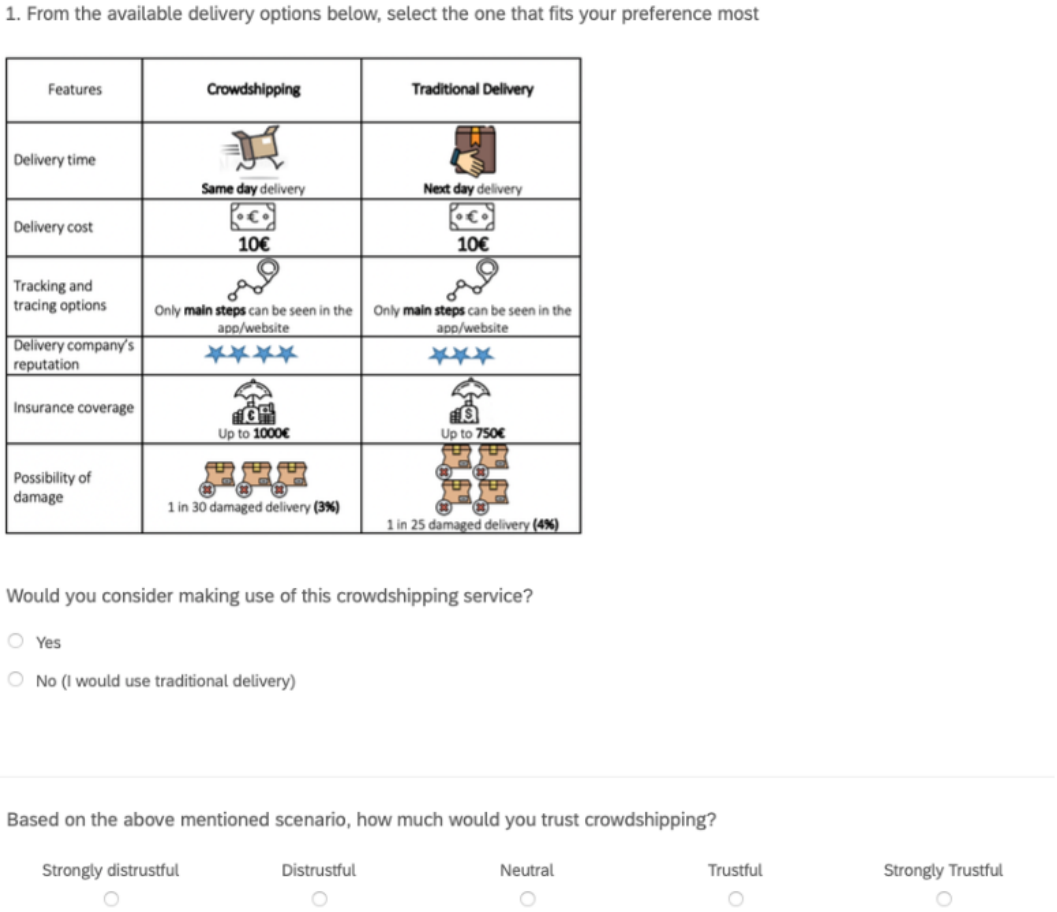

Figure 3.2: An example choice task

3.2.4. Background Variables

Background variables are used to investigate if they have an impact on individuals' preference in the choice of crowdshipping and the level of trust. These variables are included in the survey to explore whether they can differ from one individual to other. Table 3.3 below shows the used background variables in this research.

Table 3.3: Summary of the background variables

Sociodemographic	Online purchasing habit and crowdshipping awareness	Attitudinal questions
Gender	Frequency of shopping online	Risk-taking behaviour
Age	Awareness of crowdshipping	Expectations of online shopping
Occupation		Expectations of crowdshipping
Education level		
Income		

As the first group in the background variables, sociodemographic characteristics are asked. These characteristics consist of gender, age, occupation, education level and income questions in order to check whether the sample data is representative in the population and if these profiles have an impact on the service adoption as well as the level of trust.

Next, people are asked to provide their frequency of shopping online and the price that they usually pay for these purchases. The last group of questions in this section is related to awareness of crowdshipping service in general. With the help of these questions, it is expected to analyse the familiarity of the crowdshipping delivery.

The last group of questions are categorised as attitudinal. In this group, questions regarding risk-taking behaviour, expectations of online shopping and crowdshipping are included. As explained in Section 2.3.2, risk-taking behaviour is one of the essential aspects to assess the level of trust. For this reason, four lottery questions are created to measure the person's risk-taking attitude in different circumstances. For these types of questions, a domain-specific risk-taking (DOSPERT) scale is used [57]. For this category, statements are divided into two categories: safe lottery and risky lottery questions. On the one hand, in the safe lottery context, the respondents can keep some money for themselves. In the risky lottery context, on the other hand, all the money is gambled. Regarding the expectations about online shopping and crowdshipping, they are categorised on a 5-point Likert scale to understand how much importance the concepts have for respondents. In order to measure this group of questions, factor analysis is applied.

Table 3.4 below shows the questions which are asked to individuals in the attitudinal category.

Table 3.4: Summary of the attitudinal questions

Risk-taking behaviour
20% chance you will lose 50€; 80% chance you will gain extra 100€
80% chance you will lose 50€; 20% chance you will gain extra 100€
20% chance you will lose 100€ (all the money); 80% chance you will gain extra 400€
80% chance you will lose 100€ (all the money); 20% chance you will receive extra 400€
Expectations of online shopping
I would like to have the opportunity to see delivery options
(e.g. click and collect, pick-up points, traditional delivery or crowdshipping)
There should be an option to choose a delivery time window
(e.g. to be delivered between 11-12 am)
Delivery should be shipped on the same day or out of service hours
Expectations of crowdshipping
I should be able to see crowdshipper's credibility
Crowdshipping service should provide a specific delivery time window
(e.g. between 10-12am package will be delivered)
The tracking and tracing facility of the app improves the service trustworthiness
The service's trustworthiness increases if the crowdshipping company has a feedback system

3.2.5. Survey Design

Once the experimental design is completed, the next step is to create the questionnaire in order to collect the data. In this section, the set-up of the survey is described by providing the structure of the survey.

The questionnaire was built by using an online web platform called "Qualtrics" and consisted of four main parts and an introductory section in which the aim of the survey was explained, and the consent of the participants was asked. In total, the survey had 36 questions, and it took approximately 10 minutes to complete, which is in line with the ideal survey length.

In the first part, respondents were asked about their online purchasing habits and their awareness of crowdshipping. While the online shopping questions were asked to measure the respondents' characteristics regarding online shopping, crowdshipping awareness was asked to understand how much respondents are familiar with the crowdshipping service.

Before the SP questions, which was the second main part of the survey, people were asked to provide the last item they bought online and the value of that item. These questions were then used in the SP section as a reference point. Regarding the SP section, the experiment was designed in two different blocks. These blocks are randomly assigned to the respondents. In this part of the survey, individuals filled in 8 choice sets with two sub-questions each.

Next, three sets of attitudinal questions were asked. First of all, to measure the risk-taking or risk aversion of respondents, lottery questions were created. In this part, with the differentiation of safe and risky lottery questions, it was expected to measure not only respondents' risk-taking threshold but also their safety perception. Next, three statements were given to understand the preferences while ordering online. Lastly, four statements were composed to understand the preferences in case of using crowdshipping.

In the last part of the questionnaire, sociodemographic characteristics were asked. In this part, individuals were filled in the information regarding gender, age, occupation, education level and monthly income.

The list of the questions which are explained above and one of the final survey versions can be found in Appendix- D and in Appendix- E respectively.

3.2.6. Survey Distribution

The survey was distributed to the author's direct contacts, acquaintances, and social media platforms. Besides that, the flyers, which can be found in Appendix- F were handed out to reach more respondents.

The data collection process is done through the help of the survey circulation. Before that process, the pilot survey is executed in order to assess if the data collection is executed without any technical issue and to check if the survey content is understandable by respondents. To test the survey, 17 respondents filled the pilot questionnaire. The pilot survey showed that choice sets for the stated choice experiment need to be modified; however, no technical error originated from the used online survey platform.

After the pilot survey circulation, the final data collection process took place in the last week of April in 2021 and was kept online for three weeks. Respondents who live in the Netherlands and are above 18 years of age were able to fill in the survey In the end, 248 responses were collected, of which 215 were fully completed. As also explained in Section 3.2.5, the survey is divided into two blocks of SP questions, resulting in 108 responses from the first block and 107 responses from the second block.

3.3. Mediation Choice Model

To answer sub-question 3 and 4, MCM is applied. The model is developed to analyse the data which is gathered in SPE. In this model, the level of trust acts as a mediating variable among the relevant attributes and adoption of the crowdshipping service. To the best of the author's knowledge, in the crowdshipping context, there is no study in which the level of trust is directly included in a choice model as a mediating variable. Thereby, it is also important to point out that this research provides a methodological contribution to the literature.

MCM is used when there is an availability of mediating structure, meaning that the effect of a variable on the other can be mediated by another variable (M). With this model technique, direct effects of level of trust is distinguished from the indirect effects. Thanks to this analysis, more elaborate picture of the direct impact of the independent variables on the service adoption and indirect effect through level of

trust is obtained. The overall representation of the mediation model is shown in Figure 3.3 below. To ensure that there is a mediating structure three-variable system is needed [58]. This system consists of two causal paths through dependent variable, which are represented below. While path c shows the direct impact of the independent variable (X) on the dependent variable (Y), path a indicates the role of the mediator (M). Finally, from the mediator, there is another path (b) showing the impact of the mediator on the dependent variable (Y).

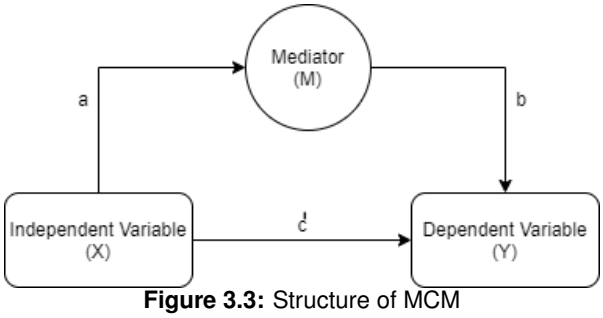

Figure 3.3: Structure of MCM
Source: Adapted from [58]

Thanks to this analysis, mediation can be explored, including independent, dependent, and mediating variable settings [59]. This analysis is preferred to quantify direct and indirect pathways where an independent variable transmits its effect on a dependent variable through a mediating variable [60]. The generic equations below are used for the mediation choice model [59].

$$Y = i_1 + cX + \epsilon_1 \tag{3.1}$$

$$Y = i_2 + c^{'}X + bM + \epsilon_2 \tag{3.2}$$

$$M = i_3 + aX + \epsilon_3 \tag{3.3}$$

Where:

Y = The dependent variable
X = The independent (predictor) variable
M = The mediator
a = The coefficient linking the independent variable to mediator
b = The coefficient linking the mediator variable to dependent variable adjusted for the mediator
c = The coefficient linking the independent and dependent variable
$c^{'}$ = The coefficient linking the independent variable to the dependent variable adjusted for the mediator
i_1, i_2, i_3 = Intercepts
$\epsilon_1, \epsilon_2, \epsilon_3$ = Residual terms

In the base model, it is tested if the level of trust acts as a mediator between the choice sets, where the main attributes are placed, and the adoption of the crowdshipping service. Moreover, the attitudinal profile and sociodemographic characteristics are added to independent variables to test their effect on crowdshipping service adoption as well as the level of trust.

A visual representation of the base model is shown in Figure 3.4.

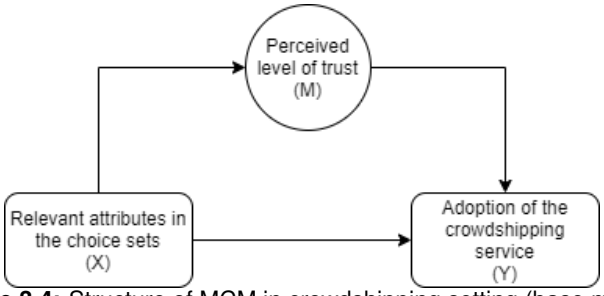

Figure 3.4: Structure of MCM in crowdshipping setting (base model)

Based on this setting, the variable X is the independent/the exogenous variable and M and Y are the dependent/endogenous variables. M also acts as the mediating variable. In the scope of this research, the level of trust is assumed to be an observable variable and directly measured with a 5-point Likert scale in the choice experiment. Thereby, this part of the model is investigated with a linear regression model. Thanks to this approach, it is possible to analyse how relevant attributes in the choice sets would impact the level of trust.

$$\widehat{Trust}_j = C^{Trust} + \sum \beta_i^{Trust} * X_{ij} \tag{3.4}$$

Where:

$Trust_j$ = Level of trust for a crowdshipping choice set j
C^{Trust} = Regression constant
β_i^{Trust} = Regression coefficient for attribute i on level of trust
X_{ij} = Dummy coded attributes i (shown in Table 3.1) for crowdshipping choice set j

Concerning the adoption of the service, the respondents are asked to make a choice if they would opt for the crowdshipping service or not. Hence, the variable Y is examined as a dichotomous dependent variable. This part of the model is measured with a binary logistic regression model which is shown below.

$$\widehat{Adopt}_j = logit = ln\left(\frac{P_{Yes}}{P_{No}}\right) = C^{Trust} + \beta_{Trust}^{Adopt} * Trust_j + \sum \beta_i^{Trust} * X_{ij} \tag{3.5}$$

Where:

$\widehat{Adopt}_j$ = Adoption of the crowdshipping service for choice set j
P_{Yes} = Opting for crowdshipping service
P_{No} = Rejecting crowdshipping service
C^{Trust} = Regression constant
β_{Trust}^{Adopt} = Regression coefficient for level of trust on the adoption of the crowdshipping
$Trust_j$ = Level of trust for a crowdshipping choice set j
β_i^{Trust} = Regression coefficient for attribute i on level of trust
X_{ij} = Dummy coded attributes i (shown in Table 3.1) for crowdshipping choice set j

There are many statistical packages to analyse MCM. A few of them are M-plus, Lisrell, Analysis Moment of Structure (AMOS), and Statistical Anaylsis System (SAS). Throughout the research, the analysis is conducted with the help of M-plus [61].

3.3.1. Path Analysis

With the help of the path analysis, the relationship amongst the independent and dependent variables tested in the research are investigated. The analysis method is used to evaluate fitting a causal model with measured variables, and it can be seen as a sub-model of a full structural model where there are no unmeasured variables involved [62]. Path analysis also enables the author to test the impact of the

variables on the specific path. With this analysis, the importance of the assumed relationships and arguments can be found out.

In this research path analysis is conducted via the same software package (M-plus) where the mediation choice model is also estimated. The results of the analysis can be found in Section 5.1.1, Appendix- G and Appendix- H.

3.4. Latent Class Choice Model

In the scope of this research, the LCCM is used to capture individual's heterogeneity in preferences. With the help of this method, the sample can be divided into segments based on the specific combinations. This technique assumes that there are classes where respondents' preferences are homogeneous, and the difference in preferences among classes is heterogeneous. In LCCM, the chance that a respondent with certain sociodemographic characteristics votes against or in favour of crowdshipping can also be investigated. LCCM consists of two components: a class-specific choice model and a class membership model [63]. While the class-specific choice model explains the choice of the decision-maker, the class membership is a function formulating the explanatory variables of the class for the specific individual [63].

The LCCM is defined with the following Formula 3.6 below [64]. Herein, $P_n(i|\beta)$ refers to the probability that individual n chooses alternative i, which is conditional on the model parameters β. Assuming s is a class, π_{ns} represents the class membership probability, in other words, the probability that an individual n belongs to class s. Lastly, $P_n(i|\beta_s)$ refers to the probability of an individual n choosing alternative i, ensuring the individual n belongs to the class s.

$$P_n(i|\beta) = \sum_{s=1}^{S} \pi_{ns} P_n(i|\beta_s) \tag{3.6}$$

To investigate the individual's probability of belonging to each class, a class membership function is estimated. This enables to examine whether this probability is related to personal characteristics or not. The formulation is given in Formula 3.7 [64]. The class-specific constants δ_s along with the vector of parameters γ_s need to be estimated. The function g($\circ$) refers to the functional form of the utility for the class. Lastly, in the formulation, z_n refers to observed variables which are taken into consideration in the model such as sociodemographics or context variables.

$$\pi_{ns} = \frac{e^{\delta_s + g(\gamma_s, z_n)}}{\sum_{l=1..S} e^{\delta_l + g(\gamma_l, z_n)}} \tag{3.7}$$

There are two types of criteria that can be used to choose the optimal number of classes. While bivariate residuals (BVRs) are used to determine the local measures of model fit, Bayesian Information Criteria (BIC) and Akaike Information Criterion (AIC) weigh both global and parsimonious model fit [65]. In addition, BVRs value is used in the case that a solution based on BIC value is difficult to interpret or is complicated to communicate [66]. However, since this is not the case in this study, BIC and AIC values are applied to assess the model fit.

The calculation of the BIC (3.8) and AIC (3.9) values are given below.

$$BIC = -Log\,Likelihood + [(number\,of\,parameters/2) * ln(the\,sample\,size)] \tag{3.8}$$

$$AIC = -2(Log\,Likelihood - number\,of\,parameters) \tag{3.9}$$

Finally, there are several software packages to estimate LCCMs. Some of them are Pythonbiogeme, Latent Gold (LG) Choice, Nlogit and R (Apollo). In this study, the model is estimated by using R (Apollo) [67] and the results of the model are shown in Section 5.7.

4

DESCRIPTIVE STATISTICS

After the survey distribution, the data collection process is carried out. In this chapter, descriptive statistics and the sample characteristics are described.

4.1. Sample Characteristics

In this section, sociodemographic characteristics, online shopping and awareness of crowdshipping as well as attitudinal profile are provided.

4.1.1. Sociodemographic Characteristics

The frequency distribution of sociodemographics based on the sample data is shown in Table 4.1 below.

Although more men have responded to the survey than women, the difference is close to a fifty-fifty distribution. Regarding the age group of the respondents, a considerable number of respondents belong to the 18-33 age group and more than half of the respondents are students who are doing master's or bachelors. Although there is an over-representation of young people in the sample data, people older than 33 years of age account for almost 15% of the data set. As the most dominant responses are students, the income distribution appears to be quite low.

To be able to show whether the sample data is representative or not, there should be a reference population where the Dutch sociodemographic characteristics need to be provided. According to the Central Bureau of Statistics (CBS) report [68], the female population in the Netherlands is 50.3%, and the same ratio for male is 49.7% in 2020. When comparing to the sample data, the male population is slightly higher than the reference value. With respect to age groups, nearly a quarter of the Dutch population is between 20 and 40 [68]. Moreover, the age group between 40 to 65 years old is almost 35% [68]. However, there is an over-representation of people between 18 and 41 years of age in the sample. Regarding the occupation, CBS statistics show that more than 50% of the Dutch population worked full-time in 2019 [69]. From the occupation point of view, the sample data is not representative as there is an over-representation of students (62.8%). As for educational level, the sample data is not representative and shows that almost 95% of respondents are either bachelor's/master's student or PhD employees. According to the CBS report in 2018 [70], a similar categorisation was done, and the statistics show that only 11% of the population has higher education attainment.

It is vital to point out that the possible applications of the research findings highly depend on the sample data gathered throughout the research. As there is an over-representation of the students with a low-income sociodemographic profile, the main outcomes of this research may differ and may result in inaccurate outcomes. Even though sociodemographic profiles are not representative in each segment in the population, it is remarkable to highlight that different sociodemographic segments are combined to obtain sufficient number of respondents to investigate the heterogeneity in preferences.

Table 4.1: Frequency distribution of sociodemographic characteristics of the sample (N=215)

Sociodemographic characteristics	Category	Frequency (N)	Relative (%)
Gender	Male	116	54.2%
	Female	93	43.5%
	Non-binary/ Third gender	4	1.9%
	Prefer not to say	1	0.5%
Age	18-25	100	46.7%
	26-33	83	38.8%
	34-41	16	7.5%
	42-49	10	4.7%
	50-57	5	2.3%
Occupation	Working full time	61	28.5%
	Working part time	9	4.2%
	Student	135	62.8%
	I have no work at the moment	8	3.7%
	Volunteer work	1	0.5%
Education level	VMBO(MAVO)	1	0.5%
	HAVO	3	1.4%
	VWO	4	1.9%
	MBO	2	0.9%
	Bachelor	52	24.3%
	Master	129	60.3%
	PhD	23	10.7%
Income level	Less than 500€	56	26.2%
	501-1000€	45	21.0%
	1001-1500€	20	9.3%
	1501-2000€	15	7.0%
	2001-2500€	10	4.7%
	2501-3000€	11	5.1%
	3001-3500€	8	3.7%
	More than 3500€	16	7.5%
	I prefer not to answer this	33	15.4%
Missing value		1	0.5%
Total		215	100%

4.1.2. Online purchasing habit and crowdshipping awareness

As an important indicator, the frequency distribution of online shopping habits and awareness of the crowdshipping service are shown in Table 4.2.

The questions being asked about the usage of ride-hailing services and awareness of crowdshipping show that respondents are more familiar with ride-hailing services such as Uber or Blablacar. As for the crowdshipping, more than three-quarters of the sample is not aware of the service. However, almost 20% of the respondents state that they have heard about the service, but they haven't used it yet. These outcomes can be seen as important indicators to examine the approach that needs to be chosen while entering the market in the Netherlands. Another interesting point that is asked in the survey is related to the online shopping habits of the respondents. Based on the sample, nearly 35% of the respondents shop online a couple of times in a month and the amount mostly spent is in the range of 0-100€.

Regarding the questions of the last item which was bought and its value, the biggest portion belongs to fashion items, followed by electronics/technological products. It is essential to point out that the value of those items is mostly in the range of 0-100€, which is in line with the above explanations.

Table 4.2: Online shopping habits and crowdshipping awareness (N=215)

Online shopping habits and crowdshipping awareness	Category	Frequency (N)	Relative (%)
Ride-hailing service usage	No, I am not familiar with these services	7	3.3%
	No, I have never used it	47	21.9%
	Yes, rarely	136	63.3%
	Yes, monthly	22	10.2%
	Yes, daily	3	1.4%
Crowdshipping awareness	No, I am not familiar with these services	164	76.3%
	No, I've heard about the service but I have never used it	41	19.1%
	I've heard about the service but I didn't know it's called crowdshipping	8	3.7%
	I have used the service	2	0.9%
Online shopping frequency	I don't use online shopping	2	0.9
	1-5 times a year	41	19.1
	6-10 times a year	49	22.8
	Once in a month	49	22.8
	Couple of times in a month	74	34.4
The amount spent on online shopping	0-50€	84	39.1%
	51-100€	74	34.4%
	101-200€	35	16.3%
	201-300€	13	6.0%
	301-400€	3	1.4%
	401-500€	1	0.5%
	500€+	5	2.3%
The last item bought online	Electronics/Technological product	58	27.0%
	Fashion item	89	41.4%
	Second hand product	8	3.7%
	Book/Music album	21	9.8%
	Other	39	18.1%
The cost of the last item	0-50€	126	58.6%
	51-100€	47	21.9%
	101-150€	19	8.8%
	151-200€	10	4.7%
	201-250€	2	0.9%
	251-300€	2	0.9%
	301-350€	3	1.4%
	351-400€	1	0.5%
	401€+	5	2.3%
Missing value		0	0
Total		215	100%

4.1.3. Attitudinal Profile

This section is divided into two parts. Firstly, the analysis of risk-taking attitude is presented, followed by expectations of online shopping and crowdshipping. In this part, to be able to search the fewest factors that can account for the common variance of a set of variables, exploratory factor analysis is used. The used technique is elaborately explained in the corresponding sections.

Risk-taking Behaviour

Risk-taking attitude is measured with four statements in the survey, and they are categorised based on being safe and risky. In a safety scenario, respondents are asked to imagine that they have 100€ and they would receive 50€ even if they lose the rest of the money. Nevertheless, in a risky situation, they would lose all the money (100€). These measurements are built on a 5-point scale ranging from "very

unlikely" to "very likely". In Table 4.3 below, the factor loadings are given, followed by the explanations of the analysis.

Table 4.3: Factor loadings of risk-taking attitude

Rotated factor matrix		
Statements	**Factors**	
	1	**2**
20% chance you will lose 50€; 80% chance you will gain extra 100€		0.764
20% chance you will lose 100€ (all the money); 80% chance you will gain extra 400€		0.826
Cronbach's Alpha	0.799	
80% chance you will lose 50€; 20% chance you will gain extra 100€	0.790	
80% chance you will lose 100€ (all the money); 20% chance you will gain extra 400€	0.849	
Cronbach's Alpha	0.768	
Kaiser-Meyer-Olkin (KMO) value	0.495	
Barlett's test value	0.000	

Before explaining the factor loadings, it is important to point out the adequacy of the sample. To do that, each dimension of a construct is tested with the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity. While KMO is used to point out the adequacy of the sample for factor analysis, Bartlett's test identifies if there is a possibility of reduction in different variables. Although the KMO test value is suggested to be higher than 0.5 in the literature, Barlett's test needs to be less than 0.05. The result of the KMO test shows that the value is 0.495, meaning that the sample might not be acceptable for the factor analysis. However, the stated four items load on two factors, which are above 0.70, and they converge on two dimensions. Therefore, the generated factors are used in the analysis. Additionally, the result of Bartlett's test of sphericity is statistically significant (<0.05), meaning that there is a scope for reducing the number of dimensions in the data set.

Based on the adequacy checks, it is concluded that the sample can be analysed with the help of factor analysis. Although there are several methods which might be used to extract the factors, principal axis factoring is used in this part of the research. There are several reasons behind this choice. First of all, the main aim is to identify a latent construct, namely risk-taking attitude along with the reduction of the items. Moreover, in this research, one of the focuses is to examine the dimensions behind the variables which makes this method useful.

After the selection of the extraction technique, rotation needs to be mentioned in order to achieve simple structure and to provide the better fit for the data. In this part of the research, varimax (orthogonal) rotation is used. With this technique it becomes possible to clarify the relationship among the items. In addition to that, this rotation method aims at maximising the variance shared among the items. To this end, the loaded factors show the correlation with each component.

Next, Cronbach's alpha coefficient is computed to be able to examine both constructs' reliability. Based on the Cronbach's alpha value of each construct, the groups stating 20% chance of losing and 80% of winning has a value of 0.799. With this coefficient value, it can be said that both of the dimensions in the construct is internally consistent. As for the second construct, the same value appears to be 0.768, which is an acceptable coefficient. As an overall outcome, Cronbach's alpha values are above the reliability threshold, which is 0.70, and coefficient values show that stated constructs have a relatively high internal consistency.

