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Research paper

Should I wait or should I go? Encouraging customers to make the more sustainable delivery choice

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ABSTRACT

The rise of e-commerce has led to an increase in parcel deliveries, increasing the need to address the cost and environmental impact of last-mile delivery. Customers who have become accustomed to next-day free delivery can play an important role therein by choosing more sustainable delivery options. Retailers and logistic service providers could give customers the choice to wait for their delivery or pick up their parcel from collection-and-delivery points. The purpose of this study was to examine how customers (the parcel recipients) can be stimulated to choose a more sustainable delivery option, and how this affects their satisfaction. Using two scenario-based experiments we found that customers can be steered towards more sustainable last mile delivery choices using financial and non-financial incentives. Financial incentives, in the form of a surcharge for the least sustainable option, were found to be very effective at extrinsically motivating customers to choose a more sustainable option yet had