Finally, estimation of the factor scores is generated with regression factor scores in IBM Statistical Package for the Social Sciences (SPSS) Statistics (Version 26) predictive analytics software. For each individual items, corresponding factors are predicted and these factors are used in mediation analysis which is explained in Section 5.1.2.

Although the items are classified as safety and risky options in experimental design, the outcome of the exploratory factor analysis shows that the constructs are formed based on the losing and winning probability. This might be due to respondents' similar risk-taking attitude towards the given scenarios. Also, this might be because of the inadequate number of statements used to measure risk-taking attitude in the questionnaire. In the end, the first group of items represented with 20% change of losing and 80% chance of winning are loaded onto factor 2. In other words, these factors describe a 20%

chance of losing and 80% of winning situation in safety (0.764) and risky (0.826) constructs. The other group presented with an 80% chance of losing, and 20% chance of winning are loaded onto factor 1. These factors present 80% of losing and 20% of winning in safety (0.790) and risky (0.849) scenarios.

Based on the analysis, the factor scores belonging to each individual are shown with the help of a scatter graph (Figure 4.1). On the coordinate plane, the first and third quadrants are noteworthy to mention in detail. According to the visual, quadrant-I (gamblers) shows respondents who are willing to take the risk of gambling irrespective of the low or high probability of losing since they have positive factor values on both the constructs. Due to the fact that gambling involves risks, people belonging to this group might have a more risk-seeking attitude. In the crowdshipping setting, this group of individuals are more likely to be optimistic regarding crowdshipping service adoption since the crowdshipping also has some risks involved due to its novelty and unfamiliarity in the market. Quadrant-III (non-gamblers) indicates respondents who are more likely to avoid crowdshipping service as they have a tendency of selecting the safest option. These people are more likely to have risk-averse behaviour since they do not prefer either of the gambling options. Concerning the quadrant-II (low risk tolerant individuals), they have higher factor loadings for factor 2 (20% chance of losing) and negative values for factor 1 (80% chance of losing), meaning that they might be eager to take the risk on the minimum level. As for the individuals in quadrant-IV (unstable individuals), it is not straightforward to interpret their preference as they might be keen to take a high risk in such a gambling situation but not the low-level risk. Thereby, it might be said that people in quadrant-IV might not be consistent in given scenarios since their absolute tendency is not fully clear.

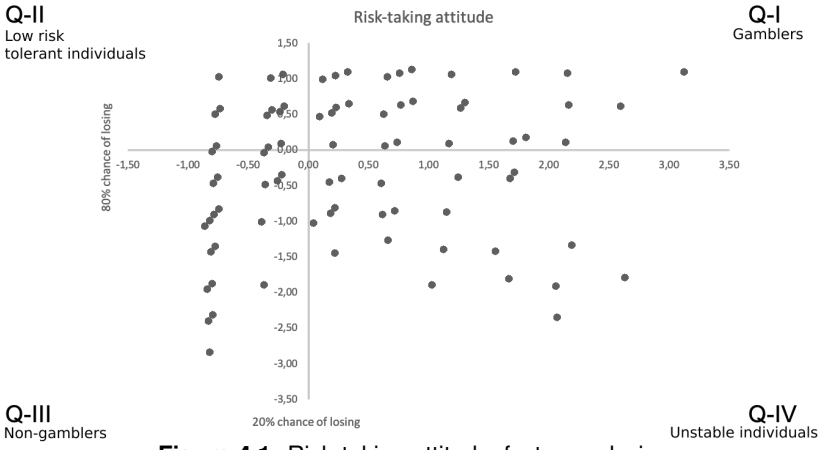

Figure 4.1: Risk-taking attitude, factor analysis

Expectations of Shopping Online and Crowdshipping

As a second part of the attitudinal questions, expectations regarding online shopping and crowdshipping are asked in the survey. These questions are formulated with 7 statements and are represented 5-point scale ranging from "strongly disagree" to "strongly agree" Similar to the technique which is explained in Section 4.1.3, exploratory factor analysis is used to check whether the statements measure the assumed constructs. However, the factor loadings show that the constructs can be classified as the quality of the delivery service and flexibility of the delivery. In this way, it is seen that the factor scores fit better than assumed constructs, namely expectations of online shopping and crowdshipping.

Based on the results which are shown in Table 4.4 below, the constructs load on two factors.

Table 4.4: Factor loadings of quality and flexibility of the delivery service

Rotated factor matrix		
Quality of the delivery service	**Factors**	
	1	**2**
I would like to have the opportunity to see delivery options (e.g. click and collect, pick-up points, traditional delivery or crowdshipping)	0.638	
I should be able to see crowdshipper's credibility	0.611	0.319
The tracking and tracing facility of the app improves the service trustworthiness	0.581	
The service's trustworthiness increases if the crowdshipping company has a feedback system	0.529	
Flexibility of the delivery service	**Factors**	
	1	**2**
There should be an option to choose a delivery time window (e.g. to be delivered between 11-12 am)	0.473	0.640
Delivery should be shipped on the same day or out of service hours		0.437
Crowdshipping service should provide a specific delivery time window (e.g. between 10-12am package will be delivered		0.724
Kaiser-Meyer-Olkin (KMO) value	0.756	
Barlett's test value	0.000	
Cronbach's Alpha	0.762	

The analysis shows that factor 1 is highly correlated with the quality of the delivery service. In this construct, the availability of seeing crowdshipper's credibility is also loaded onto factor 2. However, the value is appeared to be 0.319, which is moderately correlated comparing to factor 1. Regarding factor 2, the flexibility of the delivery service is mostly described with factor 2. In this construct, the availability of choosing delivery time window, also has a moderate correlation with factor 1. However, the factor loading is not as strong as factor 2. For this reason, only the strong factor loadings are used in the analysis which is explained in Section 5.1.2.

Similar to the factor analysis of the risk-taking attitude, individual factor loadings of quality of the delivery service and the flexibility of the delivery service are visualised in Figure 4.2. However, the factor loadings are mostly centred on the coordinate plane. Thereby, it can be said that there is no correlation among the quality of the delivery and flexibility of the delivery and they can be analysed independently.

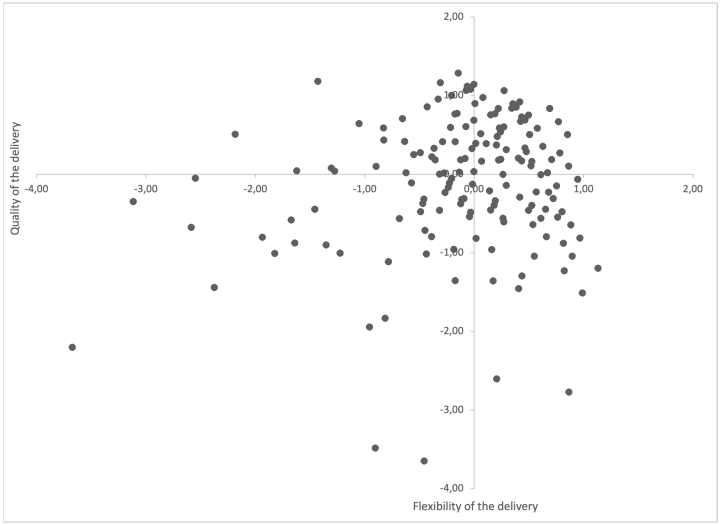

Figure 4.2: Quality and flexibility of the delivery service, factor analysis

5

RESULTS

In this chapter, the results of the MCM are provided in order to examine the direct, indirect and total effects of the level of trust in the crowdshipping setting. Furthermore, the LCCM is presented to show heterogeneity in the preferences towards the adoption of crowdshipping.

5.1. Mediation Choice Model

In this section, the outcome of the mediation analysis is shown. The analysis is categorised in a way to show the causal relationships between the independent variables on trust and the adoption of the service by using path analysis, described in Section 3.3.1 [3]

The results are structured in three model estimations to elaborate on the MCM. First, the base model is given, followed by attitudinal profile and finally combined with sociodemographic characteristics.

5.1.1. Base Model

The base model is constructed with only the main attributes, which are also shown in the conceptual model in Section 3.1. Below, the path analysis (Figure 5.1) represents the direct causal relationship between the corresponding attributes and the level of trust as well as the adoption of the service.

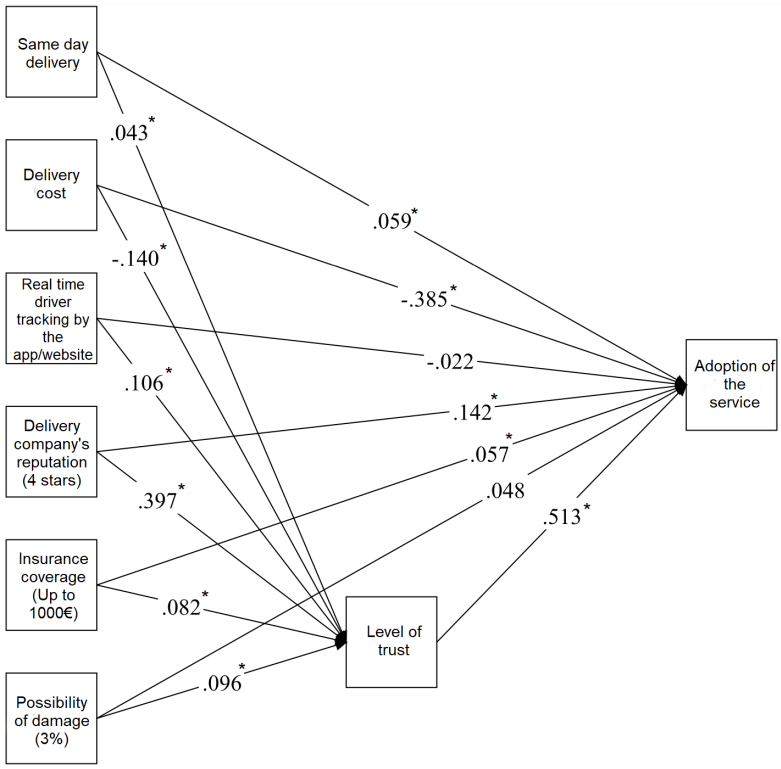

Figure 5.1: Path analysis- Base model (Standardised values)
*Significant level on 95% confidence interval (p<0,05)

[3] Since the outcome of the path analysis is similar in different model estimations, only the result of the base scenario is given in Section 5.1.1, and the rest of the outcomes are represented in Appendix- G and Appendix- H

It is noteworthy to mention that the biggest effect which can be explained between the independent variables and trust belongs to the delivery company's reputation. Based on the outcome of the path analysis, it is seen that one unit (2-stars) difference in the delivery company's reputation causes 0.397 of difference in the level of trust. This result is expected since the delivery company's reputation has an important impact on the perception of trust. Moreover, the variables, namely, real time tracking, the possibility of damage and insurance coverage, impact the difference in the level of trust, and they account for 0.106, 0.096 and 0.082, respectively. These results clearly show that the reliability-related factors has similar importance for the respondents.

It is also worth mentioning the negative relation between delivery cost and the level of trust. Based on the path analysis, an increase in the cost leads to a decrease on the level of trust towards the service. Even though this finding conflicts with the expectations, the reason might be that respondents would think that they are overcharged or lost interest as the delivery cost is crucial for them. Hence, their perceived level of trust might decrease. Lastly, same day delivery appears to be the least affecting factor on the level of trust.

The path analysis also shows the direct impact in between the attributes as well as the level of trust towards the service adoption. The figure shows that one unit difference in the level of trust leads 0.513 of difference on the service adoption, meaning that trust becomes an important indicator for the adoption of the service. Interestingly, the delivery cost becomes one of the most important indicators when it comes to the service adoption. The direct effect accounts for -0.385, which means that people are less likely to use the system as the delivery cost increases. Similar to the impact on the level of trust, one unit (2-stars) difference in delivery company's reputation causes 0.142 of difference on the service adoption. This means that reputation plays an essential role in both the level of trust and the service adoption.

All in all, the path analysis only shows the direct effects in this setting. For the sake of ease representation, only the standardised estimates without the error terms are shown in Figure 5.1. For this reason, in the following Table 5.1 standardised model results with direct (without the effect of trust), indirect (together with the effect of trust) and total effects are explained in detail.

Table 5.1: The mediation model: direct, indirect and total effects of the main attributes on the crowdshipping service adoption

		indirect effect on the service adoption		**direct effect on the service adoption**		**total effect on the service adoption**	
	Reference level	Est.	p-value	Est.	p-value	Est.	p-value
Delivery time							
Same day delivery	Next day delivery	0.022	0.048	0.059	0.015	0.081	0.002
Delivery cost		-0.072	0.000	-0.385	0.000	-0.457	0.000
Tracking and tracing options							
Real time driver tracking	Only main steps can be seen	0.054	0.000	-0.022	0.377	0.033	0.226
Delivery company's reputation							
Four stars	Two stars	0.204	0.000	0.142	0.000	0.346	0.000
Insurance coverage							
Up to 1000€	Up to 500€	0.042	0.000	0.057	0.020	0.099	0.000
Possibility of damage							
1 in 30 damaged delivery (3%)	1 in 20 damaged delivery (5%)	0.049	0.000	0.048	0.051	0.097	0.000
Level of trust				0.513	0.000		
Intercepts		3.488	0.000	0.672	0.000		
R-square (Trust)				0.206	0.000		
Pseudo R-square (Choice)				0.564	0.000		

Significance level on 95% confidence interval (p<0.05)
The coefficient values stand for standardised estimates.

From the detailed table above, some key findings emerge: First of all, it is obtained that the direct effect of trust on crowdshipping service adoption is statistically significant, and the coefficient is fairly strong, with the value of 0.513. This result highlights that when people opt for crowdshipping service, their perception of trust is affected by this value (0.513). A likely explanation of this positive relationship might be that it is more likely to adopt the crowdshipping service when there is a higher trust towards the service.

Moreover, the direct effect of the same day delivery on choice is statistically significant with the value of 0.059. As people generally seek fast delivery, this makes a choice positively linked to the same day delivery option. As for the indirect effect, which is computed through trust, there is a positive significance. This means that the same day delivery option has its indirect effect on the choice of crowdshipping through trust. This outcome is expected as the possibility of faster delivery leads to positive influence on the level of trust.

Concerning delivery cost, it is seen that the direct impact is negatively correlated on the choice of crowdshipping service (-0.385), meaning that as the cost of the crowdshipping delivery increases, it is less likely that people opt for the service. When the delivery cost increases, preference for the crowdshipping service decreases; hence, the negative relation of the cost can be seen as an expected outcome. An interesting point that needs to be mentioned is that the direct effect of delivery cost on trust. The value of the cost is negatively correlated (-0.072), which means that when the cost increases, the perceived level of trust decreases. The reason for this could be because of the risk involved is higher when the value of cost increases. Additionally, people might think that they are being overcharged; therefore, they might lose trust towards the system.

Regarding the tracking and tracing options, the direct effect of real time driver tracking by the app/website on the choice of crowdshipping service is not statistically significant, and the p-value is 0.377. Even though this result conflicts with the literature in which real time driver tracking for local deliveries is statistically significant, the reason could be that respondents focus more on other stated features instead of tracking and tracing specifically [71]. It is noteworthy to mention that the effect via trust for the same feature on the choice of the crowdshipping service is statistically significant and has the value of 0.054. This result is in line with the expected outcome since traceability of the delivery service would affect the individual's trust, and the reliability of the service increases with the real time driver tracking option. In the end, there is a fully mediating role of trust through the choice of the service.

Next, the direct impact of the delivery company's reputation and insurance coverage on the crowdshipping choice are statistically significant (0.142 and 0.057 respectively). These features impact service quality, hence, the choice of the service. The effect of the delivery company's reputation and insurance coverage via trust is also positively correlated to the crowdshipping service adoption. All in all, when the crowdshipping service provider has a good reputation and provides insurance coverage, the user's trust and the choice of the crowdshipping delivery would be positively impacted by the corresponding values (0.204 and 0.042, respectively).

As for the possibility of damage, the direct effect of this feature on the service adoption has a significance value (p-value) of 0.051. Since the value clearly shows a strong tendency towards statistical significance, the direct effect of possibility of damage on the service adoption is considered to be significant. Concerning the effect through trust, there is a positive correlation on the service adoption (0.049). This outcome is also interesting to investigate in detail since there is a partially mediating effect of trust. A likely explanation for this outcome might be because less damaged delivery enables individuals to trust the system and indirectly affects the choice of the crowdshipping service.

Furthermore, the intercept is defined as a mean of the dependent variable if all the independent variables are set to zero. In the model, dummy coding is used, and the reference values are set to 0, which can also be seen in Table 5.1. To this arrangement, the intercept for the trust is 3.488, meaning that the level of trust towards crowdshipping adoption on the reference points is nearly trustful on the rating scale. The estimated intercept on the service adoption has a value of 0.672. This means that if all independent variables are zero, there is a positive preference for crowdshipping as the parameter is positive and statistically significant. To examine the crowdshipping service adoption in the sample data, the abovementioned values are summed, resulting in 4.16, which is considered trustful in the rating scale. This result is indeed meaningful as the model predicts that individuals opting for crowdshipping is 63%.

To explain an effect-size measurement showing how close the sample data to the fitted regression line in the mediation model, the R-square and pseudo R-square values are used. This measurement

provides information regarding both direct and mediating effects in the model which are statistically significant in the base model. R-square and pseudo R-square values are shown based on the trust and the choice respectively. The reason for this differentiation is that trust is continuous outcome and choice is nominal. Concerning the trust, it can be stated that 0.206 of the variability of the response data can be explained by the model. However, pseudo R-square cannot be described based on only one model, this indicator needs to be compared with multiple models predicting the same outcome on the same data set [72].

Finally, Table 5.2 shows the percentages of the crowdshipping choice when only one attribute is changed in the model, keeping the rest constant. For instance, when the model predicts the same day delivery option in the choice set, more than half of the respondents (53.3%) would opt for crowdshipping on the condition that other attributes are not changed. When the next day delivery is the option in the choice set, the percentage of choosing the crowdshipping service becomes 46.7%. One of the important outcomes is the delivery cost since the cost is a considerably important feature for crowdshipping. When the delivery cost increases from 5€ to 12€, the choice of crowdshipping decreases by 21.3%. In line with the model results in Table 5.1, the delivery company's reputation appears to be an important feature. However, the change in the tracking and tracing options, insurance coverage, and the possibility of damage do not have a major effect on the choice of crowdshipping.

Table 5.2: The effect of crowdshipping service choice based on the attribute levels

Attribute	**Attribute levels**	**Effect on crowdshipping choice**
Delivery time	Same day delivery	53.3%
	Next day delivery	46.7%
Delivery cost	5 €	33.8%
	12 €	12.5%
Tracking and tracing options	Only main steps can be seen in the app/website	48.9%
	Real time driver tracking by the app/website	51.1%
Delivery company's reputation	Two stars	38.8%
	Four stars	61.2%
Insurance coverage	Up to 500€	46.4%
	Up to 1000€	53.6%
Possibility of damage	1 in 20 damaged delivery (5%)	46.3%
	1 in 30 damaged delivery (3%)	53.7%

5.1.2. Mediation Choice Model with Attitudinal Profile

After analysing the base model with the main attributes, it is necessary to include an attitudinal profile to cover the parameters in the conceptual model (Figure 3.1). This model run enables the author to react upon to what extent attitudinal variables have a direct and indirect effect on service adoption. The factor loadings estimated in SPSS are applied to include these variables, namely, the risk-taking behaviour, the importance of the quality and flexibility of the delivery. The reason for this choice is to be able to search the fewest factors that can account for the common variance of a set of variables.

In this part of the analysis, only the specific outcomes of the model estimation are discussed in detail. Therefore, the attributes such as delivery cost, tracking and tracing options and delivery company's reputation, are not explained as their coefficient values are similar to the base model (Table 5.1).

While the level of trust is 0.513 in the base model, it decreases to 0.377 when the attitudinal profile is taken into account. The possible explanation of this decrease might be that there is a correlation between the level of trust and the modelled attitudinal variables. This might, in the end, lead to decrease in the direct effect of trust on the service adoption.

Moreover, personal risk-taking attitude based on two factors explained in Section 4.1.3 are taken into consideration. The indirect effect of 80% chance and 20% chance of losing constructs on the service adoption is statistically significant, which means that the risk-taking behaviour indirectly affects the service adoption via trust. This result is, indeed, in line with the expectations. In the case of low-risk circumstances, the effect of trust on the service adoption is slightly more than the high risk circumstances. Similarly, the model estimation demonstrates that indirect effect of trust is slightly higher in 20% chance of losing (0.052) situation when compared to 80% chance of losing (0.030) setting. Although there is a clear significance in mediating effect of trust (indirect effect), the direct effect of the risk-taking constructs on the service adoption is not statistically significant, resulting in fully mediation. Concerning total effects, the model result indicates that the low-risk group has a significant total effect value. This outcome is noteworthy to mention since it is more likely to adopt the crowdshipping service if the risk involved is relatively low. Consequently, the crowdshipping service adoption is affected by the risk-taking behaviour of the individuals since risk involved in the service indirectly affects the adoption.

As explained in Section 4.1.3, the importance of the quality of the delivery and flexibility of the delivery are other attitudinal profiles taken into consideration in the model. The model shows that the importance of the quality of the delivery has a significant positive indirect and total effects on the service adoption, however, the direct effect of the same attribute is not significant, resulting in fully mediating effect of trust. Regarding the importance of the flexibility of the delivery, the direct, indirect and total effects of this attribute is not statistically significant. Therefore, it is not shown in Table 5.1.4. All in all, the effects of these constructs show that the importance of the quality of the delivery has clearly more impact on the service adoption rather than the flexibility of the delivery.

Looking at the attributes, the delivery time and the possibility of damage have promising change when including the attitudinal profiles into the model. Concerning delivery time, the significance of the indirect effect of this attribute appears to be closer to the value 0. As for the possibility of damage, the direct effect of the attribute become statistically significant (0.007) on the service adoption. This means that there is a correlation among these attributes and the attitudinal variables. Another likely explanation regarding these changes would be that a same day delivery with a low possibility of damage might be linked to the quality of the service and it might indirectly impact on the service adoption.

Table 5.3: The effect of crowdshipping service choice based on the attribute levels and attitudinal profiles

		indirect effect on the service adoption		**direct effect on the service adoption**		**total effect on the service adoption**	
	Reference level	Est.	p-value	Est.	p-value	Est.	p-value
Delivery time							
Same day delivery	Next day delivery	0.023	0.007	0.063	0.014	0.086	0.001
Delivery cost		-0.051	0.000	-0.400	0.000	-0.451	0.000
Tracking and tracing options							
Real time driver tracking	Only main steps can be seen	0.054	0.000	-0.025	0.342	0.029	0.283
Delivery company's reputation							
Four stars	Two stars	0.118	0.000	0.231	0.000	0.349	0.000
Insurance coverage							
Up to 1000€	Up to 500€	0.040	0.000	0.054	0.035	0.094	0.000
Possibility of damage							
1 in 30 damaged delivery (3%)	1 in 20 damaged delivery (5%)	0.028	0.001	0.069	0.007	0.097	0.000
80% chance of losing(F1)		0.030	0.000	0.014	0.583	0.045	0.100
20% chance of losing (F2)		0.052	0.000	0.023	0.356	0.075	0.004
Quality of the delivery (F1)		0.027	0.003	0.012	0.648	0.027	0.003
Level of trust				0.377	0.000		
Intercepts		3.504	0.000	0.213	0.113		
R-square (Trust)				0.188	0.000		
Pseudo R-square(Choice)				0.476	0.000		
Significance level on 95% confidence interval (p<0.05)							
The coefficient values stand for standardised estimates.							

5.1.3. Mediation Choice Model with Attitudinal Profiles and Sociodemographics

In this part, sociodemographic characteristics are also included in the explained model in Section 5.1.2 to be able to understand how different sociodemographics would impact the choice of crowdshipping.

The results show that only the level of education has a significant effect on the crowdshipping service adoption. Hence, non-significant values are not represented in Table 5.3. Based on the estimations, the level of trust decreases as the level of education is higher (master's and PhD's). Unlike the result of the study from Punel et. al.,[14] where the effect of the level of education found to be not significant, the model outcome shows that the level of trust towards the user adoption of the service increases among the bachelors and less educated people. However, the direct effect of the same variable is proved to be not significant, meaning that there is no direct effect originating from the level of education on the service adoption. This outcome also yields no significant impact on the total effects.

As for the attitudinal profile, the direct effect of the variables on the service adoption is not statistically significant. Concerning the indirect effects, risk-taking behaviour (80% chance and 20% chance of losing constructs) and the importance of the quality of the delivery have significant effects on the service adoption through trust. This outcome is noteworthy to mention since trust has a fully mediating role in this setting.

Table 5.4: The effect of crowdshipping service choice based on the attribute levels, attitudinal profiles and sociodemographics

		indirect effect on the service adoption		**direct effect on the service adoption**		**total effect on the service adoption**	
	Reference level	Est.	p-value	Est.	p-value	Est.	p-value
Delivery time							
Same day delivery	Next day delivery	0.023	0.007	0.063	0.013	0.086	0.001
Delivery cost		-0.051	0.000	-0.400	0.000	-0.451	0.000
Tracking and tracing options							
Real time driver tracking	Only main steps can be seen	0.053	0.000	-0.024	0.345	0.029	0.283
Delivery company's reputation							
Four stars	Two stars	0.118	0.000	0.231	0.000	0.349	0.000
Insurance coverage							
Up to 1000€	Up to 500€	0.040	0.000	0.054	0.037	0.094	0.000
Possibility of damage							
1 in 30 damaged delivery (3%)	1 in 20 damaged delivery (5%)	0.028	0.001	0.069	0.007	0.097	0.000
80% chance of losing (F1)		0.029	0.001	0.013	0.621	0.041	0.127
20% chance of losing (F2)		0.051	0.000	0.024	0.345	0.075	0.004
Quality of delivery (F1)		0.026	0.003	0.010	0.684	0.037	0.174
Master/PhD	Others	-0.017	0.035	-0.013	0.608	-0.030	0.251
Intercepts		3.552	0.000	0.197	0.155		
Level of trust				0.376	0.000		
R-square (Trust)				0.190	0.000		
Pseudo R-square(Choice)				0.476	0.000		

Significance level on 95% confidence interval (p<0.05)
The coefficient values stand for standardised estimates.

5.1.4. Hypothesis Testing

In this subsection, the hypotheses explained in Section 2.3.2 and framed in Figure 3.1 are tested. To do that, three different model results are considered separately. In the visualisation, black lines are used to represent direct effects, dashed lines are used to show indirect effects via trust and red lines are also used to present indirect effects where there is no significant direct effects (the case of full mediation).

Base Model

According to the base model estimation, only the direct effect of the real time driver tracking by the app/website (H5a) is not statistically significant, meaning that it is not possible to state any direct relation between this attribute and the adoption of the crowdshipping service, resulting in rejecting the hypothesis. Regarding the direct effect of the delivery time (H3a), delivery cost (H4a), insurance coverage (H6a), possibility of damage (H7a) and the delivery company's reputation (H8a), the parameters are statistically significant, which means that there is an effect among those attributes and the adoption of the crowdshipping service. Hence, the corresponding hypotheses (H3a, H4a, H6a and H8a) are accepted.

Concerning the indirect effects, it is noteworthy to mention that real time driver tracking by the app/website (H5b) has significant indirect effects through trust. This finding shows that this attribute is fully mediated (presented with the red arrow) by the level of trust based on the sample data set. Therefore, the hypothesis is rejected as there is a fully mediating effect, not the partial. Moreover, the indirect effect of the delivery time (H3b), delivery cost (H4b), insurance coverage (H6b), the possibility of damage (H7b) and delivery company's reputation (H8b) have also significant coefficient values. This means that these attributes also have an indirect effect via trust on the service adoption as well as the significant direct effect. Thereby, the corresponding hypotheses are accepted since there is a partial mediation effect via trust.

The detail representation of all the main attributes can be seen in Figure 5.2.

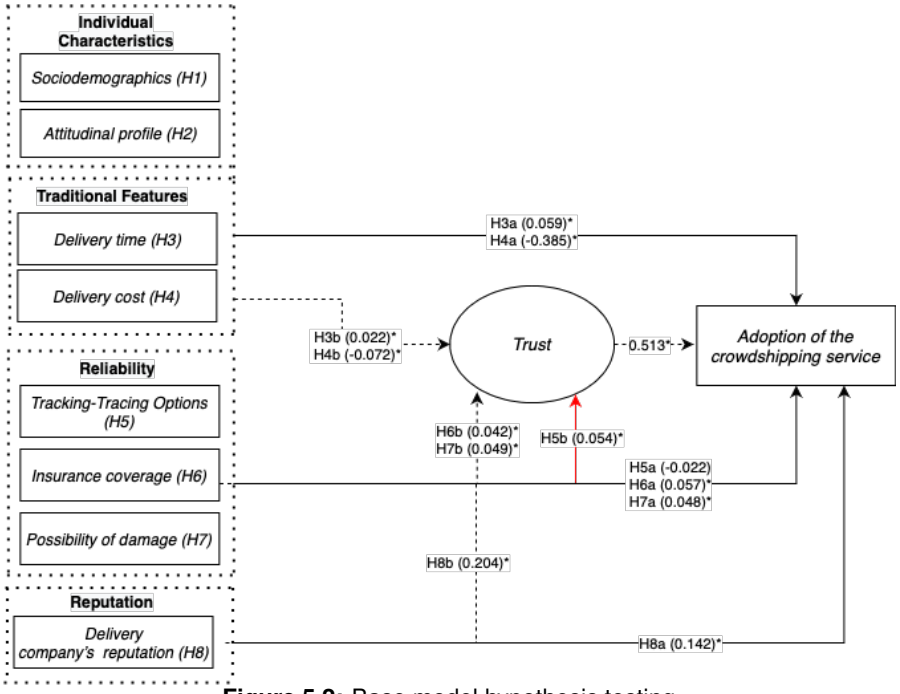

Figure 5.2: Base model hypothesis testing
*Significant level on 95% confidence interval (p<0.05)

As seen from the conceptual model above, the attitudinal profile and the sociodemographic characteristics are not covered in the base model. For this reason, the following models are estimated to capture those effects.

Mediation Choice Model with Attitudinal Profiles

The second model clearly shows no direct effects between the risk-taking behaviour and quality of the service towards the crowdshipping service adoption; therefore, the hypothesis for risk-taking behaviour (H2a- R_{F1} and R_{F2}) and quality of the service (Q_{F1}) are rejected since there is no direct effect originating from these attributes. As for the indirect effects of the attitudinal profile, the model estimates demonstrate that the indirect effect of these attributes are statistically significant, meaning that trust has a fully mediating role on service adoption. For this reason, the hypothesis of these variables (H2b- R_{F1} R_{F2} and Q_{F1}) are also rejected as there is fully mediating effect not the partial.

Interestingly, the importance of the delivery flexibility, another variable in attitudinal profile, appears to be non-significant in both the direct and indirect effects. These outcomes yield in removing this variable from the conceptual model below.

Regarding the effects of the main attributes except track and trace, the outcomes clearly show that the direct and indirect effects are statistically significant. Hence, the hypotheses (H3a, H4a, H6a, H7a, H8a and H3b, H4b, H6b, H7b, H8b) are all accepted.

Similar to the base model, real time tracking and tracing has no direct effect on service adoption, which results in rejecting hypothesis H5a. Moreover, the same variable has its indirect effect through trust on service adoption. Thereby, the hypothesis H5b is also rejected since the trust fully mediates the real time tracking and tracing on the service adoption.

As can be seen from the second model estimation, there is a need to include sociodemographics into the model to capture all the effects represented in the conceptual design. Hence, in the last model estimation, sociodemographic characteristics are taken into account.

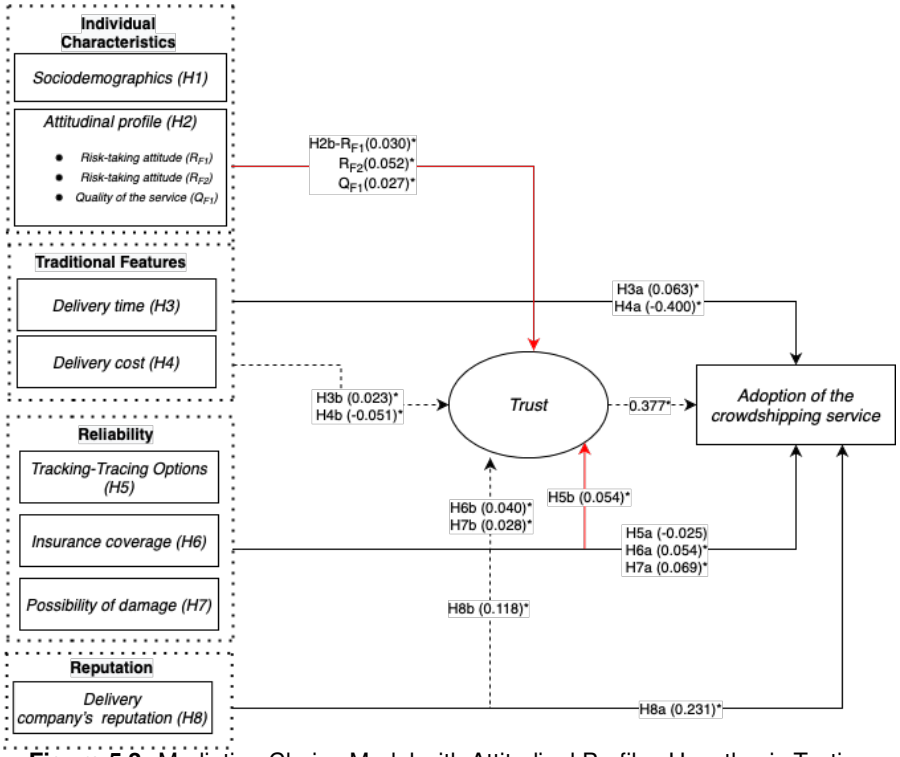

Figure 5.3: Mediation Choice Model with Attitudinal Profiles Hypothesis Testing
*Significant level on 95% confidence interval ($p<0.05$)

Mediation Choice Model with Attitudinal Profiles and Sociodemographics

Based on the last model outcome, including both attitudinal profile and sociodemographic characteristics, there is no direct effect through the sociodemographics and the adoption of the service. For this reason, these variables are not shown in the conceptual model below, and the corresponding hypotheses are rejected. However, the indirect effects of the education level is statistically significant, and this finding results in a fully mediating effect of the trust in the model. For this reason, the hypotheses H1b-EL is rejected as there is a full mediation effect of trust not a partial. With this outcome, it is important to point out that level of education is considered as an important factor through the adoption of the crowdshipping service. As for the indirect effects of age, gender occupation and income, there is no association among those features and the level of trust towards the adoption of the service given the sample data set.

Regarding the attitudinal profile (H2), the estimates of the model do not show any difference comparing to the model in Section 5.1.4. Therefore, it can be said that risk-taking attitude and quality of the service are fully mediated by trust, and there is no direct effect originating from these variables.

Delivery time (H3a, H3b) and delivery cost (H4a, H4b) are also estimated similar to the previous model. These variables have both direct and indirect effects on service adoption. Thereby, the hypotheses are all accepted. It is important to point out that trust plays a partial mediating role towards the system adoption for these attributes.

Concerning the reliability-related variables, the findings confirm that trust fully mediates real-time tracking and tracing feature (H5) just as estimations in the base model and the second model. For this reason, both the hypotheses (H5a and H5b) are rejected. Likewise, in the previous model estimations, trust partially mediates the insurance coverage and possibility of damage on the service adoption. There is also a direct effect from those variables on service adoption. Hence, the hypotheses (H6a, H6b, H7a and H7b) are all accepted.

Lastly, the delivery company's reputation has its direct impact on the service adoption as well as the effects via trust. Thereby, the hypotheses (H8a and H8b) are accepted.

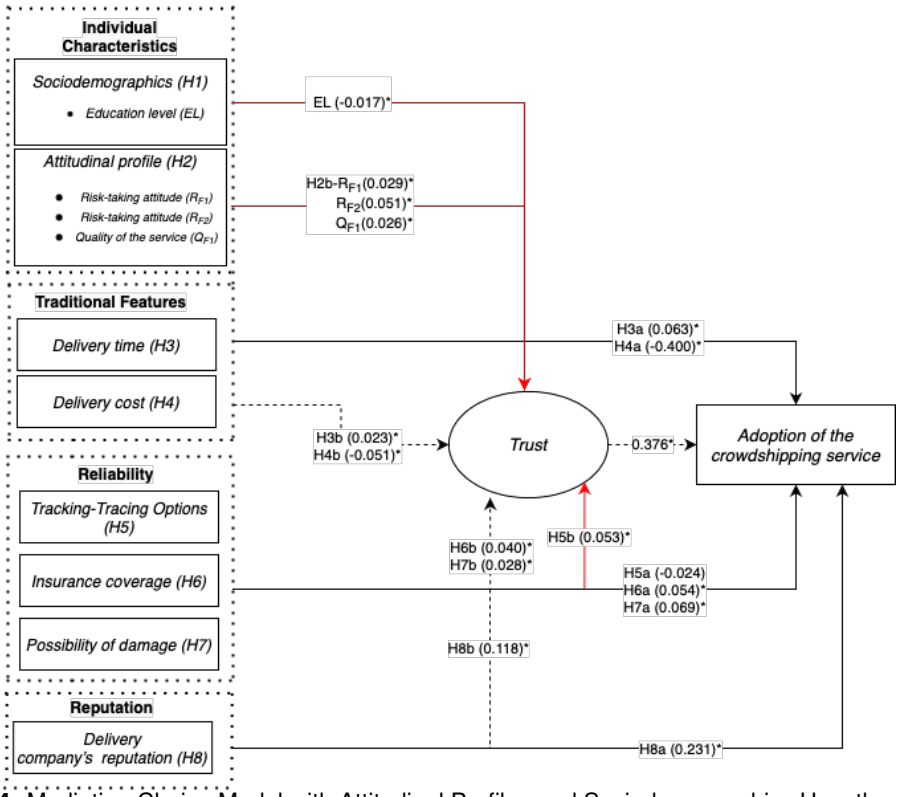

Figure 5.4: Mediation Choice Model with Attitudinal Profiles and Sociodemographics Hypothesis Testing
*Significant level on 95% confidence interval (p<0.05)

5.2. Latent Class Choice Model

In section Section 5.1 the mediation analysis is estimated to be able to assess to what extent trust mediates the effect of the attributes. In this part, the heterogeneity in preferences is explored through the LCCM. Unfortunately, the modelling framework to combine both mediation and latent class model is not directly available. Given that the mediatory effect of the trust is already investigated in the mediation analysis, the trust is left out from LCCM.

The binary logit model estimation and corresponding utility functions are provided to interpret the latent class model without trust. As expected, the total effects of the mediation analysis without trust and the binary logit model resulted in similar coefficient values. For this reason, the binary logit model findings are summarised in Section 5.2.1 to compare them with the LCCM. Next, the optimal number of latent classes is determined. As soon as this procedure is completed, the covariates are added to the class membership function in order to estimate the classes by the sociodemographic characteristics.

5.2.1. Binary Logit Model

In this section, the binary logit model estimation and corresponding utility functions are provided. Next, LCCM is applied by using the same utility function to test the heterogeneity in preferences.

In the equation, utility function for the crowdshipping delivery (V_1) alternative is shown.

$$V_1 = ASC_{CS} + \beta_{DT} * DT_{CS} + \beta_{DC} * DC_{CS} + \beta_{Track} * Track_{CS} + \beta_{Rep} * Rep_{CS} + \beta_{Ins} * Ins_{CS} + \beta_{Dmg} * Dmg_{CS} \tag{5.1}$$

where:

V_1 = Utility of crowdshipping alternative
ASC_{CS} = Base utility for crowdshipping delivery option
β_{DT} = Generic parameter for the attribute delivery time
β_{DC} = Generic parameter for the attribute delivery cost
β_{Track} = Generic parameter for the attribute tracking and tracing options
β_{Rep} = Generic parameter for the attribute delivery company's reputation
β_{Ins} = Generic parameter for the attribute insurance coverage
β_{Dmg} = Generic parameter for the attribute possibility of damage

As it can be also seen from the Equation 5.1, the attribute levels of crowdshipping delivery can vary. With the help of the constant, the base utility of the crowdshipping delivery alternative can be computed. Finally, the constant captures the average effect on utility of all factors that are not included in the model.

The model syntax used in Apollo is given in Appendix- I and the estimation of the model is shown in Table 5.5 below.

Table 5.5: Model estimation- Binary logit

Parameters	Estimates	Standard Error (robust)	t-value (robust)	p-value
β_{DT}	0.3993	0.1284	3.108	0.000*
β_{DC}	-0.3665	0.0291	-12.580	0.000*
β_{Track}	0.1232	0.0966	1.275	0.121
β_{Rep}	1.5349	0.1284	11.953	0.000*
β_{Ins}	0.4290	0.1150	3.729	0.000*
β_{Dmg}	0.4062	0.1019	3.983	0.000*
ASC_{TR}	-2.4114	0.2779	-8.675	0.000*

*Significant level on 95% confidence interval (p<0.05)

The model results in a final loglikelihood (LL) value of -883.13, an adjusted rho square (Rho^2) value of 0.25, and AIC and BIC values are 1780.28 and 1818.43 respectively and all parameters are statistically significant (p-values are less than 0.05) except the attribute track and trace. Based on the model outcome, the estimate value of delivery time shows that the utility increases by 0.3993 when the delivery is executed on the same day.

Similar to mediation choice model, delivery cost has a negative coefficient value (-0.3665) meaning that when the cost of the service increases the utility of crowdshipping decreases by this value. When looking at the estimations, it is not possible to interpret the attribute tracking and tracing as the coefficient is not statistically significant. With respect to the delivery company's reputation and insurance coverage, the utility increases in the case of relatively good reputation and high insurance coverage. It is important to point out that the dummy coding scheme for possibility of damage is conducted in a way to show "0" as 5% damaged and "1" as 3% damaged delivery. For this reason, getting positive coefficient means that when the possibility of damaged delivery is relatively less, it would positively impact on the utility function.

Finally, alternative specific constant (ASC) shows the choice probability of the crowdshipping alternative given that all the independent variables are set to 0. As the value (-2.4114) is statistically significant, it presents that the preference towards crowdshipping might also be affected by other unobserved attributes which are not considered in the scope of this research.

5.2.2. Latent Class Choice Model: Class Identification

In order to test the heterogeneity, LCCM is applied, and the utility function defined in Equation 5.1 is used to estimate the optimum number of classes among individuals.

The model is estimated from 1 to 5 classes, and as also explained in Section 3.4, BIC and AIC values are provided to find out the optimal model. Besides that, Rho^2 and LL estimates are taken into consideration. Table 5.6 shows the results of the binary logit model and different number of classes in LCCM without the sociodemographic characteristics.

In line with the expectations, as the number of classes increases, the Rho^2 value and LL estimates improve. Nevertheless, it is also essential to consider that adding new variables into the model might cause over-fitting results. Thereby, specifically, the BIC value is used to figure out the best model fit.

Table 5.6: Overview of the model estimations- without sociodemographics

Model	Number of parameters	LL	Adj Rho^2	AIC	BIC
Binary Logit	7	-883.13	0.25	1780.28	1818.43
2-class model	15	-822.26	0.29	1674.53	1772.76
3-class model	23	-809.63	0.30	1665.27	1822.50
4-class model	31	-761.05	0.33	1584.11	1802.95
5-class model	39	-747.22	0.34	1572.46	1854.89

This value is seen as one of the key criteria while deciding the number of classes that best fits the data. Based on the BIC estimation, the smaller the value, the better the model outcome; thereby, 2-class model with 15 parameters provides the best model fit to the sample data, as it has the lowest BIC value. The main model estimates can be seen in Table 5.6.

Next, to be able to examine the classes by sociodemographic characteristics and attitudinal profile, the class membership function is included in the 2-class model. The result of the model indicates significant values on risk-taking attitude (low chance of losing setting), gender, age as well as the delivery cost and delivery company's reputation in different significance levels, which are shown in Table 5.7. In Appendix- J, the model syntax used to estimate LCCM is provided.

In this part, the 2-class model is presented since the model provides the best model fit.

Table 5.7: 2-Class LCCM parameters with class membership

		Crowdshipping sceptics		**Crowdshipping enthusiasts**	
	Reference level	Est.	p-value	Est.	p-value
LCCM (Main attributes)					
Delivery time					
Same day delivery	Next day delivery	0.097	0.345	0.909	0.001***
Delivery cost		-0.154	0.003***	-1.260	0.000***
Tracking and tracing options					
Real time driver tracking	Only main steps can be seen	-0.007	0.481	3.236	0.000***
Delivery company's reputation					
Four stars	Two stars	1.679	0.000***	1.786	0.000***
Insurance coverage					
Up to 1000€	Up to 500€	0.130	0.274	0.596	0.004***
Possibility of damage					
1 in 30 damaged delivery (3%)	1 in 20 damaged delivery (5%)	0.276	0.101	3.790	0.000***
Intercepts (Constants)		0.150	0.342	8.906	0.000***
Class membership (Background variables)					
20% chance of losing (F2)		-0.470	0.022**	0.000	–
Quality of the delivery (F1)		-0.365	0.060*	0.000	–
Female	Male	-0.512	0.095*	0.000	–
Age 25+	18-25	0.559	0.066*	0.000	–
Class membership constant		-0.664	0.045**	–	–
Class share		36%		64%	

*Significant level on 90% confidence interval (p<0.10)
**Significant level on 95% confidence interval (p<0.05)
***Significant level on 99% confidence interval (p<0.01)

The model estimation shows two well differentiated classes: crowdshipping sceptics and crowdshipping enthusiasts. This differentiation is based on the estimated choice constants, which are 0.150 and 8.906 respectively, and the evaluation of the attributes. The main characteristics of the classes are summarised below:

- **Class 1: "Crowdshipping sceptics"**

  The overall probability of belonging to this group is 36%. In this class, people are mostly concerned about the delivery cost of the service and the delivery company's reputation. Additionally, for this class, they are more inclined to choose the safest option as 20% chance of losing appears to be significant. Hence, it can be said that people who belong to this group have low risk tolerance.

  It is more likely that men and older than 25 years of age individuals belong to this class. Regarding the other coefficients related to attitudinal profile and sociodemographic factors, the parameters are not statistically significant, meaning that the estimated classes cannot be described by those factors. Therefore, these parameters are not represented in Table 5.7.

- **Class 2: "Crowdshipping enthusiasts"**

  The overall probability of belonging to this group is 64% and the class has a high constant value which means that the possibility of opting for crowdshipping delivery is relatively high in this class.

  In this class, there are some noticeable outcomes. First of all, all the main attributes in this class are statistically significant on a 99% confidence interval meaning that the main attributes affect the choice of the crowdshipping service. People belonging to this class are more inclined to choose crowdshipping, and and they are more likely to be a woman who is between 18 and 25 years of age. Moreover, reliability-related features are important for people in this class, such as less damaged delivery, real-time tracking and insurance coverage. At the same time, crowdshipping enthusiasts are also sensitive to the delivery cost. Similar to the class 1 (crowdshipping sceptics), as the delivery cost increases, the choice of crowdshipping would not be attractive for this class. Lastly, same day delivery feature and delivery company's reputation is relatively important for people who belong to this class.

The estimated model provides a better understanding towards the heterogeneity in preferences in the sample data set. From the model results, it is clear that the delivery company's reputation and delivery cost are some of the most important factors in crowdshipping service adoption. These findings are remarkable to find out since a similar outcome is also estimated in the MCM where the effect of trust is investigated.

5.3. Economic Appraisal- Model Comparison

In this section, models are compared based on the value of the main research attributes. Thanks to this calculation, the coefficient values provide more insight in the trade-offs that respondents might make. For this aim, value of time (VoT) is computed in transportation domain and this value shows how much respondents give the monetary importance for a specific attribute. In this section, the value of the main attributes for the individuals is computed and compared.

The parameter estimates of different models are summarised in Table 5.8.

Table 5.8: The coefficent values based on different model estimates

Mediation Base Model (Direct effects)		**Mediation Base Model (Total effects)**		**Binary Logit Model**		**2-class Latent (sceptics)**		**2-class Latent (enthusiasts)**	
Param.	Est.	Param.	Est.	Param.	Est.	Param.	Est.	Param.	Est.
β_{Trust}	1.559	β_{Trust}	1.559						
β_{DT}	0.326	β_{DT}	0.446	β_{DT}	0.399	β_{DT}	0.090	β_{DT}	0.884
β_{DC}	-0.393	β_{DC}	-0.466	β_{DC}	-0.367	β_{DC}	-0.146	β_{DC}	-1.241
β_{Track}	**-0.120**	β_{Track}	**0.179**	β_{Track}	**0.123**	β_{Track}	**-0.023**	β_{Track}	3.177
β_{Rep}	0.780	β_{Rep}	1.898	β_{Rep}	1.535	β_{Rep}	1.664	β_{Rep}	1.792
β_{Ins}	0.314	β_{Ins}	0.544	β_{Ins}	0.429	β_{Ins}	0.123	β_{Ins}	0.599
β_{Dmg}	0.265	β_{Dmg}	0.535	β_{Dmg}	0.406	β_{Dmg}	0.254	β_{Dmg}	3.720

The coefficient values stand for unstandardised estimates.

The coefficient values represented bold stand for not significant estimates. (95% significance level)

After representing all the model estimates, the value of each parameter is computed and divided by the cost coefficient value into other parameter coefficients, which enable the author to explore how much the individuals value given attributes. The results of this calculation are given in Table 5.9 below. It is important to point out that, as expected, the mediation base model (total effects) and the binary logit model have similar values as, in the end, the mediation base model estimates binary logit with the extension of trust. The reason for providing the results of both the models is only for comparison. The noteworthy difference is the coefficient values of the direct effects in mediation analysis, explicitly described in the following.

Table 5.9: Value of the main attributes (€)

	Mediation Base Model (Direct effects)	**Mediation Base Model (Total effects)**	**Binary Logit Model**	**2-class Latent (skeptics)**	**2-class Latent (enthusiasts)**
Value of same day delivery	0.830	0.957	1.089	**0.616**	0.712
Value of real time driver tracking by the app/website	**0.305**	**0.384**	**0.336**	**0.158**	2.560
Value of delivery company's reputation (4stars)	1.985	4.073	4.188	11.397	1.444
Value of insurance coverage (Up to 1000€)	0.799	1.167	1.171	**0.842**	0.483
Value of possibility of damage (3%)	0.674	1.148	1.108	**1.740**	2.998

The coefficient values represented bold stand for not significant estimates.

The ratio of the same day delivery has the highest value in the binary logit model, which is estimated by leaving out the trust from the mediation base model. The same parameter's value in both classes is close to each other, however, the estimate is not statically significant in the class sceptics meaning that it is not possible to interpret the effect of the attribute. Regarding the mediation models, it is noteworthy to mention that individuals value the same day delivery nearly similar in both of the model estimations.

The value of real time driver tracking by the app/website is not significant in all the models except the class named enthusiasts. For this group of people, the value of having real time tracking instead of seeing only the main steps is one of the essential characteristics of crowdshipping. Also, they would value for the real time driver tracking 2.5€ instead of tracking the main delivery steps.

The ratio for the reputation of the delivery company is indispensable for the people belonging to the class called sceptics. It is computed that this group of people values an improvement in delivery company's reputation from 2-stars to 4-stars for almost 11.5€. In other words, the class sceptics value the delivery company's reputation almost 8 times as much as the enthusiasts. Knowing that the delivery company has a good reputation (4 stars) instead of relatively bad (2 stars) is also an important feature in other model estimations even though it is not as high as the sceptics.

Insurance coverage appears to be noticeable characteristics in binary logit model (consequently

in the mediation base model with total effects) estimation. The same attribute ratio is relatively less important in the case of the latent class (enthusiasts) model estimation.

Lastly, a decrease in the possibility of getting damage shows how much people value the possibility of 3% damage and 5% damage delivery. This ratio becomes quite essential in the model run with crowdshipping enthusiasts. Interestingly, this value is also considered important in mediation base model (total effects) and also binary logit model.

The economic appraisal aims to investigate the value of the main attributes in different model estimations. The outcome of the analysis shows that the coefficient values (Table 5.8) in the mediation base model (total effects), where trust is taken into account, and the binary logit model where trust is left out have similar values for the main attributes. The reason for this is due to the fact that MCM estimates binary logit with an extension of trust. However, there is a considerable difference between these model estimations and the mediation base model (direct effects). The difference is clearly because trust has an impact on the choice of the crowdshipping service. This might bring bias to the model estimations if trust is not considered an essential component in the crowdshipping service adoption.

5.4. Choice Probability Calculations

In this section, some choice probability calculations are made by aiming to emphasise on to what extent the main attributes have affect on hypothetical scenarios. As explained in Section 5.2, the total effects of the mediation analysis without trust and binary logit model result in nearly the same coefficients. Therefore, the coefficient values in binary logit model are used only with the main attributes of the research since there will not be major changes on the outcome. This section investigates some likely scenarios for crowdshipping service and explores how the probability of choosing crowdshipping would be under the given circumstances. However, it is important to emphasise that making use of only the SP data has some limitations since real elasticity and forecast models can be investigated with RP data in practice.

As shown in the scenario below, the first hypothetical scenario is provided with a 5€ delivery cost with a possibility of next day delivery. The delivery company has a relatively low (2 stars) reputation. Besides that, only the main steps can be seen, and the insurance is guaranteed with an upper value of 500€. Lastly, there is a 5% chance that the package can get damage. In this setting, the probability of a person choosing crowdshipping is 64%.

When the delivery cost varies in 7€, 10€ and 12€ and the rest of the attributes is kept fixed, the probability of opting for crowdshipping accounts for 46%, 22% and 12%, respectively. As it can also be seen from the choice probabilities, delivery cost becomes an essential factor towards service adoption due to the fact that individuals generally opt for low cost of delivery.

Table 5.10: A hypothetical scenario I

		Attribute level	**Choice probability of crowdshipping**
Attributes	Delivery cost	5 €	64%
	Delivery time	Next day delivery	
	Delivery company's reputation	Two stars	
	Tracking and tracing options	Only main steps can be seen in the app/website	
	Insurance coverage	Up to 500€	
	Possibility of damage	1 in 20 damaged delivery (5%)	

However, when the reputation is modified to a relatively high level (four stars), the crowdshipping service choice remarkably changes. In the scenario below, the probability of choosing crowdshipping accounts for 89% which is in line with the expectations.

Table 5.11: A hypothetical scenario II

		Attribute level	Choice probability of crowdshipping
Attributes	Delivery cost	5 €	89%
	Delivery time	Next day delivery	
	Delivery company's reputation	Four stars	
	Tracking and tracing options	Only main steps can be seen in the app/website	
	Insurance coverage	Up to 500€	
	Possibility of damage	1 in 20 damaged delivery (5%)	

When the delivery cost is increased to 12€ with a relatively good reputation (the other attributes are fixed), the choice probability becomes 57%. This hypothetical scenario provides evidence that the delivery company's reputation has a major improvement on crowdshipping service choice since the same setting with a relatively bad reputation results in 12%.

To assess the importance of the delivery time, the scenario below is created. In the case of the same delivery option with an average delivery cost (7€) and relatively good reputation, the choice probability of crowdshipping is 85%.

Table 5.12: A hypothetical scenario III

		Attribute level	Choice probability of crowdshipping
Attributes	Delivery cost	7 €	85%
	Delivery time	Same day delivery	
	Delivery company's reputation	Four stars	
	Tracking and tracing options	Only main steps can be seen in the app/website	
	Insurance coverage	Up to 500€	
	Possibility of damage	1 in 20 damaged delivery (5%)	

The same setting with a next day delivery option accounts for 79%. The result shows that the change in delivery time while keeping the rest of the attributes fixed results in a 6% decrease in the choice of the service. Nevertheless, a chance in reputation in the same setting leads to a major difference in the choice probability. To be able to investigate this impact, the relatively low reputation and same day delivery with an average delivery cost are tested, and the choice of the crowdshipping appears to be 56%. As it can also be seen from the results, a change in the reputation from 4 stars to 2 stars causes a 29% of decrease in the crowdshipping service choice.

5.5. Discussion and Reflections

In this section, some reflections on the outputs of the research are given. Next, the reflections on the applied methodological approaches are discussed. Finally, the limitations of the research are provided.

The research findings showed the importance of trust and to what extent trust affects crowdshipping service adoption. By disentangling the direct, indirect and total effects of the selected main attributes, it became clear that trust has partially and, for track and trace, fully mediating effect towards the crowdshipping service adoption. These results, indeed, confirmed the literature where the necessity of trust in crowdshipping is discussed [15]–[17].

By operationalising trust in crowdshipping setting, the effect of the traditional features, namely, delivery time and delivery cost on the service adoption were also investigated. Similar to the literature, the findings clearly highlighted that when a delivery is executed in a short time period and with a low delivery cost ([7], [24], [71]) the probability of opting for crowdshipping is higher.

The results showed that the tracking and tracing facility of the crowdshipping service is fully mediated by trust and there is no direct effect originating from this feature in crowdshipping service adoption. This finding conflicts with the literature where the effect of the real time driver tracking for local deliveries is

statistically significant on the crowdshipping service choice [7], [55]. However, this result can be seen as an important contribution to the crowdshipping literature as it shows when trust is considered in the choice model, the real time tracking of driver appears not to be essential in the crowdshipping service adoption but it affects the trust in the service.

In this research, the delivery company's reputation is shown with number of stars concerning the app rating. Even though a similar approach is used to show driver's credibility in a study [7], as far as the research concerns, this is the first time the crowdshipping platform's reputation is represented based on the app rating. Interestingly, the model findings showed that the reputation of the company is an essential component for the individuals and it affects the preference of crowdshipping service. Due to the fact that app rating given in the experiment provides different levels of reputation, this would indicate different levels of trust towards crowdshipping.

Given the specific focus of trust in this research, the risk-taking attitude of the individuals was taken into account as a first time. The results of the model showed that trust has a fully mediating effect on risk-taking behaviour towards the service adoption. As expected, users are more likely to adopt the crowdshipping service if the risk-involved is relatively low.

The estimated LCCM model provides a better understanding towards the heterogeneity in preferences in the sample data set. The model results showed that the 2-class latent model is the best fit for the sample data, named "crowdshipping sceptics" and "crowdshipping enthusiasts". From the model results, it is clear that the delivery company's reputation and delivery cost are some of the most important factors in crowdshipping service adoption for both of the classes. These findings are consistent with the results from the MCM where the effect of trust was investigated.

Concerning the methodological reflections of the research, it is essential to point out that this research has a unique way of including trust, which is a psychological variable, in a choice model in crowdshipping setting. Thanks to applied MCM, various attributes were explored and to what extent the effects of these attributes are mediated by the perception where the delivery of the parcel is executed in a trustworthy manner. Although the research approach is based on the working paper [48], where the authors investigate the effect of safety perception and support for policy measures while travelling by train during pandemic, this is the first time that trust is included in a choice model as a mediating variable in crowdshipping domain. In crowdshipping literature, there are several studies in which SP experiments are applied. However, the concept of trust has not been included before as a mediating variable. As far as the author is aware, this can be seen as another important contribution of this study from the methodological point of view. In addition to MCM, the heterogeneity in preferences towards crowdshipping was investigated with LCCM. With this method, the likeliness that a respondent with certain sociodemographic characteristics having different preferences towards crowdshipping can be investigated. Despite the fact that the modelling framework to combine both MCM and LCCM is not directly available, this research findings can be seen as an important step to investigate converting these modelling approaches into one unique modelling framework.

Limitations

The research has some limitations which need to be discussed to avoid unrealistic interpretations. First of all, as the research only covers the crowdshipping service acceptance from the demand (user) point of view, the effect of the level of trust in another research, including the supply side of the service (crowdshipper), might differ. However, it is noteworthy to mention that the service adoption might only be viable if there is a demand in the market, that is the user-side in the crowdshipping setting.

Additionally, only last-mile deliveries are covered in the scope of the research. Also, the research conducted in crowdshipping does not focus on the specific transport mode of crowdshipper or specific product segment. Regarding the mode of transport, this research has shown a study on one company that will possibly run this service in the Netherlands.

It is important to mention that all the online shops/websites are assumed to have a crowdshipping alternative for last-mile delivery. Regarding the focus of the research area, the study takes place in urban areas in the Netherlands. The reason for that choice is the substantial growth of last-mile delivery needs in urban cities.

Moreover, the limitations regarding the used methodologies need to be mentioned at this point. First of all, the used data to answer the research questions comes from SP data. Although this method has several advantages explained in Chapter 3, it is not possible to investigate real elasticity, demand and forecast models without revealed preference data. Concerning the MCM, the level of trust is assumed to

be an observable variable and measured with the help of a 5-point Likert scale. Lastly, the level of trust is not included in the LCCM for several reasons. First of all, the concept of trust is already disentangled in the mediation model. Also, it is not directly possible to combine LCCM and MCM into a modelling framework.

It is vital to point out that the possible applications of the research findings highly depend on the sample data gathered throughout the research. As there is an over-representation of the students with a low-income sociodemographic profile, the main outcomes of this research may differ and may result in inaccurate outcomes. Even though sociodemographic profiles are not representative in each segment in the population, it is remarkable to highlight that different sociodemographic segments are combined to obtain sufficient number of respondents to investigate the heterogeneity in preferences.

6

Conclusion and Recommendations

In this chapter, general conclusions of the research are specified, followed by answering the research questions. Based on the main research goal, this chapter also highlights the recommendations deduced from the research outcomes.

6.1. Conclusions

To be able to meet the main research objectives, the attributes that are closely related to the level of trust are defined as delivery time, delivery cost, tracking and tracing options, the delivery company's reputation, insurance coverage and the possibility of damage. On an aggregate level, the research outcome showed that the delivery company's reputation and delivery cost are some of the major components affecting the user's level of trust on the crowdshipping service adoption.

Once MCM is applied to explore to what extent the relevant attributes would impact trust towards the service adoption, the heterogeneity in preferences are investigated with the help of LCCM. By including sociodemographics and attitudinal profile in class membership function, the possibility of correlation between those variables and the choice of the individuals are also explored.

The findings showed the importance of trust and to what extent it affects crowdshipping service adoption. In general, the findings showed that there is a strong preference towards crowdshipping and the model predicted that 63% of the individuals would opt for the service given the hypothetical scenarios in SPE.

From the perspective of the user's acceptance of crowdshipping, it becomes clear that better market popularity affects the level of trust and also the adoption of the service. This result is remarkable to highlight as the adoption of crowdshipping is still not yet thoroughly investigated. Individuals would need to know about the delivery company to establish trust in the service. Another important outcome of the research is related to the cost of the delivery. Since crowdshipping has not been implemented in the Netherlands yet, the research findings could be used as inputs when determining the delivery costs. The model findings showed that the main attributes are partially mediated by trust except for the track and trace feature which is fully mediated. In other words, track and trace does not directly affect the service adoption but it affects the adoption through trust. All in all, the results demonstrated the substantial importance of trust in the crowdshipping context.

When risk-taking behaviour is included in the model, the results represented a fully mediating effect of trust in the service adoption, meaning that the attitude of being risk-seeking or risk-averse has an impact on crowdshipping service choice only via trust. Interestingly, the results showed that when the risk of loss is relatively low, the level of trust increases compared to the high-risk circumstance.

The model estimation is extended with other attitudinal variables, namely, the importance of the quality and flexibility of the delivery service. The research outcomes clearly showed that flexibility of the delivery, where the delivery time-related questions are included, is not statistically significant in the service adoption. However, the quality of the delivery becomes statistically significant and fully mediated by trust. The quality of the delivery directly affected the level of trust as the variable includes crowdshipper's credibility, tracking tracing, and feedback system in the service (Section 4.1.3).

Furthermore, sociodemographic characteristics are included in MCM and LCCM. MCM showed that only education level is statistically significant. Although education level does not directly affect the service adoption, this parameter has an indirect effect on the service adoption via trust. Surprisingly, the level of trust decreases as the level of education is higher (master's and PhD's). The possible explanation would be that this group of people might consider crowdshipping as a distrustful option or they would request additional features to trust the service. Regarding LCCM results, the research findings demonstrated that gender and age influence latent class membership as only these variables are statistically significant. Based on the estimations, it is more likely that men and older than 25 years

of age individuals belong to the class crowdshipping sceptics.

The estimated LCCM provides a better understanding towards the heterogeneity in preferences in the sample data set. The model results showed that 2-class latent model is the best fit for the sample data, named "crowdshipping sceptics" and "crowdshipping enthusiasts". From the model results, it is clear that the delivery company's reputation and delivery cost are some of the most important factors in crowdshipping service adoption for both of the classes. As explained in Section 5.3, crowdshipping sceptics were inclined to pay more for a better delivery company's reputation (nearly 11.5€), the same value was around 1.5€ for the crowdshipping enthusiasts. These findings are consistent with the results from the MCM where the effect of trust is investigated.

6.2. Research Questions

Based on the gaps which were found in the literature and the research purpose, the main research question addressed in this report is:

"To what extent do various attributes of crowdshipping delivery services influence the level of trust in the service and the decision to use the service?"

To be able to answer the main research question, firstly, the following sub-research questions are answered, and finally, the main research question is covered.

6.2.1. Sub-questions

What is the definition of trust in the context of crowdshipping?

Trust has been the subject of different disciplines of social sciences such as psychology, political science, sociology, economics, and management. Each discipline explains the role of trust in social processes from different perspectives. There are various categorisations that can be found in the literature such as characteristic trust, rational trust, and institutional trust. As a first step of the conceptual model, trust is defined. To be able to fill the knowledge gap on trust in crowdshipping setting, two mostly cited definitions of trust are preferred as they provide broader perspective in adoption of the crowdshipping service. First, trust can be seen as one person's willingness to act on another person's action or decision [28], [29]. Based on this definition, trust is a credence and positive expectation of the individual towards a person, situation or service. In crowdshipping, expectations that delivery will be carried out in a safely manner can improve trust levels. Secondly, trust is defined as one party's willingness to be vulnerable to another party's action [29]. Thus, one party's willingness to be involved in crowdshipping service plays a pivotal role in trust building process.

What are the attributes that play an important role in user acceptance towards crowdshipping?

Together with the first sub-question, the essential components of trust in crowdshipping setting were determined. In order to build user trust and to achieve the adoption of the service, important attributes needed to be found out so that these attributes can be taken into account in the experimental design. There are several characteristics that literature highlights. First of all, delivery time is one of the key factors which enables user to get the package delivered in a flexible time manner. Since the crowdshippers are self-scheduled bringers, the service which is provided is not necessarily in the office hours or in a specific time window. Next to that, delivery cost is directly linked to rational trust, which is defined with perceived outcomes of the service such as reward and cost, and is considered one of the other attributes that might affect the user trust towards the system. In line with the trust literature, reliability should also be taken into account to measure the level of trust in the crowdshipping adoption. In the research, reliability is operationalised with several attributes, namely, tracking and tracing options of the service, insurance coverage and possibility of damaged delivery. Besides these attributes, the delivery company's reputation is considered one of the other vital features that might impact on the service adoption. Thereby, in the scope of this research, reputation is seen directly linked to service trustworthiness. Moreover, sociodemographic characteristics and attitudinal profile such as risk-taking attitude, the importance of the flexibility or quality of the delivery were found to be some of the indispensable characteristics which might have an impact on crowdshipping service adoption.

Through the model estimations, the direct effects of all the selected attributes were found to have a significant effect on service adoption except for the attribute track and trace.

Regarding the indirect effects, all the main attributes were statistically significant. This finding showed that trust has a mediating role through the service adoption. Specifically, the effect of tracking

and tracing options was fully mediated by trust, meaning that trust has fully control over the effect of this attribute.

Lastly, the total effects of the main research attributes were found to be significant apart from the attribute tracking and tracing options. The research showed that the delivery company's reputation and delivery cost were some of the most important attributes through the service adoption followed by the insurance coverage and the possibility of damage.

What is the level of trust in crowdshipping depending on the relevant attributes?

In order to investigate the level of trust in crowdshipping setting, in total three different models were estimated.

In the first estimation, the base model was composed with the main attributes which are presented in the conceptual model (Section 2.2.2). The base model showed that delivery company's reputation is the most important feature which would impact on the crowdshipping service adoption through trust. As for the delivery cost, there is a negative correlation between level of trust and the delivery cost. The reasons for this can be that respondents might perceive that they are over-charged or they might believe that the service is too risky. Consequently, their level of trust decreases if the delivery cost increases. For this reason, pricing of the crowdshipping service would become other vital aspect which needs to be considered by the crowdshipping service providers.

In the second model estimation, the analysis was extended with the attitudinal profiles which were found essential to include in the literature. Attitudinal characteristic, namely, risk-taking behaviour, and the importance of the quality and flexibility of the delivery were assessed. This model findings showed that there is a correlation between these variables and the level of trust which leads to decrease in the level of trust on crowdshipping service adoption.

In the last model, the estimation was extended with sociodemographic characteristics which enables the author to assess the relation between the sociodemographic profiles and the level of trust as well as the adoption of the service. In detailed analysis in MCM, the sociodemographic parameters were not statistically significant except the education level.

To what extent does the level of trust mediate the choice of the crowdshipping system?

Answering the previous sub-question also enables the author to investigate if trust has a mediating effect on the choice of the crowdshipping service. Similar to the previous question, this sub-question is also answered based on the three different model estimations.

According to the base model, only real time driver tracking by the app/website was not statistically significant, meaning that it is not possible to state any direct relation between this attribute and the adoption of the crowdshipping service. However, the track and trace becomes statistically significant when trust is taken into consideration, meaning that trust has a fully mediating role in the crowdshipping service adoption for this attribute. Regarding the effect of the delivery cost, delivery time, insurance coverage, possibility of damage and delivery company's reputation, trust appeared to be a partially mediating factor in the model.

In the second model, in which the attitudinal profiles were added, another promising finding was that the risk-taking behaviour and the importance of the quality of the service are fully mediated by trust, meaning that there is no direct effect between these factors and the adoption of the crowdshipping service. However, the importance of the flexibility of the delivery appeared to be not significant in the direct, indirect and total effects. The second model estimates led to similar results as the base model in terms of the effect of the main attributes.

In the last model, where both attitudinal profile and sociodemographic characteristics were included, there was no direct effect through the sociodemographics and the adoption of the service. However, the indirect effect via trust for the education level was statistically significant, resulting in a fully mediating effect of trust in the model only for this variable.

To what extent does heterogeneity in choice preference exist for the type of delivery method?

In order to assess the heterogeneity in individual's preferences, LCCM was applied, and the model results showed that 2-class latent model is the best fit for the sample data. The results of the model also showed that two classes can be generated. These classes were named as "crowdshipping sceptics" and "crowdshipping enthusiasts" based on the estimated choice constants, which were 0.150 and 8.906.

In this setting, crowdshipping sceptics are mostly concerned about the delivery cost of the service and the delivery company's reputation. However, crowdshipping enthusiasts are more inclined to choose crowdshipping and they consider all the main attributes while opting for the service. Regarding the results of the class membership, the research findings demonstrated that gender and age influence latent class membership as only these variables were statistically significant. Based on the estimations, it is more likely that men and older than 25 years of age individuals belong to the class crowdshipping sceptics. Additionally, for this class, individuals are more inclined to choose the safest option as 20% chance of losing appears to be significant. Hence, it can be said that people who belong to this group have low risk tolerance.

6.2.2. Main Research Question

With the help of the sub-questions, the main research question needs to be answered.

"To what extent do various attributes of crowdshipping delivery services influence the level of trust in the service and the decision to use the service?"

For all the various attributes associated with assessing trust in this research, the results of the experiment found that the delivery company's reputation and delivery cost are some of the most important features for the individuals. The base model showed that a negative change in the delivery company's reputation leads to a 22.4% decrease in the individuals' crowdshipping delivery choice. This outcome is remarkable to highlight as it directly affects the crowdshipping service adoption. With respect to the delivery cost, the base model findings demonstrated that the choice of crowdshipping decreases by 21.3% when the delivery cost increases from 5€ to 12€. Next, delivery time became another essential feature that needs to be taken into account meaning that fast delivery would be one of the other essential characteristics towards service adoption. Comparing to other attributes, a change in the tracking and tracing options, insurance coverage, and the possibility of damage did not have a major effect on the choice of crowdshipping.

The research results found evidence for the relation between risk-taking attitude and the level of trust. According to the model estimations, it became clear that risk-taking behaviour is fully mediated by trust, meaning the risk-taking behaviour directly affects trust towards the crowdshipping service adoption. The obtained results showed that the indirect effect of trust on the service adoption is slightly more in the low-risk circumstances.

Moreover, from the sociodemographic characteristics added to the MCM, the obtained results showed that education level has a significant impact on crowdshipping service adoption. Regarding the LCCM, the results showed that gender and age have a significant effect in class-membership.

All in all, the service attributes identified in this research clearly showed that the delivery company's reputation and delivery cost are essential factors for the crowdshipping service adoption, followed by the insurance coverage and the possibility of damage.

6.3. Recommendations

Whilst the conclusion and research contribution are directly deduced from the model results, in this section, some reflections on the research are discussed. This part is divided in two sub-sections. Firstly, some recommendations for the future research are given followed by the recommendations for practice.

6.3.1. Recommendations for Future Research

In this research, six attributes are used to investigate the effect of the trust for a hypothetical crowdshipping alternative. For future research, more alternatives to crowdshipping can be added in a future choice experiment.

Next, future research might emphasise on the impact of crowdshipping service with other sharing economy services such as ride-hailing and ride-sharing. In this way, it would be possible to understand the economic and environmental impact of sharing economy services.

As explained in the research limitations, the research takes only the user's side of the service into account. To have a deeper understanding of the actors, the level of trust from the crowdshipper point of view needs to be studied since the crowdshipper can also be asked to deliver dangerous/illegal or hazardous items. Therefore, considering the crowdshipper's point of view would provide more detailed knowledge regarding the trust and the parties involved in crowdshipping.

In this research, trust is treated as an observable variable, however, with the help of multiple measurement factors trust can be measured in structural equation modelling setting. As an improvement of the model, the risk-taking attitude can be also taken into consideration as a latent variable to capture the link between risk and trust thoroughly. Additionally, as explained in Section 5.5, the applied MCM and LCCM are two separate models which cannot be directly merged into one modelling framework. However, it is not trivial to explore the possibilities of converting them into a unique modelling framework.

The research scope does not cover the role of the policy making process and possible interventions. For example, it can be analysed what would be the effect in trust when a regulatory framework is enforced such as minimum tariff for compensations. Additionally, the basic regulations to control the delivery service would affect user's trust in the service adoption, as the service user's would be protected and the regulations would control the crowdshippers to securely execute deliveries.

Another future research direction would be related to the used data. To avoid the limitations of SP, there is a need to include revealed preference data. In this way, it would be possible to fill the knowledge gap in forecasting demand in crowdshipping.

Lastly, environmental advantages of the crowdshipping might be explored explicitly and emphasised to increase willingness to adopt the service since this would create involvement from environmentally conscious individuals.

6.3.2. Recommendations for Practice

From a practical point of view, various recommendations can be given to provide road-maps for crowdshipping service providers. The first one refers to the market reputation of the crowdshipping company. The research showed that the delivery company's reputation is the most important feature that affects the service adoption and the level of trust towards the service. Even though flexible or outside service hours parcel delivery would be possible in crowdshipping, these advantages can only be successful if the company has a good reputation. Thereby, a crowdshipping service provider who is new in the market might have difficulty establishing a profitable demand without building high quality service reputation. All in all, a crowdshipping service provider should have specific actions to build a positive reputation and a high app rating. However, it is still not clear how crowdshipping companies acquire good reputation in their business model. For this aim, the service provider might cooperate with the local authorities such as municipalities or might use advertisement channels to establish awareness among the citizens before starting the actual operation.

The second recommendation would be related to the delivery cost of the crowdshipping. Even though the delivery cost in crowdshipping delivery is determined based on the distance/km, it is vital to compare those prices with the traditional delivery options. The cost of the service needs to be arranged such a way that is affordable and cost-competitive since individuals would rather use traditional delivery in the case of high delivery cost.

Lastly, describing the possible market segments would be noteworthy to reflect upon. Based on the results, the marketing efforts should be targeted to younger women, since they were more likely to adopt the service. Moreover, crowdshipping companies can attract the group named sceptics by improving their reputation in the market since the reputation is an indispensable factor for this group of people.

BIBLIOGRAPHY

[1] *World urbanization prospects 2018 highlights*, 2018. [Online]. Available: https://population.un.org/wup/Publications/Files/WUP2018-Highlights.pdf (visited on 02/26/2021).

[2] J. Weltevreden and O. Rotem-Mindali, "Mobility effects of b2c and c2c e-commerce: A literature review and assessment," in *Third international specialist meeting on ICT, everyday life and urban change*, 2008, pp. 16–19. [Online]. Available: https://bit.ly/3f1dZUu.

[3] R. Gevaers, E. Van de Voorde, and T. Vanelslander, "Characteristics and typology of last-mile logistics from an innovation perspective in an urban context," *City Distribution and Urban Freight Transport: Multiple Perspectives, Edward Elgar Publishing*, pp. 56–71, 2011. DOI: https://doi.org/10.4337/9780857932754.00009.

[4] A. Devari, A. G. Nikolaev, and Q. He, "Crowdsourcing the last mile delivery of online orders by exploiting the social networks of retail store customers," *Transportation Research Part E: Logistics and Transportation Review*, vol. 105, pp. 105–122, 2017, ISSN: 1366-5545. DOI: https://doi.org/10.1016/j.tre.2017.06.011.

[5] V. Gatta, E. Marcucci, M. Nigro, and S. Serafini, "Sustainable urban freight transport adopting public transport-based crowdshipping for b2c deliveries," *European Transport Research Review*, vol. 11, no. 1, pp. 1–14, 2019. DOI: https://doi.org/10.1186/s12544-019-0352-x.

[6] S. Wicaksono, "Exploring the market potential of bicycle crowdshipping: A bi-level acceptance perspective," M.S. thesis, Delft University of Technology, the Netherlands, 2018. [Online]. Available: https://bit.ly/30sCUYv.

[7] A. Punel and A. Stathopoulos, "Modeling the acceptability of crowdsourced goods deliveries: Role of context and experience effects," *Transportation Research Part E: Logistics and Transportation Review*, vol. 105, pp. 18–38, 2017, ISSN: 1366-5545. DOI: https://doi.org/10.1016/j.tre.2017.06.007.

[8] C. Archetti, M. Savelsbergh, and M. G. Speranza, "The vehicle routing problem with occasional drivers," *European Journal of Operational Research*, vol. 254, no. 2, pp. 472–480, 2016, ISSN: 0377-2217. DOI: https://doi.org/10.1016/j.ejor.2016.03.049.

[9] Y. Wang, D. Zhang, Q. Liu, F. Shen, and L. H. Lee, "Towards enhancing the last-mile delivery: An effective crowd-tasking model with scalable solutions," *Transportation Research Part E: Logistics and Transportation Review*, vol. 93, pp. 279–293, 2016, ISSN: 1366-5545. DOI: https://doi.org/10.1016/j.tre.2016.06.002.

[10] A. M. Arslan, N. Agatz, L. Kroon, and R. Zuidwijk, "Crowdsourced delivery—a dynamic pickup and delivery problem with ad hoc drivers," *Transportation Science*, vol. 53, no. 1, pp. 222–235, 2019. DOI: https://doi.org/10.1287/trsc.2017.0803.

[11] J. Miller, Y. Nie, and A. Stathopoulos, "Crowdsourced urban package delivery: Modeling traveler willingness to work as crowdshippers," *Transportation Research Record*, vol. 2610, no. 1, pp. 67–75, 2017. DOI: https://doi.org/10.3141/2610-08.

[12] T. V. Le and S. V. Ukkusuri, "Modeling the willingness to work as crowd-shippers and travel time tolerance in emerging logistics services," *Travel Behaviour and Society*, vol. 15, pp. 123–132, 2019, ISSN: 2214-367X. DOI: https://doi.org/10.1016/j.tbs.2019.02.001.

[13] M. Briffaz and C. Darvey, "Crowd-shipping in geneva exploratory and descriptive study of crowd-shipping," M.S. thesis, University of Gothenburg, Sweden, 2016. [Online]. Available: https://gupea.ub.gu.se/handle/2077/44874.

[14] A. Punel, A. Ermagun, and A. Stathopoulos, "Studying determinants of crowd-shipping use," *Travel Behaviour and Society*, vol. 12, pp. 30–40, 2018, ISSN: 2214-367X. DOI: https://doi.org/10.1016/j.tbs.2018.03.005.

[15] T. V. Le, A. Stathopoulos, T. Van Woensel, and S. V. Ukkusuri, “Supply, demand, operations, and management of crowd-shipping services: A review and empirical evidence,” *Transportation Research Part C: Emerging Technologies*, vol. 103, pp. 83–103, 2019, ISSN: 0968-090X. DOI: https://doi.org/10.1016/j.trc.2019.03.023.

[16] E. Pourrahmani and M. Jaller, “Crowdshipping in last mile deliveries: Operational challenges and research opportunities,” *Socio-Economic Planning Sciences*, p. 101 063, 2021, ISSN: 0038-0121. DOI: https://doi.org/10.1016/j.seps.2021.101063.

[17] J. F. Rougès and B. Montreuil, “Crowdsourcing delivery: New interconnected business models to reinvent delivery,” in *1st international physical internet conference*, vol. 1, 2014, pp. 1–19. [Online]. Available: https://www.cirrelt.ca/ipic2014/pdf/1027a.pdf.

[18] *Lead*, 2019. [Online]. Available: https://www.leadproject.eu/about/ (visited on 02/10/2021).

[19] B. V. Wee and D. Banister, “How to write a literature review paper?” *Transport Reviews*, vol. 36, no. 2, pp. 278–288, 2016. DOI: https://doi.org/10.1080/01441647.2015.1065456.

[20] K. Gdowska, A. Viana, and J. P. Pedroso, “Stochastic last-mile delivery with crowdshipping,” *Transportation Research Procedia*, vol. 30, pp. 90–100, 2018, EURO Mini Conference on "Advances in Freight Transportation and Logistics", ISSN: 2352-1465. DOI: https://doi.org/10.1016/j.trpro.2018.09.011.

[21] C. van Cooten, “Crowdsourced delivery the traditional delivery method reinvented,” M.S. thesis, Eindhoven University of Technology, the Netherlands, 2016. [Online]. Available: https://bit.ly/2Q5BjWy.

[22] M. Behrend and F. Meisel, “The integration of item-sharing and crowdshipping: Can collaborative consumption be pushed by delivering through the crowd?” *Transportation Research Part B: Methodological*, vol. 111, pp. 227–243, 2018. DOI: https://doi.org/10.1016/j.trb.2018.02.017.

[23] V. Gatta, E. Marcucci, M. Nigro, S. M. Patella, and S. Serafini, “Public transport-based crowdshipping for sustainable city logistics: Assessing economic and environmental impacts,” *Sustainability*, vol. 11, no. 1, p. 145, 2019. DOI: https://doi.org/10.3390/su11010145.

[24] S. Wicaksono, X. Lin, and L. A. Tavasszy, “Market potential of bicycle crowdshipping: A two-sided acceptance analysis,” *Research in Transportation Business Management*, p. 100 660, 2021, ISSN: 2210-5395. DOI: https://doi.org/10.1016/j.rtbm.2021.100660.

[25] X. Lin, Y. Nishiki, and L. A. Tavasszy, “Performance and intrusiveness of crowdshipping systems: An experiment with commuting cyclists in the netherlands,” *Sustainability*, vol. 12, no. 17, 2020, ISSN: 2071-1050. DOI: https://doi.org/10.3390/su12177208.

[26] V. Frehe, J. Mehmann, and F. Teuteberg, “Understanding and assessing crowd logistics business models–using everyday people for last mile delivery,” *Journal of Business & Industrial Marketing*, 2017. DOI: https://doi.org/10.1108/JBIM-10-2015-0182.

[27] M. Laeequddin, B. Sahay, V. Sahay, and K. A. Waheed, “Measuring trust in supply chain partners’ relationships,” *Measuring Business Excellence*, vol. 14, no. 3, pp. 53–69, 2010. DOI: https://doi.org/10.1108/13683041011074218.

[28] D. J. McAllister, “Affect-and cognition-based trust as foundations for interpersonal cooperation in organizations,” *Academy of management journal*, vol. 38, no. 1, pp. 24–59, 1995. DOI: https://doi.org/10.5465/256727.

[29] R. C. Mayer, J. H. Davis, and F. D. Schoorman, “An integrative model of organizational trust,” *Academy of management review*, vol. 20, no. 3, pp. 709–734, 1995. DOI: https://doi.org/10.5465/amr.1995.9508080335.

[30] R. Elliott and N. Yannopoulou, “The nature of trust in brands: A psychosocial model,” *European journal of marketing*, vol. 14, no. 9/10, pp. 988–998, 2007. DOI: https://doi.org/10.1108/03090560710773309.

[31] B. McEvily and M. Tortoriello, “Measuring trust in organisational research: Review and recommendations,” *Journal of Trust Research*, vol. 1, no. 1, pp. 23–63, 2011. DOI: https://doi.org/10.1080/21515581.2011.552424.

[32] M. F. Baumann, C. Brändle, C. Coenen, and S. Zimmer-Merkle, "Taking responsibility: A responsible research and innovation (rri) perspective on insurance issues of semi-autonomous driving," *Transportation Research Part A: Policy and Practice*, vol. 124, pp. 557–572, 2019, ISSN: 0965-8564. DOI: https://doi.org/10.1016/j.tra.2018.05.004.

[33] G. Agag and R. Eid, "Examining the antecedents and consequences of trust in the context of peer-to-peer accommodation," *International Journal of Hospitality Management*, vol. 81, pp. 180–192, 2019, ISSN: 0278-4319. DOI: https://doi.org/10.1016/j.ijhm.2019.04.021.

[34] L. G. Zucker, "Production of trust: Institutional sources of economic structure, 1840–1920.," *Research in organizational behavior*, 1986. [Online]. Available: https://digitalassets.lib.berkeley.edu/irle/ucb/text/irla0277.pdf.

[35] A. Punel, A. Ermagun, and A. Stathopoulos, "Push and pull factors in adopting a crowdsourced delivery system," *Transportation Research Record*, vol. 2673, no. 7, pp. 529–540, 2019. DOI: https://doi.org/10.1177/0361198119842127.

[36] D. H. McKnight and N. L. Chervany, "What trust means in e-commerce customer relationships: An interdisciplinary conceptual typology," *International journal of electronic commerce*, vol. 6, no. 2, pp. 35–59, 2001. DOI: https://doi.org/10.1080/10864415.2001.11044235.

[37] K. S. Cook, T. Yamagishi, C. Cheshire, R. Cooper, M. Matsuda, and R. Mashima, "Trust building via risk taking: A cross-societal experiment," *Social psychology quarterly*, vol. 68, no. 2, pp. 121–142, 2005. DOI: https://doi.org/10.1177/019027250506800202.

[38] J. C. Hauff, "Trust and risk-taking in a pension investment setting," *International Journal of Bank Marketing*, 2014. DOI: https://doi.org/10.1108/IJBM-11-2013-0138.

[39] J. R. Yao, "Risk preference and risk perception and their interactions with risk choices in the stock market," M.S. thesis, Erasmus School of Economics, 2017. [Online]. Available: https://bit.ly/3sPgPz9.

[40] T. S. Teo and J. Liu, "Consumer trust in e-commerce in the united states, singapore and china," *Omega*, vol. 35, no. 1, pp. 22–38, 2007, ISSN: 0305-0483. DOI: https://doi.org/10.1016/j.omega.2005.02.001.

[41] J. A. Colquitt, B. A. Scott, and J. A. LePine, "Trust, trustworthiness, and trust propensity: A meta-analytic test of their unique relationships with risk taking and job performance.," *Journal of applied psychology*, vol. 92, no. 4, p. 909, 2007. DOI: https://doi.org/10.1037/0021-9010.92.4.909.

[42] M. Savelsbergh and T. Van Woensel, "50th anniversary invited article—city logistics: Challenges and opportunities," *Transportation Science*, vol. 50, no. 2, pp. 579–590, 2016. DOI: https://doi.org/10.1287/trsc.2016.0675.

[43] R. Bachmann and A. Zaheer, *Handbook of trust research*. Edward Elgar Publishing, 2006.

[44] E. T. Chancey, J. P. Bliss, A. B. Proaps, and P. Madhavan, "The role of trust as a mediator between system characteristics and response behaviors," *Human factors*, vol. 57, no. 6, pp. 947–958, 2015. DOI: https://doi.org/10.1177/0018720815582261.

[45] E. T. Chancey, J. P. Bliss, Y. Yamani, and H. A. Handley, "Trust and the compliance–reliance paradigm: The effects of risk, error bias, and reliability on trust and dependence," *Human factors*, vol. 59, no. 3, pp. 333–345, 2017. DOI: https://doi.org/10.1177/0018720816682648.

[46] A. Jøsang, R. Ismail, and C. Boyd, "A survey of trust and reputation systems for online service provision," *Decision Support Systems*, vol. 43, no. 2, pp. 618–644, 2007, Emerging Issues in Collaborative Commerce, ISSN: 0167-9236. DOI: https://doi.org/10.1016/j.dss.2005.05.019.

[47] Z. Shao, L. Zhang, X. Li, and Y. Guo, "Antecedents of trust and continuance intention in mobile payment platforms: The moderating effect of gender," *Electronic Commerce Research and Applications*, vol. 33, p. 100 823, 2019, ISSN: 1567-4223. DOI: https://doi.org/10.1016/j.elerap.2018.100823.

[48] E. Molin and M. Kroesen, *Travelling by train in corona time? safety perceptions of and support for policy measure*, 2021.

[49] *Discrete choice methods with simulation*, 2003. [Online]. Available: https://eml.berkeley.edu/books/choice2.html (visited on 05/23/2021).

[50] E. Molin, *Introduction to experimental designs. sen1221 - lecture 1.* Dec. 2019.

[51] E. J. Molin and H. J. Timmermans, "Context dependent stated choice experiments: The case of train egress mode choice," *Journal of Choice Modelling*, vol. 3, no. 3, pp. 39–56, 2010. DOI: https://doi.org/10.1016/S1755-5345(13)70013-7.

[52] M. E. Kløjgaard, M. Bech, and R. Søgaard, "Designing a stated choice experiment: The value of a qualitative process," *Journal of Choice Modelling*, vol. 5, no. 2, pp. 1–18, 2012, ISSN: 1755-5345. DOI: https://doi.org/10.1016/S1755-5345(13)70050-2.

[53] J. Coast and S. Horrocks, "Developing attributes and levels for discrete choice experiments using qualitative methods," *Journal of health services research & policy*, vol. 12, no. 1, pp. 25–30, 2007. DOI: https://doi.org/10.1258/135581907779497602.

[54] T. V. Le and S. V. Ukkusuri, "Crowd-shipping services for last mile delivery: Analysis from survey data in two countries," *arXiv preprint arXiv:1810.02856*, 2018. [Online]. Available: http://arxiv-export-lb.library.cornell.edu/abs/1810.02856.

[55] L. T. V and S. V. Ukkusuri, "Influencing factors that determine the usage of the crowd-shipping services," *Transportation Research Record*, vol. 2673, no. 7, pp. 550–566, 2019. DOI: https://doi.org/10.1177/0361198119843098.

[56] *Ngene 1.2 user manual reference guide. the cutting edge in experimental design*, 2018. [Online]. Available: http://www.choice-metrics.com/download.html#manual (visited on 05/24/2021).

[57] A.-R. Blais and E. U. Weber, "A domain-specific risk-taking (dospert) scale for adult populations," *Judgment and Decision making*, vol. 1, no. 1, 2006. [Online]. Available: https://ssrn.com/abstract=1301089.

[58] R. M. Baron and D. A. Kenny, "The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations.," *Journal of personality and social psychology*, vol. 51, no. 6, p. 1173, 1986. DOI: https://doi.org/10.1037/0022-3514.51.6.1173.

[59] D. P. MacKinnon, A. J. Fairchild, and M. S. Fritz, "Mediation analysis," *Annu. Rev. Psychol.*, vol. 58, pp. 593–614, 2007. DOI: https://doi.org/10.1146/annurev.psych.58.110405.085542.

[60] A. F. Hayes. (2014). "Mechanisms of behavior change," Youtube, [Online]. Available: https://www.youtube.com/watch?v=q3TCj0ymu_c&t=244s.

[61] *Statistical analysis with latent variables user's guide*, 2017. [Online]. Available: https://www.statmodel.com/ugexcerpts.shtml (visited on 05/08/2021).

[62] L. Klem, *Reading and understanding multivariate statistics, Chapter 7: Structural Equation Modeling*, P. R. Y. LAURENCE G . GRIMM, Ed. AMERICAN PSYCHOLOGICAL ASSOCIATION, 1995, ISBN: 1-55798-698-3. [Online]. Available: https://psycnet.apa.org/record/1995-97110-003.

[63] A. Vij, A. Carrel, and J. L. Walker, "Incorporating the influence of latent modal preferences on travel mode choice behavior," *Transportation Research Part A: Policy and Practice*, vol. 54, pp. 164–178, 2013, ISSN: 0965-8564. DOI: https://doi.org/10.1016/j.tra.2013.07.008.

[64] S. van Cranenburgh, *Latent class discrete choice models for travel behaviour research - lecture 8.* Nov. 2020.

[65] M. Kroesen, *Latent class discrete cluster models ii - lecture 7.* Nov. 2020.

[66] E. Molin, P. Mokhtarian, and M. Kroesen, "Multimodal travel groups and attitudes: A latent class cluster analysis of dutch travelers," *Transportation Research Part A: Policy and Practice*, vol. 83, pp. 14–29, 2016, ISSN: 0965-8564. DOI: https://doi.org/10.1016/j.tra.2015.11.001.

[67] S. H. D. Palma, *Apollo: A flexible, powerful and customisable freeware package for choice model estimation and application, version 0.2.4- user manual*, Feb. 2021. [Online]. Available: www.ApolloChoiceModelling.com (visited on 06/11/2021).

[68] *Central bureau for statistics, population key figures*, Oct. 2020. [Online]. Available: https://opendata.cbs.nl/statline/#/CBS/en/dataset/37296eng/table?fromstatweb (visited on 06/01/2021).

[69] *Central bureau for statistics, more than half of dutch people work full-time*, Feb. 2020. [Online]. Available: https://www.cbs.nl/en-gb/news/2020/08/more-than-half-of-dutch-people-work-full-time (visited on 06/01/2021).

[70] *Central bureau for statistics, trends in the netherlands 2018*, 2018. [Online]. Available: https://longreads.cbs.nl/trends18-eng/society/figures/education/ (visited on 06/01/2021).

[71] T. V. Le and S. V. Ukkusuri, "Crowd-shipping services for last mile delivery: Analysis from american survey data," *Transportation Research Interdisciplinary Perspectives*, vol. 1, p. 100 008, 2019, ISSN: 2590-1982. DOI: https://doi.org/10.1016/j.trip.2019.100008.

[72] *What are pseudo r-squareds?* Oct. 2011. [Online]. Available: https://stats.idre.ucla.edu/other/mult-pkg/faq/general/faq-what-are-pseudo-r-squareds/ (visited on 06/19/2021).

A

RESEARCH PAPER

THE EFFECT OF TRUST IN THE CHOICE FOR CROWDSHIPPING SERVICES FROM THE USER'S PERSPECTIVE

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ABSTRACT

Thanks to growing online shopping, last mile logistics is becoming a more relevant problem for cities due to its negative impacts, such as congestion and environmental problems. In this research, one of the urban freight transport services aiming to tackle these externalities is analysed: crowdshipping. Crowdshipping is a service where the package is delivered via a traveller who is already making an unrelated trip. Trust is a key concept affecting the adoption of crowdshipping yet to be explicitly investigated . Thereby, this research aims to explore the effect of trust and examine how users' adoption can be achieved. To analyse the stated gap, a stated choice experiment is conducted to test the effect of travel time, travel cost, track and trace, insurance, damage and reputation. A Mediation Choice Model is applied to explore how the relevant attributes would impact trust towards the service adoption. Based on the findings, the direct effects of all the selected attributes were found significant, except for tracking and tracing. Regarding the indirect effects, all the main attributes were statistically significant, meaning that trust has a mediating effect on the adoption of the service. Additionally, the heterogeneity in preferences is explored through a Latent Class Choice Model resulting in a two-class latent model, crowdshipping sceptics and crowdshipping enthusiasts, the latter being more likely to be composed of younger women. Although enthusiasts consider more features while opting for crowdshipping, the delivery company's reputation and delivery cost were the most important factors in crowdshipping service adoption.

Keywords: Crowdshipping delivery, Trust, Stated preference experiment, Mediation choice model, Latent class choice model

INTRODUCTION

The demand for last-mile delivery has grown rapidly since consumers would rather shop online instead of physically being in the shopping place. Additionally, final customers seek more customised on-demand deliveries, leading to an increase in parcel shipments in urban areas. In addition, the increasing business-to-consumer and consumer-to-consumer commerce leads to negative externalities in urban areas, such as congestion and pollution.

As an innovative solution to tackle these issues, shared mobility services such as crowdshipping are proposed for on-demand delivery requests. Crowdshipping can be considered an effective way of delivering goods to end-users by enabling environmentally friendly vehicle options (*1, 2*). Crowdshipping provides potentially faster and cheaper parcel deliveries for users since the system uses existing infrastructure and passenger flows to deliver the parcel (*3–5*).Traditional carriers use fewer vehicles and make fewer vehicle kilometres in total, which reduces the negative impact of the last-mile on the environment. Additionally, crowdshippers (travellers who occasionally act as couriers) are compensated generating an extra source of income. In this delivery system, a package is delivered via occasional drivers who are making their regular travel and are willing to take the package and drop it off at the intended location. From the last-mile logistics perspective, the main idea behind crowdshipping is that the item is transported by a commuter who is already making their trip for other purposes and thus, not adding extra travelled kilometres to the operation. Besides the advantages of crowdshipping, there are some concerns about the concept which might hinder service adoption. The challenges mainly originate from the uncertainty regarding the package delivery.

Literature review shows that crowdshipping service can only be applied if user acceptance, that defines the demand for crowdshipping service, is achieved (*6–8*). Behavioural studies focusing on user acceptance should incorporate the factors that affect the user acceptability and user preferences for the service (*6*). The factors affecting acceptability include reliability, privacy, safety and liability (*1, 6–9*) and are all closely related to one essential phenomenon: trust. Although trust should be considered as a distinctive factor in crowdshipping service adoption, limited studies have included user's trust in crowdshipping.

Trust is considered one of the indispensable factors towards crowdshipping service adoption (*7, 10, 11*). According to Rougès and Montreuil (*7*), building trust is a key performance indicator, and the crowdshipping service providers are challenged to achieve high level of trust. However, there is no study on operationalising trust in crowdshipping context.

Consequently, the main objective of this research is to investigate the users' perception towards crowdshipping while operationalising trust. Firstly, a literature review is conducted to define trust in crowdshipping and the attributes that might impact on the level of trust. A Stated Preference Experiment (SPE) is constructed for data collection. The attribute weights are estimated by a Mediation Choice Model (MCM) which is used to analyse the impact of the level of trust on choice for crowdshipping service. The estimated MCM also enables the authors to disentangle the direct, indirect through trust and total effects of the main attributes on the service adoption. Next, a Latent Class Choice Model (LCCM) is applied. Thanks to LCCM, the heterogeneity in preferences is explored and the class membership function is included to characterise the classes with sociodemographic profile and attitudinal variables.

In the following section, a literature review on trust and crowdshipping is presented . Next, the applied methodologies are described, followed by the research results. Lastly, research conclusions are discussed.

LITERATURE REVIEW

This section aims to find possible conceptual connections between consumer trust and the adoption of crowdshipping as well as the attributes highlighted in the literature that can be applied to measure trust.

The Concept of Trust

Trust has been researched by different disciplines of social sciences such as psychology, political science and economics. Each discipline explains the role of trust in social processes from a different perspective. Various trust categories can be be found in the literature such as characteristic trust, rational trust, and institutional trust (*12, 13*). A plethora of studies assesses the antecedents of trust, and the literature converges defining trust as a complex psychological phenomenon (*12, 13*). Trust is necessary for organizational success, but requires effort that cannot be created in a short time (*14*). Building customers' trust towards the organisation provides an effective operation and continuity of the business. Thereby, in crowdshipping, the development of trust is expected to increase the willingness to use the service.

Although there are different definitions of trust, the literature extensively cites two of them. First, trust can be seen as one person's willingness to act on another person's action or decision (*15, 16*). Based on this definition, trust is a credence and positive expectation of the individual towards a person, situation or service. In crowdshipping, expectations that delivery will be carried out in a safely manner can improve trust levels. Secondly, trust is defined as one party's willingness to be vulnerable to another party's action (*16*). Thus, one party's willingness to be involved in crowdshipping service plays a pivotal role in trust building process.

Based on the definitions above, trust incorporates two main roles, the trustee and the trustor. The trustee is defined as the party on whom trust is being placed, while the trustor is the person placing himself in a vulnerable and uncertain situation to trust the trustee (*12*). Due to the nature of trust, the relation between both sides is bilateral. The development of trust between the trustee and trustor reduces the perceived risk and affects consumers' behaviour (*13*). In crowdshipping setting, trustee is not only the crowdshipper but also the online platform which matches sender with crowdshipper. Additionally, trustor is the party that is willing to send the package or to use the platform.

All in all, the literature converges into common definitions and concepts of trust, however, it is still not clear if there is a common view on the measures that can be used to achieve trust (*13*).

Crowdshipping as an Innovative Delivery Service

Crowdshipping is an emerging service that requires the cooperation of technology firms, retailers, consumers and travellers (*6*). This new delivery service emerged as an alternative to urban freight distribution by utilising existing travellers' capacity to perform goods transportation (*17*). According to Gdowska et al. (*18*), crowdshipping involves ordinary people in the package delivery to other customers. From this point, this service is defined as a platform that links customers to a crowd of travellers that are willing to pick up and deliver packages.

For the success of crowdshipping, delivery time is considered an important factor (*19*). Lead times can very between a couple of hours, same day, or next day delivery. The ability to define pickup time is found to be a significant factor in the research by Punel and Stathopoulos (*6*). Delivery cost can be seen another essential factor and is defined on an hourly-based or parcel-based level (*7*). Additional attributes influencing the choice for crowdshipping are driver

performance, courier expertise, and experience. These features also affect the trustworthiness of the crowdshipping service (*6*).

In the literature, studies focusing on the behavioural acceptance of crowdshipping state that trust is an important concept enabling the service adoption (*7, 8, 20, 21*). Trust can be affected by various factors. For instance, reliability is an indispensable part of the successful crowdshipping operation (*7, 8, 10*). Studies prove the existence of a strong relation between reliability and level of trust (*22, 23*). When the service is perceived as reliable, the user's trust would be higher for that specific service. Providing users with the ability to real-time track and trace their parcel increases the trust of the users in the service. Rouges and Montreuil (*7*) propose crowdshipping service providers to offer tracking and tracing features to build user's trust towards the service. Moreover, insurance provision is considered an essential factor to solve any liability issues caused by damage or stolen packages (*7*).

Reputation is directly linked to trustworthiness (*24*). This feature can be evaluated based on the satisfied customer reviews and app ratings. Interestingly, in some studies the reputation of the crowdshipping company is found more influential than the cost of the delivery and the delivery time (*10*). In crowdshipping, there might be unwanted consequences such as misdelivery or damage. In those circumstances, users are exposed to risky service or poor service quality. As the company's reputation provides information about the service, this knowledge can diminish unwanted service outcomes (*25*). Reputation enables the user to envision the service quality as it provides other user's reviews and comments.

Literature shows that there is a relation between sociodemographic characteristics and crowdshipping service adoption. According to Punel et. al., (*20*), men, young, and full-time employed individuals are more likely to adopt the crowdshipping. Additionally, building trust between different sociodemographic segments would differ. Therefore, sociodemographic characteristics are considered another important parameter for service adoption.

Crowdshipping is also linked to risky or uncertain situations (*26*) where a crowdshipper might keep the package for himself instead of delivering it to the receiver, or the package might get damaged during the delivery process. For such circumstances, it is important to incorporate the risk tolerance of the users.

From the literature review the key attributes that can operationalise trust in the crowdshipping were identified. Although there are several attributes mentioned in the literature review, six main attributes are selected: delivery time, delivery cost, tracking and tracing options, insurance coverage, possibility of damage and delivery company's reputation. Moreover, the sociodemographic profile and attitudinal characteristics of users should be taken into consideration. The rationale behind this selection is that they are more likely to be favored by relevant stakeholders , namely, the users and crowdshipping service providers to measure the impact of trust on the service adoption.

METHODOLOGY

In this section, the conceptual model of this research is presented as well as the MCM and LLCM models. The research approach is based on the working paper (*27*), where the authors investigate the effect of safety perception and support for policy measures while travelling by train during pandemic.

Conceptual Model

Based on the objectives of the research, the focus of the conceptual model is to understand how various features affect the adoption of the crowdshipping service and to investigate the possibility that the level of trust plays a mediatory role in this adoption. The conceptual model is presented in Figure 1. The causal paths are used to explain the relations between various features related to trust and the adoption of the service. First, the direct effect of the main crowdshipping attributes, namely, delivery time, delivery cost, reliability (tracking-tracing options, insurance coverage and possibility of damage) and reputation along with user sociodemographic and attitudinal profile on the adoption of the service are examined (the paths represented with the straight lines). Secondly, the indirect effect of these measurements mediated by the trust is shown with the second path in the conceptual design (the paths represented with the dashed lines).

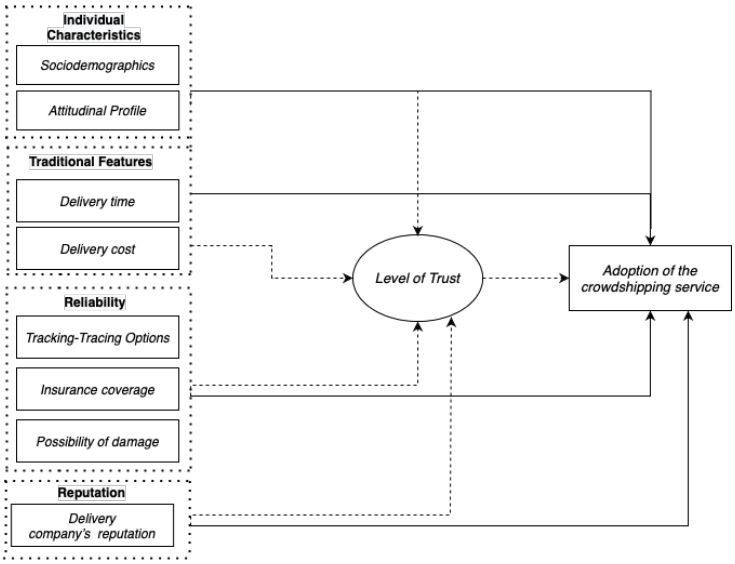

FIGURE 1 Conceptual model

To show the heterogeneity in preferences, LCCM is also needed to be mentioned in the conceptualisation. Due to the fact that MCM and LCCM are two separate models applied to this research, it is not directly possible to visualise both the models in the same framework.

Mediation Choice Model

To model the causality between the variables, MCM is used to analyse the data (*28*). This method is used when there is an availability of mediating structure, meaning that the effect of a variable on the other can be mediated by another variable (M). The overall representation of the model is shown in Figure 2. To ensure that there is a mediating structure, a three-variable system is needed (*28*). This system consists of two causal paths to estimate the dependent variable, represented below. While path c shows the direct impact of the independent variable (X) on the dependent variable (Y), path a indicates the role of the mediator (M). Finally, from the mediator, there is another path (b) showing the impact of the mediator on the dependent variable (Y). The MCM is estimated in Mplus which is a tool for analysing structural equation models (*29*).

The level of trust (M) is assumed to be a dependent interval level measurement and directly measured with a 5-point Likert scale in the choice experiment. This part of the model is

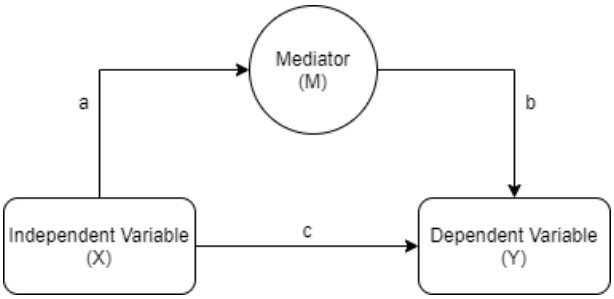

FIGURE 2 Structure of mediation choice model, Source: Adapted from (*28*)

investigated through a linear regression model. In this way, it is possible to analyse how relevant attributes in the choice sets would impact the level of trust. To estimate this relation, the following equation is used.

$$\widehat{Trust}_j = C^{Trust} + \sum \beta_i^{Trust} * X_{ij} \quad (1)$$

Where

$Trust_j$ = Level of trust for a crowdshipping choice set j
C^{Trust} = Regression constant
β_i^{Trust} = Regression coefficient for attribute i on level of trust
X_{ij} = Dummy coded attributes i (shown in Table 1) for crowdshipping choice set j

Concerning the adoption of the service, the respondents are asked to make a choice if they would opt for the crowdshipping service or not. Thereby, the choice of the service (Y) is treated as a dichotomous dependent variable. This part of the model is measured with a binary logistic regression model. The function below is applied to estimate binary logistic regression.

$$\widehat{Adopt}_j = logit = ln\left(\frac{P_{Yes}}{P_{No}}\right) = C^{Trust} + \beta_{Trust}^{Adopt} * Trust_j + \sum \beta_i^{Trust} * X_{ij} \quad (2)$$

Where

$\widehat{Adopt}_j$ = Adoption of the crowdshipping service for choice set j
P_{Yes} = Opting for crowdshipping service
P_{No} = Rejecting crowdshipping service
C^{Trust} = Regression constant
β_{Trust}^{Adopt} = Regression coefficient for level of trust on the adoption of the crowdshipping
$Trust_j$ = Level of trust for a crowdshipping choice set j
β_i^{Trust} = Regression coefficient for attribute i on level of trust
X_{ij} = Dummy coded attributes i (shown in Table 1) for crowdshipping choice set j

Latent Class Choice Model

The heterogeneity in preferences is explored through LCCM (*30*). The classes are heterogeneous relative to other classes and homogeneous within each class. With this method, the likeliness that a respondent with certain sociodemographic characteristics having different preferences towards crowdshipping can be investigated.

As expected, the total effects of the variables in MCM without trust and the binary logit model resulted in similar coefficient values since the MCM applied is an extension of binary logit

model by considering the effect of trust. Next, the class membership function is included to characterise the classes through sociodemographic characteristics and attitudinal variables shown in conceptual design (Figure 1). The model is estimated by using R-Apollo (*31*).

The model was tested for up to 5 classes. Rho^2, log-likelihood estimates and BIC value are used to find out the optimal model. As expected, as the number of classes increases, the Rho^2 value and log-likelihood estimates improve. Nevertheless, adding new variables into the model might cause over-fitting results. To counter this, the BIC values are used to figure out the best model fit since they weigh both global and parsimonious model fit (*32*). Based on the BIC estimation, the smaller the value, the better the model outcome; thereby, 2 class model with 15 parameters provides the best model fit to the sample data.

The LCCM is defined with the following Formula 3 (*33*) where, $P_n(i|\beta)$ refers to the probability that individual n chooses alternative i, conditional on the model parameters β. Assuming s is a class, π_{ns} represents the class membership probability, in other words, the probability that an individual n belongs to class s. Lastly, $P_n(i|\beta_s)$ refers to the probability of an individual n choosing alternative i, ensuring the individual n belongs to the class s.

$$P_n(i|\beta) = \sum_{s=1}^{S} \pi_{ns} P_n(i|\beta_s) \tag{3}$$

To investigate the individual's probability of belonging to each class, a class membership function is estimated. This enables to examine whether this probability is related to personal characteristics or not. The formulation is given in Formula 4 (*33*). The class-specific constants δ_s along with the vector of parameters γ_s need to be estimated. The function g($\circ$) refers to the functional form of the utility for the class. Lastly, in the formulation, z_n refers to observed variables which are taken into consideration in the model such as sociodemographics or attitudinal variables.

$$\pi_{ns} = \frac{e^{\delta_s + g(\gamma_s, z_n)}}{\sum_{l=1..S} e^{\delta_l + g(\gamma_l, z_n)}} \tag{4}$$

Data

This section presents the data collection process and describes the data and the characteristics of the sample.

Data Collection

A survey is developed that consists of four different parts: 1) description of the respondent's online purchase, 2) attitudinal questions, 3) socieconomic characteristcs and 4) a stated preference experiment. The questionnaire was developed in an online web platform called "Qualtrics". In the first part of the questionnaire respondents were asked to provide information on the last item they bought online and the value of that item. These questions were then used in the SP section as a reference point.

Next, three sets of attitudinal questions were asked. Firstly, to measure the risk-taking or risk-aversion behaviour of the respondents, lottery questions were created. In this part, with the differentiation of low risk (20% chance of losing construct) and high risk (80% chance of losing construct) lottery questions, it was expected to measure respondents' risk-taking threshold. Next, four statements were composed to understand the importance of the quality of delivery for individ-

uals. Additionally, three statements were given to understand the importance of the flexibility of delivery for individuals.

In the following part of the questionnaire, sociodemographic characteristics were asked. Individuals were filled in the information regarding gender, age, occupation, education level and monthly income.

Finally, to identify the preferences of individuals, a Stated Preference (SP) survey is designed. In the experiment, individuals are asked to make choices based on a set of hypothetical situations, since they have no previous experience with crowdshipping in the Netherlands.

The attributes related to trust and crowdshipping are selected from the literature and validated through discussions with a crowdshipping service provider. The attributes identified in the literature and incorporated in the survey are: delivery time (*3, 19*), delivery cost (*7, 19*), reliability (tracing and tracking options, insurance coverage, the possibility of damage) (*7, 8, 10*), and the delivery company's reputation (*10, 24, 25*).

Regarding the attribute levels for delivery time, two options are defined: same day or next day delivery. As the main goal of the research is to understand how the relevant attributes affect trust and if trust has a mediatory role in the service adoption, delivery time is not needed to be represented with hours specifically. Hence, only generic information (either same day or next day) is provided to assess the importance of delivery speed for the respondents. Next, the cost of the service is assumed to be 5-7-10 and 12€. These levels are included in order to investigate to what extent people are conscious regarding the cost. Although the crowdshipping service cost is calculated based on the distance travelled, since travel distance is not included in the experiment, respondents are provided with pre-specified cost values.

As for the tracking and tracing options, it represents whether the alternative has real-time tracking or not. Due to the novelty of the platform, it is assumed that this feature might impact the reliability of the service and users' level of trust. Moreover, insurance coverage is represented with an upper bound value in the choice set. These values are used to describe the limit of the insurance since this is also the way insurance coverage is represented in real-life. Also, the possibility of damage is shown with the percentages representing the possibility that the item can get damaged or lost. The values are given to measure if the the possibility of damage affects the service adoption and the level of trust in crowdshipping.

To show the delivery company's reputation, the number of stars is provided concerning the app rating. The stars reflect the credibility of the delivery company, which is directly related to the concept of trust. Although the level of reputation is considered as low, medium or high in some studies (*34, 35*), as far as the research concerns, this is the first time that the number of stars in the app is considered in users' service adoption. Providing one or five stars might lead to bias in attribute since they are both extreme values in app rating. Hence, two and four stars are applied in the experimental design.

While the attribute levels of crowdshipping vary, the traditional delivery option values are fixed (shown in Figure 3). The reason for this choice is that the traditional delivery option is considered as the base alternative permitting respondents to compare it with the crowdshipping option.

To be able to combine defined attribute levels into a choice set, an orthogonal fractional factorial design with one 4-level (delivery cost) and five 2-level attributes (the rest) are chosen, which result in 16 unique profiles. Dummy coding is used to code binary level attributes. The experiment was designed in two different blocks. These blocks are randomly assigned to the

respondents. In this part of the survey, individuals filled in 8 choice sets with two sub-questions each (shown in Figure 3). Ngene software package is used to generate the choice tasks (*36*).

Table 1 shows the summary of the attribute levels and Figure 3 illustrates an example choice task.

TABLE 1 Summary of the attribute levels for crowdshipping delivery

Attribute	Number of attribute levels	Levels	Coding
Delivery time	2	Next day delivery Same day delivery	0 1
Delivery cost	4	5€ 7€ 10€ 12€	5 7 10 12
Tracking tracing options	2	Only main steps can be seen in the app/website Real time driver tracking by the app/website	0 1
Delivery company's reputation	2	★★ ★★★★	0 1
Insurance coverage	2	Up to 500€ Up to 1000€	0 1
Possibility of damage	2	1 in 20 damaged delivery (5%) 1 in 30 damaged delivery (3%)	0 1

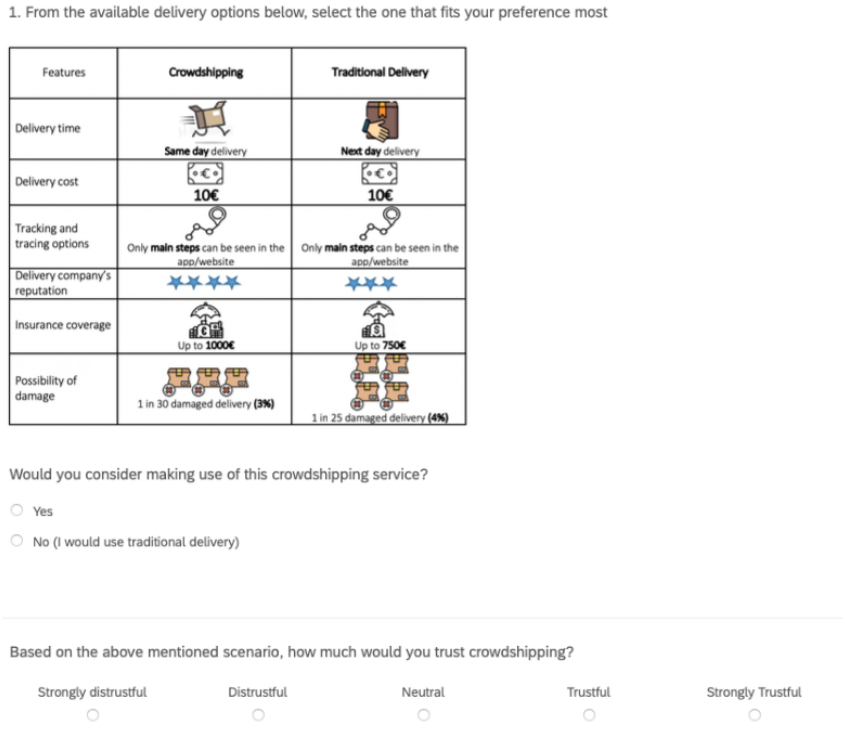

FIGURE 3 An example choice task

Sample Characteristics

The data collection process took place in the last week of April in 2021 and was kept online for three weeks. Respondents who live in the Netherlands and are above 18 years of age were able to fill in the survey. In the end, 248 responses were collected, of which 215 were fully completed. Table 2 shows that the sample consists of approximately the equal number of men and women. Regarding the age group, a considerable number of respondents (85%) belong to the 18-33 age segment and more than half of the respondents are students who are doing master's or bachelors. Thereby, there is an over-representation of young people and students in the sample data and people older than 33 years of age account for almost 15% of the data set. As the most dominant responses belong to students, the monthly income represented with less than 1000€ in a month appears to be 47.2% of the total respondents.

The frequency distribution of sociodemographics based on the sample data is shown in Table 2 below and the next section presents and discusses the results of both models.

TABLE 2 Frequency distribution of sociodemographic characteristics of the sample (N=215)

Sociodemographic characteristics	Category	Frequency (N)	Relative (%)
Gender	Male	116	54.2%
	Female	93	43.5%
	Non-binary/ Third gender	4	1.9%
	Prefer not to say	1	0.5%
Age	18-25	100	46.7%
	26-33	83	38.8%
	34-41	16	7.5%
	42-49	10	4.7%
	50-57	5	2.3%
Occupation	Working full time	61	28.5%
	Working part time	9	4.2%
	Student	135	62.8%
	I have no work at the moment	8	3.7%
	Volunteer work	1	0.5%
Education level	VMBO(MAVO)	1	0.5%
	HAVO	3	1.4%
	VWO	4	1.9%
	MBO	2	0.9%
	Bachelor	52	24.3%
	Master	129	60.3%
	PhD	23	10.7%
Income level	Less than 500€	56	26.2%
	501-1000€	45	21.0%
	1001-1500€	20	9.3%
	1501-2000€	15	7.0%
	2001-2500€	10	4.7%
	2501-3000€	11	5.1%
	3001-3500€	8	3.7%
	More than 3500€	16	7.5%
	I prefer not to answer this	33	15.4%
Missing value		1	0.5%
Total		215	100%

RESULTS

In this section, MCM results are provided followed by LCCM.

Mediation Choice Model

Based on the conceptual model represented in Figure 1, the MCM is estimated.

From the detailed table below, some key findings emerge: First of all, the direct effect of trust on crowdshipping service adoption is statistically significant, and the coefficient is strong, with the value of 0.376. The positive value of the coefficient is expected, since the larger the trust

in the service, the more likely the adoption.

TABLE 3 Mediation choice model results

		indirect effect on the service adoption		direct effect on the service adoption		total effect on the service adoption	
	Reference level	Est.	p-value	Est.	p-value	Est.	p-value
Delivery time							
Same day delivery	Next day delivery	0.023	0.007	0.063	0.013	0.086	0.001
Delivery cost		-0.051	0.000	-0.400	0.000	-0.451	0.000
Tracking and tracing options							
Real time driver tracking	Only main steps can be seen	0.053	0.000	-0.024	0.345	0.029	0.283
Delivery company's reputation							
Four stars	Two stars	0.118	0.000	0.231	0.000	0.349	0.000
Insurance coverage							
Up to 1000€	Up to 500€	0.040	0.000	0.054	0.037	0.094	0.000
Possibility of damage							
1 in 30 damaged delivery (3%)	1 in 20 damaged delivery (5%)	0.028	0.001	0.069	0.007	0.097	0.000
80% chance of losing (F1)		0.029	0.001	0.013	0.621	0.041	0.127
20% chance of losing (F2)		0.051	0.000	0.024	0.345	0.075	0.004
Quality of delivery (F1)		0.026	0.003	0.010	0.684	0.037	0.174
Master/PhD	Others	-0.017	0.035	-0.013	0.608	-0.030	0.251
Intercepts		3.552	0.000	0.197	0.155		
Level of trust				0.376	0.000		
R-square (Trust)				0.190	0.000		
Pseudo R-square(Choice)				0.476	0.000		

Significance level on 95% confidence interval (p<0.05)
The coefficient values stand for standardised estimates.

Moreover, the direct effect of the same day delivery on choice is statistically significant with the value of 0.013. As people generally seek fast delivery, this makes a choice positively linked to the same day delivery option. As for the indirect effect, which is computed through trust, there is a positive significance. This means that the same day delivery option has its indirect effect on the choice of crowdshipping through trust. This outcome is expected as the possibility of faster delivery leads to positive influence on the level of trust.

Concerning delivery cost, it is seen that the direct impact is negatively related on the choice of crowdshipping service (-0.400). The negative relation of the cost can be seen as an expected outcome since the cost of the crowdshipping delivery increases, it is less likely that people opt for the service. An interesting point is that the direct effect of delivery cost on trust. The cost has a negative coefficient (-0.051), which means that when the cost increases, the level of trust decreases. The reason for this could be because of the risk involved is higher when the value of cost increases. Additionally, people might think that they are being overcharged; therefore, they might lose trust towards the system.

Regarding the tracking and tracing options, the direct effect of real time driver tracking on the choice is not statistically significant, but the effect via trust is statistically significant (0.053). Even though this result might appear to be in conflict with the literature where real time driver tracking for local deliveries is significant (*34, 37*), the model suggests that the actual effect of tracking and tracing occurs because it improves trust of the system and not because it affects directly the adoption. This result is in line with the expectations since traceability of the delivery service would affect the individual's trust, and the reliability of the service increases with the real-time driver tracking. This means that trust fully mediates this attribute on the service adoption.

Next, the direct impact of the delivery company's reputation and insurance coverage are statistically significant (0.231 and 0.054 respectively). These features impact service quality, hence, the choice of the service. The effect of the delivery company's reputation and insurance coverage via trust is also positively correlated to the service adoption. This means that trust has a statistically significant indirect effect on the choice of the crowdshipping service. Consequently, when the crowdshipping service provider has a good reputation and provides higher level insurance coverage, the user's trust and the choice of crowdshipping delivery would be positively impacted by the values 0.118 and 0.040, respectively.

As for the possibility of damage, the direct and indirect effect of this attribute is statistically significant, meaning that there is a partially mediating effect via trust. The possible explanation would be that the lower the damage enables individuals to trust the system and indirectly affect the choice of the crowdshipping service.

Regarding the attitudinal profile, the direct effect of the risk-taking constructs (80% chance of losing and 20% chance of losing) on the service adoption is not statistically significant. However, the indirect effect of these constructs on the service adoption is significant, meaning that trust has a fully mediating effect on risk-taking behaviour towards the service adoption. This result is in line with the expectations. In the case of low-risk circumstances, the indirect effect of trust on the service adoption is slightly more than the high risk circumstances. Similarly, the model estimation demonstrates that indirect effect of trust is slightly higher in 20% chance of losing (0.051) situation when compared to 80% chance of losing (0.029) setting. This outcome is noteworthy since it is more likely to adopt the crowdshipping service if the risk-involved is relatively low.

As for the importance of the delivery quality, the direct and total effects of this variable are not statistically significant. However, its indirect effect has a significant positive impact on the service adoption. As for the importance of the delivery flexibility, the variable does not have its direct, indirect and total effects on the service adoption that's why it is not included in the Table 2. To this end, the results highlight that the quality of the delivery is more important for respondents and has clearly more impact on the service adoption rather than the flexibility of the delivery.

Lastly, sociodemographic characteristics are included in MCM. The result illustrates that only the education level has a significant impact on trust (Table 2). Concerning the education level, the level of trust decreases as the level of education is higher (master's and PhD's). The possible explanation would be that these individuals might consider crowdshipping as a distrustful option or they would request additional features to trust the service. Furthermore, the direct effect of the same variable is proved not to be significant, meaning that there is no direct effect originating from the level of education on the service adoption.

The intercept for trust is 3.552, meaning that the baseline level of trust towards crowdshipping tends to be high. The estimated intercept on the service adoption has a value of 0.197. When only looking at the constant of trust, the value means that if all independent variables are

zero, there is a positive preference for crowdshipping as the parameter is positive and statistically significant. This result is indeed meaningful as the model predicts that the responses in favour of crowdshipping account for 63%.

Latent Class Choice Model

Table 4 indicates the effects of the main attributes as well as the class membership in crowdshipping setting. In the table, only the statistically significant values of sociodemographic profile and attitudinal variables are represented.

TABLE 4 2-Class LCCM parameters with class membership

		Crowdshipping sceptics		**Crowdshipping enthusiasts**	
	Reference level	Est.	p-value	Est.	p-value
LCCM (Main attributes)					
Delivery time					
Same day delivery	Next day delivery	0.097	0.345	0.909	0.001***
Delivery cost		-0.154	0.003***	-1.260	0.000***
Tracking and tracing options					
Real time driver tracking	Only main steps can be seen	-0.007	0.481	3.236	0.000***
Delivery company's reputation					
Four stars	Two stars	1.679	0.000***	1.786	0.000***
Insurance coverage					
Up to 1000€	Up to 500€	0.130	0.274	0.596	0.004***
Possibility of damage					
1 in 30 damaged delivery (3%)	1 in 20 damaged delivery (5%)	0.276	0.101	3.790	0.000***
Intercepts (Constants)		0.150	0.342	8.906	0.000***
Class membership (Background variables)					
20% chance of losing (F2)		-0.470	0.022**	0.000	–
Quality of the delivery (F1)		-0.365	0.060*	0.000	–
Female	Male	-0.512	0.095*	0.000	–
Age 25+	18-25	0.559	0.066*	0.000	–
Class membership constant		-0.664	0.045**	–	–
Class share		36%		64%	

*Significant level on 90% confidence interval (p<0.10)
**Significant level on 95% confidence interval (p<0.05)
***Significant level on 99% confidence interval (p<0.01)

The model estimation shows two well differentiated classes: crowdshipping sceptics and crowdshipping enthusiasts. This differentiation is based on the estimated constants, which are 0.150 and 8.906 respectively, and the evaluation of the attributes. The main characteristics of the classes are summarised below:

- **Class 1: "Crowdshipping sceptics"** The overall probability of belonging to this group is 36%. In this class, people are mostly concerned about the delivery cost of the service and the delivery company's reputation. Additionally, for this class, they are more inclined

to choose the safest option as 20% chance of losing appears to be significant. Hence, it can be said that people who belong to this group have low risk tolerance.
It is more likely that men and older than 25 years of age individuals belong to this class. Regarding the other coefficients related to attitudinal profile and sociodemographic factors, the parameters are not statistically significant. Therefore, these parameters are not represented in Table 4.

- **Class 2: "Crowdshipping enthusiasts"**
The overall probability of belonging to this group is 64% and the class has a high constant value which means that the possibility of opting for crowdshipping delivery is relatively high in this class.
Regarding the attributes, all the main attributes in this class are statistically significant on a 99% confidence interval meaning that the attributes affect the choice of the crowdshipping service. People belonging to this class are more inclined to choose crowdshipping and they are more likely to be a woman who is between 18 and 25 years of age. Moreover, reliability-related features are important for people in this class, such as less damaged delivery, real-time tracking and higher insurance coverage. For people who belong to this class, same day delivery feature and delivery company's reputation is relatively important. Lastly, similar to sceptics, enthusiasts are also sensitive to the delivery cost.

CONCLUSIONS

Based on the research objectives, various attributes were explored in MCM and to what extent the effects of these attributes are mediated by the perception where the delivery of the parcel is executed in a trustworthy manner. Moreover, the heterogeneity in preferences are investigated with the help of LCCM. By including sociodemographics and attitudinal profile in class membership function, the possibility of correlation between those variables and the choice of the individuals are also explored.

The findings showed the importance of trust and to what extent it affects crowdshipping service adoption. By disentangling the direct and indirect effects of trust towards the service adoption, it became clear that trust has partially and, for some features, fully mediating effect towards the crowdshipping service choice. In general, the findings showed that there is a strong preference towards crowdshipping and 63% of the individuals would opt for the service given the hypothetical choice scenarios.

The MCM showed that the tracking and tracing facility of the service is fully mediated by trust, meaning that this feature is directly affected by trust towards the service adoption. This outcome is interesting since the real time tracking and tracing of the crowdshipper is seen as a factor that increases the level of trust towards the service. Additionally, the results demonstrated that the reputation of the company, measured with app rating, is important for the individuals as it affects the choice of crowdshipping. Due to the fact that app rating given in the experiment provides different levels of reputation, this would create different level of trust towards crowdshipping. Moreover, the risk-taking attitude of the individuals is directly linked to the level of trust through crowdshipping service. This means that being risk-averse or risk-seeking attitude might directly affect the level of trust, resulting in an indirect effect on the service adoption.

The estimated model provides a better understanding towards the heterogeneity in preferences in the sample data set. The model results showed that the 2-class latent model is the best fit for the sample data, named crowdshipping sceptics and crowdshipping enthusiasts. From the

model results, it is clear that the delivery company's reputation and delivery cost are some of the most important factors in crowdshipping service adoption for both of the classes. These findings are consistent with the results from the MCM where the effect of trust is investigated.

Furthermore, sociodemographic characteristics are included in both MCM and LCCM. MCM showed that only education level is statistically significant. Although there is no direct effect on service adoption, this parameter has an indirect effect on the service adoption. Surprisingly, the level of trust decreases as the level of education is higher (master's and PhD's). The possible explanation would be that this group of people might consider crowdshipping as a distrustful option or they would request additional features to trust the service. Regarding LCCM results, the research findings demonstrated that gender and age influence latent class membership as only these variables are statistically significant. Based on the estimations, it is more likely that men and older than 25 years of age individuals belong to the class crowdshipping sceptics.

This is the first time that trust is included in a choice model as a mediating variable in crowdshipping domain. Hence, this can be seen as the most important contribution of this study from the methodological point of view. To the best of the author's knowledge, the number of studies about crowdshipping is still limited in respect to the user preferences. Although SP experiments are already applied to other studies, the concept of trust have not been included before. However, in this research, trust is treated as an observable latent variable which enables authors to operationalise trust in the service adoption which can be seen another important contribution of this study.

From a practical perspective, three recommendations can be given. The first one refers to the market reputation of the crowdshipping service provider. The research showed that the delivery company's reputation is the most important feature that affects the service adoption and the level of trust towards the service. Thereby, a crowdshipping service provider should have specific actions to build a positive reputation and a high app rating. For this aim, the service provider might cooperate with the local authorities such as municipalities or might use advertisement channels to establish awareness among the citizens. The second recommendation would be related to the delivery cost of the crowdshipping. The cost of the service needs to be arranged such a way that is affordable and cost-competitive since individuals would rather use traditional delivery in the case of high delivery cost. Finally, the marketing efforts should be targeted to younger women, since they were more likely to adopt the service.

One of the main limitations of the research is the over-representation of students and low-income segment interviewees in the sample hindering the application of the models for business recommendations and policy making. Additionally, the used data to answer the research questions comes from SP data. Although this method has several advantages, it is not possible to investigate real elasticity and forecast models without revealed preference data. Lastly, it is important to mention that all the online shops/websites are assumed to have a crowdshipping alternative for last mile delivery in the survey.

For future research, more alternatives to crowdshipping can be added in a future choice experiment. Trust from the crowdshipper point of view needs to be studied more deeply to have a better understanding of the actors. The basic regulations to control the delivery service would affect user's trust in the service adoption, as the service user's would be protected and the regulations would control the crowdshippers to securely execute deliveries. Lastly, the research scope does not cover the role of the policy making process and possible interventions. For example it can be analysed what would be the effect in trust when a regulatory framework such as minimum tariff

for compensations is enforced.

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AUTHOR CONTRIBUTIONS

The authors confirm contribution to the paper as follows: study conception and design: Cebeci, Tapia, Kroesen, Amankwah, Tavasszy; data collection: Cebeci; analysis and interpretation of results: Cebeci, Tapia, Kroesen, Kourounioti; draft manuscript preparation: Cebeci, Tapia, Kroesen, Kourounioti, Amankwah, Tavasszy. All authors reviewed the results and approved the final version of the manuscript.

REFERENCES

1. Wang, Y., D. Zhang, Q. Liu, F. Shen, and L. H. Lee, Towards enhancing the last-mile delivery: An effective crowd-tasking model with scalable solutions. *Transportation Research Part E: Logistics and Transportation Review*, Vol. 93, 2016, pp. 279–293.
2. Archetti, C., M. Savelsbergh, and M. G. Speranza, The Vehicle Routing Problem with Occasional Drivers. *European Journal of Operational Research*, Vol. 254, No. 2, 2016, pp. 472–480.
3. Devari, A., A. G. Nikolaev, and Q. He, Crowdsourcing the last mile delivery of online orders by exploiting the social networks of retail store customers. *Transportation Research Part E: Logistics and Transportation Review*, Vol. 105, 2017, pp. 105–122.
4. Arslan, A. M., N. Agatz, L. Kroon, and R. Zuidwijk, Crowdsourced delivery—A dynamic pickup and delivery problem with ad hoc drivers. *Transportation Science*, Vol. 53, No. 1, 2019, pp. 222–235.
5. Briffaz, M. and C. Darvey, *Crowd-shipping in Geneva exploratory and descriptive study of Crowd-shipping*. Master's thesis, University of Gothenburg, Sweden, 2016.
6. Punel, A. and A. Stathopoulos, Modeling the acceptability of crowdsourced goods deliveries: Role of context and experience effects. *Transportation Research Part E: Logistics and Transportation Review*, Vol. 105, 2017, pp. 18–38.
7. Rougès, J. F. and B. Montreuil, Crowdsourcing delivery: New interconnected business models to reinvent delivery. In *1st international physical internet conference*, 2014, Vol. 1, pp. 1–19.
8. Punel, A., A. Ermagun, and A. Stathopoulos, Studying determinants of crowd-shipping use. *Travel Behaviour and Society*, Vol. 12, 2018, pp. 30–40.
9. Le, T. V. and S. V. Ukkusuri, Modeling the willingness to work as crowd-shippers and travel time tolerance in emerging logistics services. *Travel Behaviour and Society*, Vol. 15, 2019, pp. 123–132.
10. Le, T. V., A. Stathopoulos, T. Van Woensel, and S. V. Ukkusuri, Supply, demand, operations, and management of crowd-shipping services: A review and empirical evidence. *Transportation Research Part C: Emerging Technologies*, Vol. 103, 2019, pp. 83–103.
11. Pourrahmani, E. and M. Jaller, Crowdshipping in last mile deliveries: Operational challenges and research opportunities. *Socio-Economic Planning Sciences*, 2021, p. 101063.
12. Laeequddin, M., B. Sahay, V. Sahay, and K. A. Waheed, Measuring trust in supply chain partners' relationships. *Measuring Business Excellence*, Vol. 14, No. 3, 2010, pp. 53–69.
13. McEvily, B. and M. Tortoriello, Measuring trust in organisational research: Review and recommendations. *Journal of Trust Research*, Vol. 1, No. 1, 2011, pp. 23–63.
14. Lin, X., Y. Nishiki, and L. A. Tavasszy, Performance and Intrusiveness of Crowdshipping Systems: An Experiment with Commuting Cyclists in The Netherlands. *Sustainability*, Vol. 12, No. 17, 2020.
15. McAllister, D. J., Affect-and cognition-based trust as foundations for interpersonal cooperation in organizations. *Academy of management journal*, Vol. 38, No. 1, 1995, pp. 24–59.
16. Mayer, R. C., J. H. Davis, and F. D. Schoorman, An integrative model of organizational trust. *Academy of management review*, Vol. 20, No. 3, 1995, pp. 709–734.

17. Wicaksono, S., *Exploring the Market Potential of Bicycle Crowdshipping: A Bi-level Acceptance Perspective*. Master's thesis, Delft University of Technology, the Netherlands, 2018.
18. Gdowska, K., A. Viana, and J. P. Pedroso, Stochastic last-mile delivery with crowdshipping. *Transportation Research Procedia*, Vol. 30, 2018, pp. 90–100, eURO Mini Conference on "Advances in Freight Transportation and Logistics".
19. Behrend, M. and F. Meisel, The integration of item-sharing and crowdshipping: Can collaborative consumption be pushed by delivering through the crowd?, ????
20. Punel, A., A. Ermagun, and A. Stathopoulos, *How Different Are Crowd-shipping Users and Non-users?* Washington DC, United States, 2018.
21. Huynh, G., N. Chung, and T. Phung, How to purchase an order from brick and mortar retailers during COVID-19 pandemic? A rise of crowdshipping. *International Journal of Data and Network Science*, Vol. 5, No. 3, 2021, pp. 439–450.
22. Chancey, E. T., J. P. Bliss, A. B. Proaps, and P. Madhavan, The role of trust as a mediator between system characteristics and response behaviors. *Human factors*, Vol. 57, No. 6, 2015, pp. 947–958.
23. Chancey, E. T., J. P. Bliss, Y. Yamani, and H. A. Handley, Trust and the compliance–reliance paradigm: The effects of risk, error bias, and reliability on trust and dependence. *Human factors*, Vol. 59, No. 3, 2017, pp. 333–345.
24. Jøsang, A., R. Ismail, and C. Boyd, A survey of trust and reputation systems for online service provision. *Decision Support Systems*, Vol. 43, No. 2, 2007, pp. 618–644, emerging Issues in Collaborative Commerce.
25. Shao, Z., L. Zhang, X. Li, and Y. Guo, Antecedents of trust and continuance intention in mobile payment platforms: The moderating effect of gender. *Electronic Commerce Research and Applications*, Vol. 33, 2019, p. 100823.
26. McKnight, D. H. and N. L. Chervany, What trust means in e-commerce customer relationships: An interdisciplinary conceptual typology. *International journal of electronic commerce*, Vol. 6, No. 2, 2001, pp. 35–59.
27. Molin, E. and M. Kroesen, *Travelling by train in corona time? Safety perceptions of and support for policy measure*, 2021.
28. Baron, R. M. and D. A. Kenny, The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of personality and social psychology*, Vol. 51, No. 6, 1986, p. 1173.
29. *Statistical Analysis With Latent Variables User's Guide*, 2017.
30. Vij, A., A. Carrel, and J. L. Walker, Incorporating the influence of latent modal preferences on travel mode choice behavior. *Transportation Research Part A: Policy and Practice*, Vol. 54, 2013, pp. 164–178.
31. Palma, S. H. . D., *Apollo: a flexible, powerful and customisable freeware package for choice model estimation and application, version 0.2.4- User manual*, 2021.
32. Kroesen, M., *Latent class discrete cluster models II - Lecture 7.*, 2020.
33. van Cranenburgh, S., *Latent class discrete choice models for travel behaviour research - Lecture 8.*, 2020.
34. Le, T. V. and S. V. Ukkusuri, Crowd-shipping services for last mile delivery: analysis from survey data in two countries. *arXiv preprint arXiv:1810.02856*, 2018.

35. Le, T. V. and S. V. Ukkusuri, Influencing factors that determine the usage of the crowd-shipping services. *Transportation Research Record*, Vol. 2673, No. 7, 2019, pp. 550–566.
36. *Ngene 1.2 USER MANUAL REFERENCE GUIDE. The Cutting Edge in Experimental Design*, 2018.
37. Le, T. V. and S. V. Ukkusuri, Crowd-shipping services for last mile delivery: Analysis from American survey data. *Transportation Research Interdisciplinary Perspectives*, Vol. 1, 2019, p. 100008.

B

NGENE SYNTAX AND EXPERIMENTAL DESIGN

Ngene Syntax

The code shown below is used to create choice sets in SP experiment.

?Crowdshipping SP Experiment
design ; alts = crowdshipping, traditional
; orth = seq
; rows = 16
; block = 2
; model:
U(crowdshipping) = beta_time * time[0,1] + beta_price * price[5,7,10,12] + beta_track * track[0,1] + beta_reputation * reput[0,1] + beta_insurance * insurance[500,1000] + beta_damage * damage[0.03,0.05]/
U(traditional) = beta_tr $

Experimental Design

Experimental design which is generated in Ngene is represented below.

Table B.1: Experimental design created in Ngene

Design							
Choice situation	time_CS	price_CS	track_CS	reput_CS	insur_CS	dmg_CS	Block
1	0	5	0	1	1000	0.05	2
2	1	10	0	1	1000	0.03	1
3	0	10	0	1	500	0.03	2
4	0	12	0	0	500	0.03	1
5	0	10	1	0	500	0.05	1
6	0	5	1	0	1000	0.03	1
7	1	7	1	1	500	0.03	1
8	1	7	0	0	500	0.05	2
9	1	10	1	0	1000	0.05	2
10	0	7	1	1	1000	0.03	2
11	1	5	0	1	500	0.05	1
12	1	12	0	0	1000	0.03	2
13	0	12	1	1	500	0.05	2
14	0	7	0	0	1000	0.05	1
15	1	12	1	1	1000	0.05	1
16	1	5	1	0	500	0.03	2

time_CS: Delivery time of crowdshipping service
price_CS: Delivery cost of crowdshipping service
track_CS: Tracking and tracing options of crowdshipping service
reput_CS: Delivery company's reputation
insur_CS: Insurance coverage in crowdshipping service
dmg_CS: Possibility of damage in crowdshipping service

C
Pilot Survey

Before starting the actual survey distribution, a pilot survey has been released. This enables the author to examine if the variety in choices achieved and if the process goes smoothly without any technical problem. During the pilot circulation, few points have been noted, which are discussed in this section.

First of all, sample collection has been completed with the help of 17 respondents. The average questionnaire length was around 10 minutes which is in line with the preferred survey length. Based on the discussions and suggestions gathered from respondents, some updates have been made in the actual survey. These changes are listed below.

- It is noted that the explanations regarding the choice sets were not clear enough. For this reason, assumptions need to be made, and the description of the choice experiment has been updated, as can be seen in Appendix- E.
- A few design-related changes have been made, and the order of the questions have been changed.
- The attribute levels of the attribute "possibility of damage" have been modified as the given range has not been found distinctive for the respondents.
- Representation of the choice sets has been modified with different images, making the stated preference questions more visual. An example choice set is provided below in order to present the differences between the pilot and the actual survey.

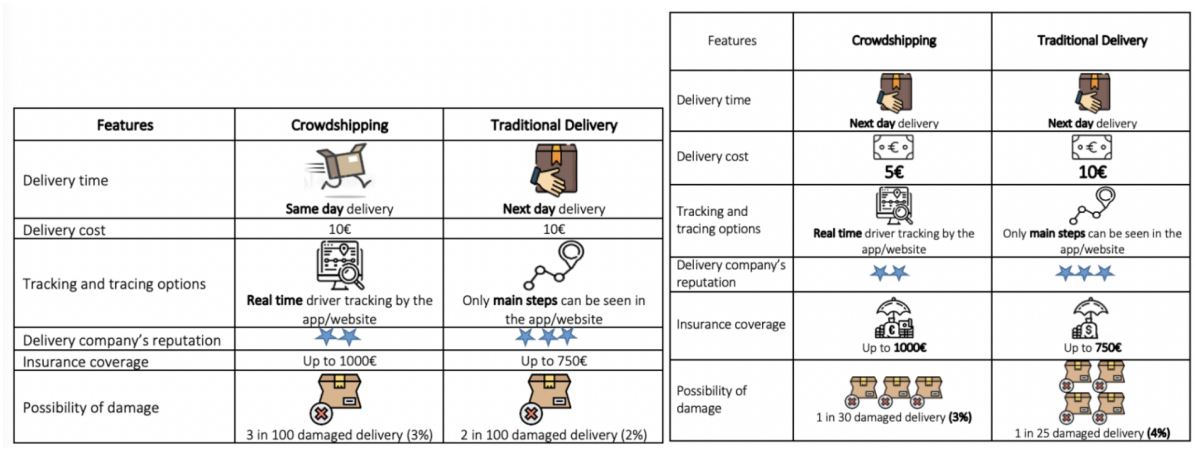

Figure C.1: Example: Old version (left) and new version (right) of a choice set

D

VARIABLE LIST

Variable Information			
Variable	**Position**	**Label**	**Measurement Level**
id	1	<none>	Scale
A1_RideHailing	2	A1_RideHailing	Nominal
A2_CS	3	Crowdshipping	Nominal
B1_ShpFreq	4	How often do you shop online?	Nominal
B2_Amountspent	5	The amount which is spent on online shopping	Ordinal
B3_Lsitem	6	The last item which has been bought online	Nominal
B4_PriceLstitem	7	How much did the item cost in Euros?	Ordinal
D1_1_Shpexpc	8	Availability of different delivery options	Scale
D1_2_Shpexpc	9	Delivery time window	Scale
D1_3_Shpexpc	10	Same day or out of service hours delivery	Scale
E1_1_CSexpc	11	Credibility of crowdshipper	Scale
E1_2_CSexpc	12	Specific delivery time window	Scale
E1_3_CSexpc	13	Tracking and tracing	Scale
E1_4_CSexpc	14	Feedback system	Scale
F1_1_Safelottery	15	Lottery safe winning %80	Scale
F1_2_Safelottery	16	Lottery safe winning %20	Scale
F1_3_Riskylottery	17	Lottery risky winning %80	Scale
F1_4_Riskylottery	18	Lottery risky winning %20	Scale
G1_Gender	19	Gender	Nominal
G2_Age	20	Age	Ordinal
G3_Occup	21	Occupation	Nominal
G4_Edu	22	Education level	Nominal
G5_Incm	23	Income level	Ordinal

Variable Values		
Value		**Label**
Choice	0	Traditional Delivery
	1	Crowdshipping
Trust	1	Strongly distrusful
	2	Distrusful
	3	Neutral
	4	Trustful
	5	Strongly trustful
A1_RideHailing	1	No, I am not familiar with these service
	2	No, i have never used it
	3	Yes, rarely
	4	Yes, monthly
	5	Yes, dailly
A2_CS	1	No, I am not familiar with these services
	2	No, I've heard about the service but I have never used it
	3	I've heard about the service but I didn't know it's called crowdshipping
	4	I have used the service
B1_ShpFreq	1	I don't use online shopping
	2	1-5 times a year
	3	6-10 times a year
	4	Once in a month
	5	Couple of times in a month
B2_Amountspent	1	0-50
	2	51-100
	3	101-200
	4	201-300
	5	301-400
	6	401-500
	7	500+
B3_Lsitem	1	Electronics/Technological product
	2	Fashion item
	3	Second hand product
	4	Book/Music album
	5	Other
B4_PriceLstitem	1	0-50
	2	51-100
	3	101-150
	4	151-200
	5	201-250
	6	251-300
	7	301-350
	8	351-400
	9	401+
D1_1_Shpexpc	1	Strongly disagree
	2	Somewhat disagree
	3	Neither agree nor disagree
	4	Somewhat agree
	5	Strongly agree
D1_2_Shpexpc	1	Strongly disagree
	2	Somewhat disagree
	3	Neither agree nor disagree
	4	Somewhat agree
	5	Strongly agree
D1_3_Shpexpc	1	Strongly disagree
	2	Somewhat disagree
	3	Neither agree nor disagree
	4	Somewhat agree
	5	Strongly agree

Variable Values		
Value		**Label**
E1_1_CSexpc	1	Strongly disagree
	2	Somewhat disagree
	3	Neither agree nor disagree
	4	Somewhat agree
	5	Strongly agree
E1_2_CSexpc	1	Strongly disagree
	2	Somewhat disagree
	3	Neither agree nor disagree
	4	Somewhat agree
	5	Strongly agree
E1_3_CSexpc	1	Strongly disagree
	2	Somewhat disagree
	3	Neither agree nor disagree
	4	Somewhat agree
	5	Strongly agree
E1_4_CSexpc	1	Strongly disagree
	2	Somewhat disagree
	3	Neither agree nor disagree
	4	Somewhat agree
	5	Strongly agree
F1_1_Safelottery	1	Very unlikely
	2	Unlikely
	3	Not sure
	4	Likely
	5	Very likely
F1_2_Safelottery	1	Very unlikely
	2	Unlikely
	3	Not sure
	4	Likely
	5	Very likely
F1_3_Riskylottery	1	Very unlikely
	2	Unlikely
	3	Not sure
	4	Likely
	5	Very likely
F1_4_Riskylottery	1	Very unlikely
	2	Unlikely
	3	Not sure
	4	Likely
	5	Very likely
G1_Gender	0	Male
	1	Female and others
G2_Age	0	18-25
	1	25+
G3_Occup	0	Student
	1	Working and others
G4_Edu	0	Others
	1	MasterPhD
G5_Incm	0	Less than 500
	1	More than 500

E

Final Survey

The purpose of this study is to understand how trust towards the crowdshipping service influences its adoption for last-mile deliveries.

What is crowdshipping? Crowdshipping is a new way of delivery system where the package is delivered via any citizen (non-professional) who is willing to provide the service, already making a trip for his/her own purposes. In this delivery method, while crowdshippers get monetary compensation, the package can potentially be delivered more cheaply and quickly to the receiver. Like Uber and Lyft are successful in passenger transportation, some new platforms offer last-mile crowdshipping delivery services such as Nimber and PiggyBee.

We would like to ask you some questions to determine your attitude towards the crowdshipping service, in different scenarios. The survey consists of 6 parts and will take approximately 10 minutes to complete.
Your participation in this study is entirely voluntary and you can withdraw at any time. The information that you provide will be used for research purposes only. Your answers in this study remain completely anonymous and your answers cannot be traced back to you.
It would be very helpful if you would consider forwarding the survey in your social network.

Thank you for your help and participation.
Merve Seher Cebeci
M.S.Cebeci@student.tudelft.nl

- I have read the above information
- I am above 18 years of age
- I live in the Netherlands

Do you agree with the above statements?

Agree

Disagree

A. Awareness about crowdshipping

Do you use ride-hailing services (such as Uber, BlaBlacar)?

**Please indicate your answers based on the pre-pandemic situation

- ○ No, I am not familiar with these services
- ○ No, I've never used it
- ○ Yes, rarely
- ○ Yes, monthly
- ○ Yes, weekly
- ○ Yes, daily

Have you sent any item with crowdshipping service before? (such as Nimber, PiggyBee)

**Please indicate your answers based on the pre-pandemic situation

- ○ No, I am not familiar with these services
- ○ No, I've heard about the service but I have never used it
- ○ I have heard about the service but I didn't know it is called as crowdshipping
- ○ I have used the service

B. Online shopping experience

How often do you use Internet to shop online?

**Please indicate your answers based on the pre-pandemic situation

- ○ I don't use online shopping
- ○ 1-5 times a year
- ○ 6-10 times a year
- ○ Once in a month
- ○ Couple of times a month

Which option represents the amount that you spend on average per month for online shopping in Euros?

**Please indicate your answers based on the pre-pandemic situation

- ○ 0-50
- ○ 51-100
- ○ 101-200
- ○ 201-300
- ○ 301-400
- ○ 401-500
- ○ 500+

What was the last item that you bought online?

- ○ Electronics/Technological product
- ○ Fashion item (cloth, accessories etc.)
- ○ Second hand product
- ○ Book/Music album
- ○ Other (Please give further explanation)

How much did the item cost in Euros?

- ○ 0-50
- ○ 51-100
- ○ 101-150
- ○ 151-200
- ○ 201-250
- ○ 251-300
- ○ 301-350
- ○ 351-400
- ○ 401+

C. Stated preference questions

Imagine **the last item** that you bought online, the shop (website) provides two alternatives to deliver your package to your intended location with the following features.

In this specific case;

- It is assumed that you don't need the product urgently
- It is assumed that you have to be at your predefined location to collect the package
- Imagine that you can only reach out the transportation company for your claims in case of a damaged or wrong delivery.

Features	Explanation
Delivery time	This feature refers to **same day** or **next day** delivery options.
Delivery cost	This feature represents the **cost** of the service
Tracking and tracing options	This feature represents whether the alternative has a **tracking and tracing facility** or not.
Delivery company's reputation	This feature refers to the **credibility** of the delivery company and the rating of the company's app
Insurance coverage	This feature shows the **insurance limits** for the alternative.
Possibility of damage	This feature represents the possibility that the item can **get damaged or lost.**

1. From the available delivery options below, select the one that fits your preference most

Features	**Crowdshipping**	**Traditional Delivery**
Delivery time	 **Same day** delivery	 **Next day** delivery
Delivery cost	 **10€**	 **10€**
Tracking and tracing options	 Only **main steps** can be seen in the app/website	 Only **main steps** can be seen in the app/website
Delivery company's reputation		
Insurance coverage	 Up to **1000€**	 Up to **750€**
Possibility of damage	 1 in 30 damaged delivery **(3%)**	 1 in 25 damaged delivery **(4%)**

Would you consider making use of this crowdshipping service?

- ○ Yes
- ○ No (I would use traditional delivery)

Based on the above mentioned scenario, how much would you trust crowdshipping?

Strongly distrustful	Distrustful	Neutral	Trustful	Strongly Trustful
○	○	○	○	○

Imagine **the last item** that you bought online, the shop (website) provides two alternatives to deliver your package to your intended location with the following features.
2. From the available delivery options below, select the one that fits your preference most

Features	**Crowdshipping**	**Traditional Delivery**
Delivery time	**Next day** delivery	**Next day** delivery
Delivery cost	**12€**	**10€**
Tracking and tracing options	Only **main steps** can be seen in the app/website	Only **main steps** can be seen in the app/website
Delivery company's reputation		
Insurance coverage	Up to **500€**	Up to **750€**
Possibility of damage	1 in 30 damaged delivery **(3%)**	1 in 25 damaged delivery **(4%)**

Would you consider making use of this crowdshipping service?

- Yes
- No (I would use traditional delivery)

Based on the above mentioned scenario, how much would you trust crowdshipping?

Strongly distrustful	Distrustful	Neutral	Trustful	Strongly Trustful

Imagine **the last item** that you bought online, the shop (website) provides two alternatives to deliver your package to your intended location with the following features.
3. From the available delivery options below, select the one that fits your preference most

Features	**Crowdshipping**	**Traditional Delivery**
Delivery time	**Next day** delivery	**Next day** delivery
Delivery cost	**10€**	**10€**
Tracking and tracing options	**Real time** driver tracking by the app/website	Only **main steps** can be seen in the app/website
Delivery company's reputation		
Insurance coverage	Up to **500€**	Up to **750€**
Possibility of damage	1 in 20 damaged delivery **(5%)**	1 in 25 damaged delivery **(4%)**

Would you consider making use of this crowdshipping service?

- Yes
- No (I would use traditional delivery)

Based on the above mentioned scenario, how much would you trust crowdshipping?

Strongly distrustful	Distrustful	Neutral	Trustful	Strongly Trustful

Imagine **the last item** that you bought online, the shop (website) provides two alternatives to deliver your package to your intended location with the following features.

4. From the available delivery options below, select the one that fits your preference most

Features	**Crowdshipping**	**Traditional Delivery**
Delivery time	**Next day** delivery	**Next day** delivery
Delivery cost	**5€**	**10€**
Tracking and tracing options	**Real time** driver tracking by the app/website	Only **main steps** can be seen in the app/website
Delivery company's reputation		
Insurance coverage	Up to **1000€**	Up to **750€**
Possibility of damage	1 in 30 damaged delivery **(3%)**	1 in 25 damaged delivery **(4%)**

Would you consider making use of this crowdshipping service?

- Yes
- No (I would use traditional delivery)

Based on the above mentioned scenario, how much would you trust crowdshipping?

Strongly distrustful	Distrustful	Neutral	Trustful	Strongly Trustful

Imagine **the last item** that you bought online, the shop (website) provides two alternatives to deliver your package to your intended location with the following features.

5. From the available delivery options below, select the one that fits your preference most

Features	**Crowdshipping**	**Traditional Delivery**
Delivery time	**Same day** delivery	**Next day** delivery
Delivery cost	**7€**	**10€**
Tracking and tracing options	**Real time** driver tracking by the app/website	Only **main steps** can be seen in the app/website
Delivery company's reputation		
Insurance coverage	Up to **500€**	Up to **750€**
Possibility of damage	1 in 30 damaged delivery **(3%)**	1 in 25 damaged delivery **(4%)**

Would you consider making use of this crowdshipping service?

- Yes
- No (I would use traditional delivery)

Based on the above mentioned scenario, how much would you trust crowdshipping?

Strongly distrustful	Distrustful	Neutral	Trustful	Strongly Trustful

Imagine **the last item** that you bought online, the shop (website) provides two alternatives to deliver your package to your intended location with the following features.

6. From the available delivery options below, select the one that fits your preference most

Features	**Crowdshipping**	**Traditional Delivery**
Delivery time	**Same day** delivery	**Next day** delivery
Delivery cost	**5€**	**10€**
Tracking and tracing options	Only **main steps** can be seen in the app/website	Only **main steps** can be seen in the app/website
Delivery company's reputation		
Insurance coverage	Up to **500€**	Up to **750€**
Possibility of damage	1 in 20 damaged delivery **(5%)**	1 in 25 damaged delivery **(4%)**

Would you consider making use of this crowdshipping service?

- Yes
- No (I would use traditional delivery)

Based on the above mentioned scenario, how much would you trust crowdshipping?

Strongly distrustful	Distrustful	Neutral	Trustful	Strongly Trustful

Imagine **the last item** that you bought online, the shop (website) provides two alternatives to deliver your package to your intended location with the following features.

7. From the available delivery options below, select the one that fits your preference most

Features	**Crowdshipping**	**Traditional Delivery**
Delivery time	**Next day** delivery	**Next day** delivery
Delivery cost	**7€**	**10€**
Tracking and tracing options	Only **main steps** can be seen in the app/website	Only **main steps** can be seen in the app/website
Delivery company's reputation		
Insurance coverage	Up to **1000€**	Up to **750€**
Possibility of damage	1 in 20 damaged delivery **(5%)**	1 in 25 damaged delivery **(4%)**

Would you consider making use of this crowdshipping service?

- Yes
- No (I would use traditional delivery)

Based on the above mentioned scenario, how much would you trust crowdshipping?

Strongly distrustful	Distrustful	Neutral	Trustful	Strongly Trustful

Imagine **the last item** that you bought online, the shop (website) provides two alternatives to deliver your package to your intended location with the following features.

8. From the available delivery options below, select the one that fits your preference most

Features	**Crowdshipping**	**Traditional Delivery**
Delivery time	**Same day** delivery	**Next day** delivery
Delivery cost	**12€**	**10€**
Tracking and tracing options	**Real time** driver tracking by the app/website	Only **main steps** can be seen in the app/website
Delivery company's reputation		
Insurance coverage	Up to **1000€**	Up to **750€**
Possibility of damage	1 in 20 damaged delivery **(5%)**	1 in 25 damaged delivery **(4%)**

Would you consider making use of this crowdshipping service?

- ○ Yes
- ○ No (I would use traditional delivery)

Based on the above mentioned scenario, how much would you trust crowdshipping?

Strongly distrustful	Distrustful	Neutral	Trustful	Strongly Trustful
○	○	○	○	○

D. Expectations about online shopping and crowdshipping

How much do you agree or disagree with the following statements when you think of ordering online?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I would like to have the opportunity to see delivery options (e.g. click and collect, pick-up points, traditional delivery or crowdshipping)	○	○	○	○	○
There should be an option to choose a delivery time window (e.g. to be delivered between 11-12 am)	○	○	○	○	○
Delivery should be shipped on the same day or out of service hours	○	○	○	○	○

E. Expectations about crowdshipping

How much do you agree or disagree with the following statements when you think of crowdshipping delivery?

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I should be able to see crowdshipper's credibility	○	○	○	○	○
Crowdshipping service should provide a specific delivery time window (e.g. between 10-12am package will be delivered)	○	○	○	○	○
The tracking and tracing facility of the app improves the service trustworthiness	○	○	○	○	○
The service's trustworthiness increases if the crowdshipping company has a feedback system	○	○	○	○	○

F. Understanding of risk-taking behaviour
In this section, we ask you to assume that **you have 100€** and you will gamble with all the money. The aim of these questions is to understand the risk-taking threshold for the given statements.
For each of the following tasks, please indicate your likelihood of engaging in each activity. Provide a rating from very unlikely to very likely, using the following scale:

	Very Unlikely	Unlikely	Not sure	Likely	Very Likely
20% chance you will lose 50€; 80% chance you will gain extra 100€	○	○	○	○	○
80% chance you will lose 50€; 20% chance you will gain extra 100€	○	○	○	○	○
20% chance you will lose 100€ (all the money); 80% chance you will gain extra 400€	○	○	○	○	○
80% chance you will lose 100€ (all the money); 20% chance you will receive extra 400€	○	○	○	○	○

G. Demographic characteristics
What is your gender?

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

What is your age?

- ○ 18- 25
- ○ 26-33
- ○ 34-41
- ○ 42-49
- ○ 50-57
- ○ 58-65
- ○ Above 65

What is your current occupation?

- ○ Working full time
- ○ Working part time
- ○ Student
- ○ I have no work at the moment
- ○ Volunteer work
- ○ Retired

What is your highest, or current, level of education?

- ○ VMBO (MAVO)
- ○ HAVO
- ○ VWO
- ○ MBO
- ○ Bachelor
- ○ Master
- ○ PhD
- ○ Other (please give further explanation)

What is your individual net monthly income in Euros?

- ○ Less than 500
- ○ 501-1000
- ○ 1001-1500
- ○ 1501-2000
- ○ 2001-2500
- ○ 2501-3000
- ○ 3001-3500
- ○ More than 3500
- ○ I prefer not to answer this

F

SURVEY FLYER

The designed survey flyer is represented in the figure below.

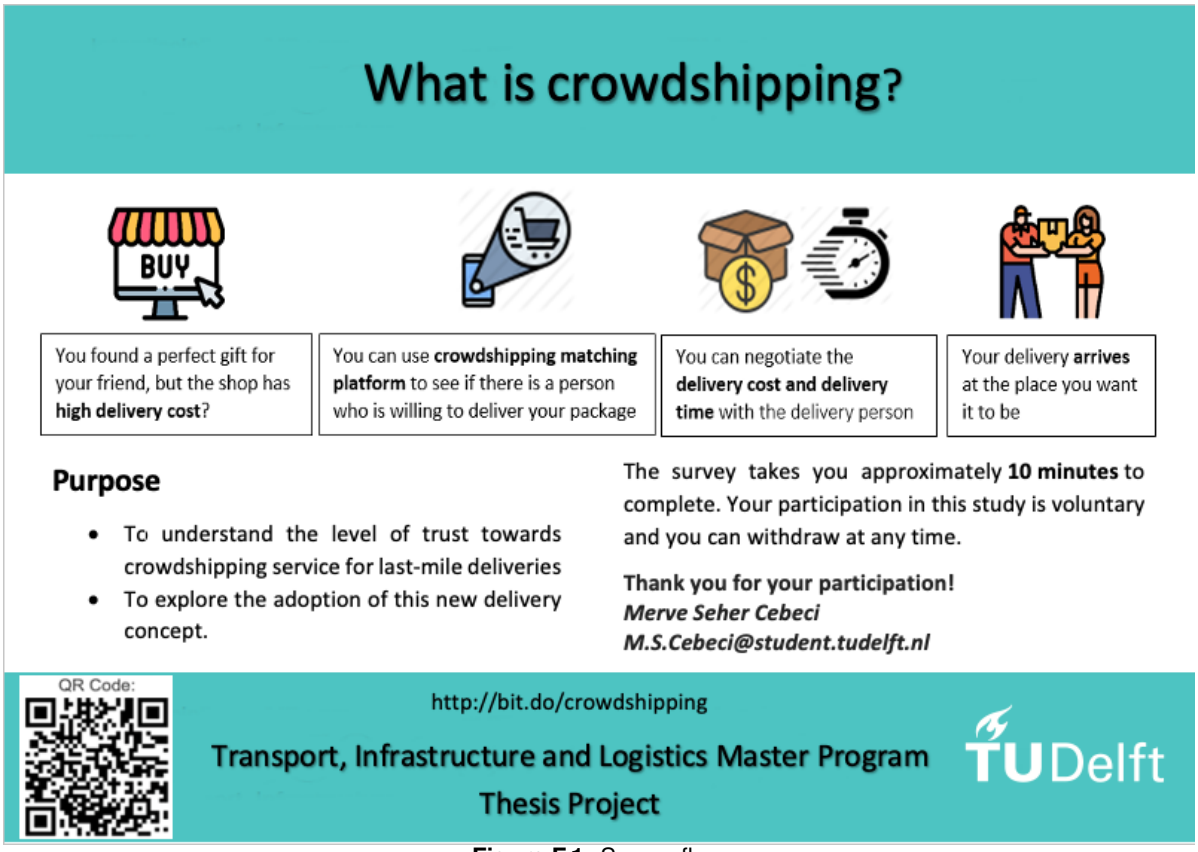

Figure F.1: Survey flyer

G

PATH ANALYSIS-MCM WITH ATTITUDINAL PROFILES

The Figure G.1 below shows the path analysis which is created for the MCM with the attitudinal profile. In this figure, besides the main research attributes, risk factors 1 and 2 and the quality of the delivery service (q1) and flexibility of the delivery service (q2) are represented.

Comparing to the path analysis in Figure 5.1, the direct effects of the attitudinal variables on the service adoption are not all statistically significant, meaning that it is not possible to make an interpretation based on the direct effect of these variables on the adoption of the service. However, as it can be seen in Section 5.1.2, the direct effects of the attitudinal variables on trust are statistically significant except for the flexibility of the service. This means that trust has a mediating effect on those attributes. However, there is a need to explore the mediation in detail as discussed in Table 5.3.

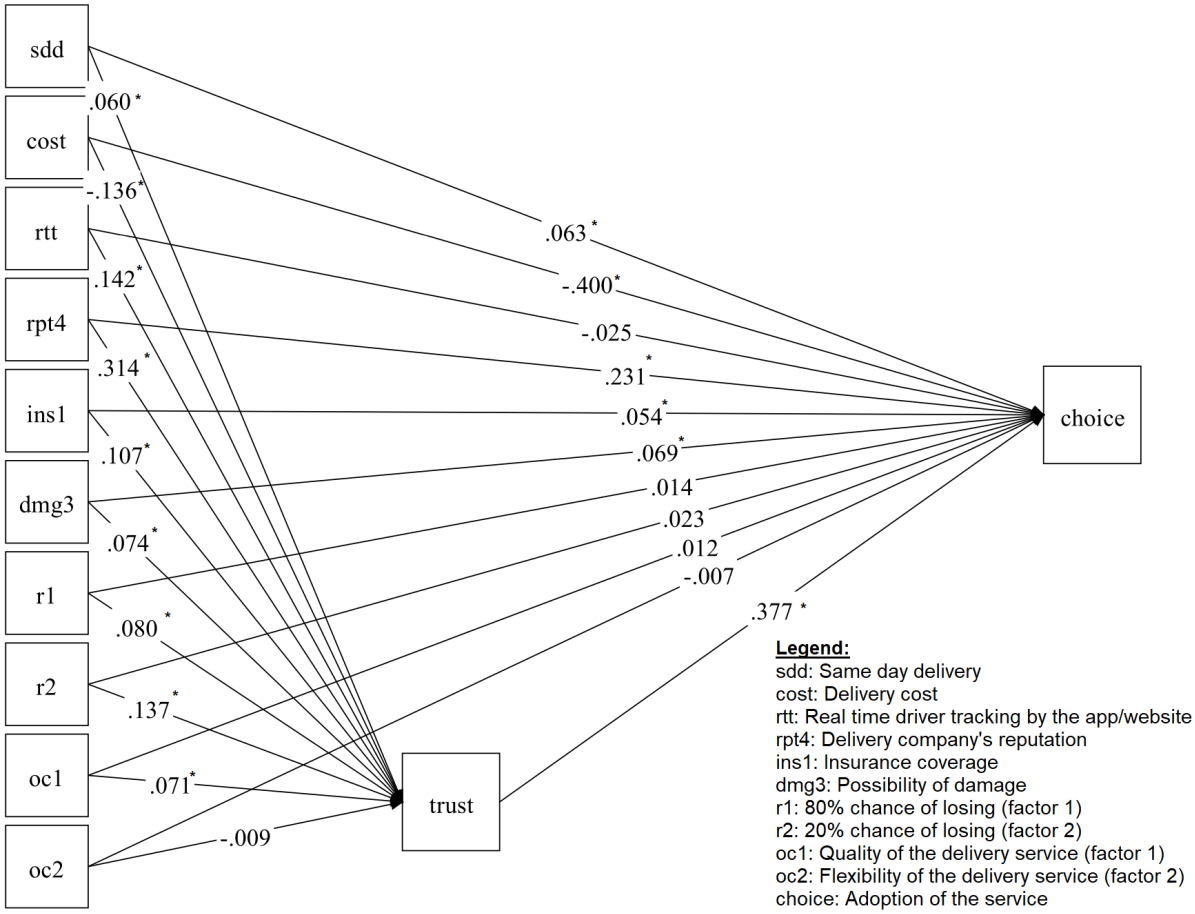

Figure G.1: Path Analysis with Attitudinal Profiles
*Significant level on 95% confidence interval (p<0,05)

H

Path Analysis-MCM with Attitudinal Profiles and Sociodemographic

The Figure H.1 below shows the path analysis which is created for the MCM with the attitudinal profile and sociodemographic characteristics. In this figure, besides the main research attributes and attitudinal variables, sociodemographic characteristics are represented.

Comparing to the path analysis in Figure 5.1, the direct effects of the attitudinal variables and sociodemographic profile on the service adoption are not all statistically significant. Hence, corresponding coefficient values cannot be interpreted. However, as it can be seen in Section 5.1.3, the direct effects of the attitudinal variables (except for the flexibility of the service) and also age and education level on trust are statistically significant. This means that trust has a mediating effect on those attributes. However, there is a need to explore the mediation in detail as discussed in Table 5.4.

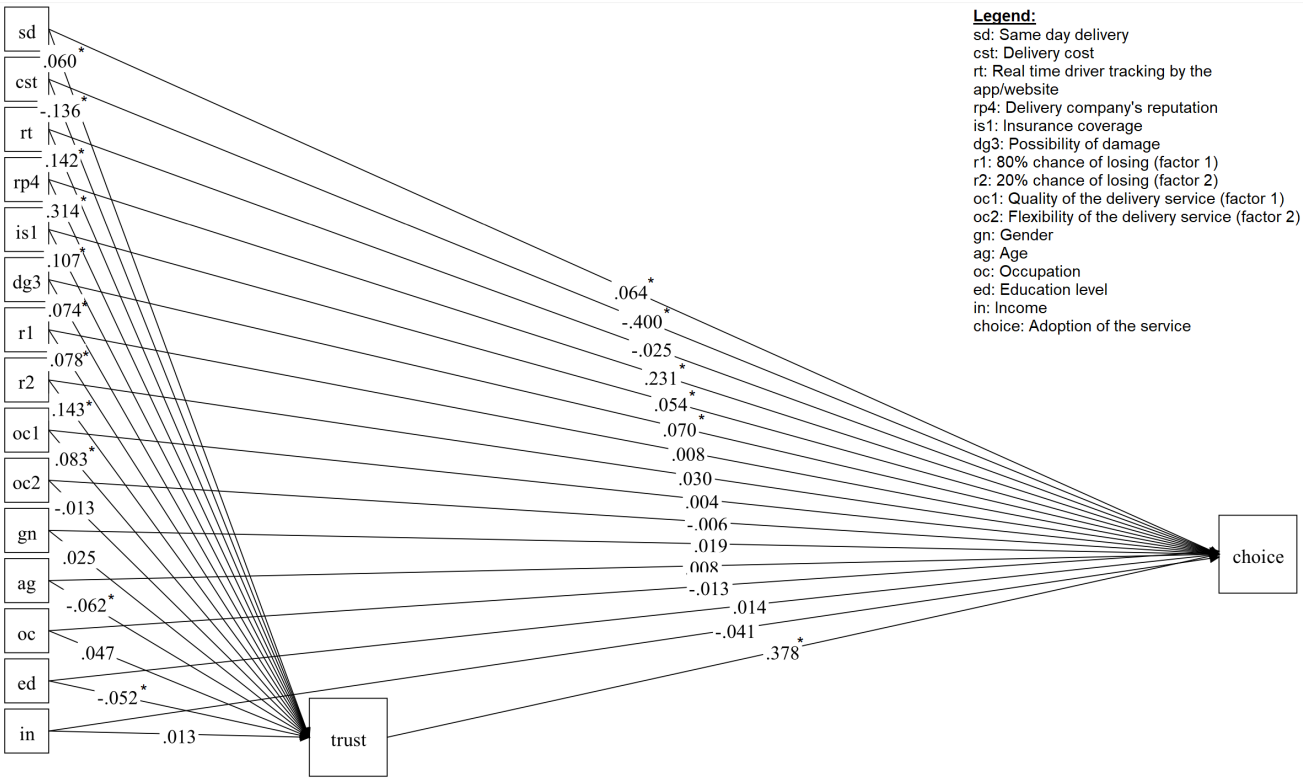

Figure H.1: Path Analysis with Attitudinal Profiles and Sociodemographics
*Significant level on 95% confidence interval (p<0,05)

I

APOLLO SYNTAX BINARY LOGIT MODEL

```
### Load Apollo library
library(apollo)

### Initialise code
apollo_initialise()

### Set core controls
apollo_control = list(
  modelName  ="MNL_Result",
  modelDescr ="Choice Experiment MNL Results",
  indivID    ="ID"
)

#### LOAD DATA
database = read.delim("data.dat",header=TRUE)

### Vector of parameters, including any that are kept fixed in estimation
apollo_beta=c(ASC_TR = 0,
              BETA_DTIME  = 0,
              BETA_DCOST  = 0,
              BETA_TRACK  = 0,
              BETA_REPUT  = 0,
              BETA_INSUR  = 0,
              BETA_DAMG   = 0)

### Vector with names (in quotes) of parameters to be kept fixed at their starting value in
apollo_beta, use apollo_beta_fixed = c() if none
apollo_fixed = c()


#### GROUP AND VALIDATE INPUTS
apollo_inputs = apollo_validateInputs()


#### DEFINE MODEL AND LIKELIHOOD FUNCTION

apollo_probabilities=function(apollo_beta, apollo_inputs, functionality="estimate"){


  ### Attach inputs and detach after function exit
  apollo_attach(apollo_beta, apollo_inputs)
  on.exit(apollo_detach(apollo_beta, apollo_inputs))


  ### Create list of probabilities P
  P = list()

  ### List of utilities: these must use the same names as in mnl_settings, order is irrelevant
  V = list()
    V[['crowdshipping']]  = DTIME_CS * BETA_DTIME + DCOST_CS * BETA_DCOST +
TRACK_CS * BETA_TRACK + REPUT_CS * BETA_REPUT + INSUR_CS * BETA_INSUR
+ DAMG_CS * BETA_DAMG
    V[['traditional']]  = ASC_TR
```

```
  ### Define settings for MNL model component
  mnl_settings = list(
    alternatives  = c(crowdshipping=1, traditional=0),
    avail         = list(crowdshipping=1, traditional=1),
    choiceVar     = CHOICE,
    V             = V
  )

  ### Compute probabilities using MNL model
  P[['model']] = apollo_mnl(mnl_settings, functionality)

  ### Take product across observation for same individual
  P = apollo_panelProd(P, apollo_inputs, functionality)

  ### Prepare and return outputs of function
  P = apollo_prepareProb(P, apollo_inputs, functionality)
  return(P)
}


#### MODEL ESTIMATION
model = apollo_estimate(apollo_beta, apollo_fixed, apollo_probabilities, apollo_inputs)


#### MODEL OUTPUTS
apollo_modelOutput(model,modelOutput_settings=list(printPVal=TRUE))

apollo_saveOutput(model)
```

J

APOLLO SYNTAX LATENT CLASS CHOICE MODEL

```
# ################################################################# #
#### LOAD LIBRARY AND DEFINE CORE SETTINGS                    ####
# ################################################################# #

### Clear memory
rm(list = ls())

### Load Apollo library
library(apollo)

### Initialise code
apollo_initialise()

### Set core controls
apollo_control = list(
  modelName  ="Latent class model_CS",
  modelDescr ="LCM",
  indivID    ="ID"
)

# ################################################################# #
#### LOAD DATA AND APPLY ANY TRANSFORMATIONS                  ####
# ################################################################# #

database = read.delim("data.dat",header=TRUE)

# ################################################################# #
#### DEFINE MODEL PARAMETERS                                  ####
# ################################################################# #

### Vector of parameters, including any that are kept fixed in estimation
apollo_beta=c(CONSTANTa     = 0,
              BETA_DTIMEa   = 0,
              BETA_DCOSTa   = 0,
              BETA_TRACKa   = 0,
              BETA_REPUTa   = 0,
              BETA_INSURa   = 0,
              BETA_DAMGa    = 0,
              GAMMA_RISK1a  = 0,
              GAMMA_RISK2a  = 0,
              GAMMA_OC1a    = 0,
              GAMMA_OC2a    = 0,
              GAMMA_GENDERa = 0,
```

```
          GAMMA_AGEa    = 0,
          GAMMA_OCCUPa  = 0,
          GAMMA_EDUa    = 0,
          GAMMA_INCMa   = 0,
          CONSTANTb     = 0,
          BETA_DTIMEb   = 0,
          BETA_DCOSTb   = 0,
          BETA_TRACKb   = 0,
          BETA_REPUTb   = 0,
          BETA_INSURb   = 0,
          BETA_DAMGb    = 0,
          GAMMA_RISK1b  = 0,
          GAMMA_RISK2b  = 0,
          GAMMA_OC1b    = 0,
          GAMMA_OC2b    = 0,
          GAMMA_GENDERb = 0,
          GAMMA_AGEb    = 0,
          GAMMA_OCCUPb  = 0,
          GAMMA_EDUb    = 0,
          GAMMA_INCMb   = 0,
          ASC_TR        = 0,
          delta_a       = 0,
          delta_b       = 0)

### Vector with names (in quotes) of parameters to be kept fixed at their starting value in
apollo_beta, use apollo_beta_fixed = c() if none
apollo_fixed = c("ASC_TR", "delta_b", "GAMMA_RISK1b", "GAMMA_RISK2b",
"GAMMA_OC1b", "GAMMA_OC2b", "GAMMA_GENDERb", "GAMMA_AGEb",
"GAMMA_OCCUPb", "GAMMA_EDUb", "GAMMA_INCMb")

# ################################################################### #
#### DEFINE LATENT CLASS COMPONENTS                          ####
# ################################################################### #

apollo_lcPars=function(apollo_beta, apollo_inputs){
  lcpars = list()

  lcpars[["CONSTANT"]]  = list(CONSTANTa, CONSTANTb)
  lcpars[["BETA_DTIME"]]     = list(BETA_DTIMEa, BETA_DTIMEb)
  lcpars[["BETA_DCOST"]]     = list(BETA_DCOSTa, BETA_DCOSTb)
  lcpars[["BETA_TRACK"]]     = list(BETA_TRACKa, BETA_TRACKb)
  lcpars[["BETA_REPUT"]]     = list(BETA_REPUTa, BETA_REPUTb)
  lcpars[["BETA_INSUR"]]     = list(BETA_INSURa, BETA_INSURb)
  lcpars[["BETA_DAMG"]]      = list(BETA_DAMGa,  BETA_DAMGb)


  V=list()
```

```
 V[["class_a"]] = delta_a + GAMMA_RISK1a * Risk_f1 + GAMMA_RISK2a * Risk_f2 +
GAMMA_OC1a * OC_f1 + GAMMA_OC2a * OC_f2 + GAMMA_GENDERa * GENDER +
GAMMA_AGEa * Age + GAMMA_OCCUPa * OCCUP + GAMMA_EDUa * EDU +
GAMMA_INCMa * INCM
 V[["class_b"]] = delta_b + GAMMA_RISK1b * Risk_f1 + GAMMA_RISK2b * Risk_f2 +
GAMMA_OC1b * OC_f1 + GAMMA_OC2b * OC_f2 + GAMMA_GENDERb * GENDER +
GAMMA_AGEb * Age + GAMMA_OCCUPb * OCCUP + GAMMA_EDUb * EDU +
GAMMA_INCMb * INCM

 mnl_settings = list(
  alternatives = c(class_a=1, class_b=2),
  avail       = 1,
  choiceVar    = NA,
  V           = V
 )
 lcpars[["pi_values"]] = apollo_mnl(mnl_settings, functionality="raw")

 lcpars[["pi_values"]] = apollo_firstRow(lcpars[["pi_values"]], apollo_inputs)

 return(lcpars)
}

# ################################################################### #
#### GROUP AND VALIDATE INPUTS                                     ####
# ################################################################### #

apollo_inputs = apollo_validateInputs()

# ################################################################### #
#### DEFINE MODEL AND LIKELIHOOD FUNCTION                          ####
# ################################################################### #

apollo_probabilities=function(apollo_beta, apollo_inputs, functionality="estimate"){

 ### Attach inputs and detach after function exit
 apollo_attach(apollo_beta, apollo_inputs)
 on.exit(apollo_detach(apollo_beta, apollo_inputs))

 ### Create list of probabilities P
 P = list()

 ### Define settings for MNL model component that are generic across classes

 mnl_settings = list(
  alternatives  = c(crowdshipping=1, traditional=0),
  avail        = list(crowdshipping=1, traditional=1),
  choiceVar     = CHOICE
```

```
 )

 ### Loop over classes
 s=1
 while(s<=2){

  ### Compute class-specific utilities
  V = list()

  V[['crowdshipping']]  = CONSTANT[[s]] + BETA_DTIME[[s]] * DTIME_CS + BETA_DCOST[[s]]
* DCOST_CS +
    BETA_TRACK[[s]] * TRACK_CS + BETA_REPUT[[s]] * REPUT_CS + BETA_INSUR[[s]] *
INSUR_CS +
    BETA_DAMG[[s]] * DAMG_CS
  V[['traditional']]  = ASC_TR

  mnl_settings$V = V
  mnl_settings$componentName = paste0("Class_",s)

  ### Compute within-class choice probabilities using MNL model
  P[[paste0("Class_",s)]] = apollo_mnl(mnl_settings, functionality)

  ### Take product across observation for same individual
  P[[paste0("Class_",s)]] = apollo_panelProd(P[[paste0("Class_",s)]], apollo_inputs
,functionality)

  s=s+1}

 ### Compute latent class model probabilities
 lc_settings   = list(inClassProb = P, classProb=pi_values)
 P[["model"]] = apollo_lc(lc_settings, apollo_inputs, functionality)

 ### Prepare and return outputs of function
 P = apollo_prepareProb(P, apollo_inputs, functionality)
 return(P)
}

# ################################################################# #
#### MODEL ESTIMATION                                            ####
# ################################################################# #

### Optional starting values search
# apollo_beta=apollo_searchStart(apollo_beta, apollo_fixed,apollo_probabilities,
apollo_inputs)

#model = apollo_estimate(apollo_beta, apollo_fixed, apollo_probabilities, apollo_inputs)
```

```
### Estimate model
model = apollo_estimate(apollo_beta, apollo_fixed,
                        apollo_probabilities, apollo_inputs,
                        estimate_settings=list(writeIter=FALSE))


# ################################################################### #
#### MODEL OUTPUTS                                                  ####
# ################################################################### #

# ----------------------------------------------------------------- #
#---- FORMATTED OUTPUT (TO SCREEN)                                 ----
# ----------------------------------------------------------------- #

apollo_modelOutput(model)

# ----------------------------------------------------------------- #
#---- FORMATTED OUTPUT (TO FILE, using model name)                 ----
# ----------------------------------------------------------------- #

apollo_saveOutput(model)
```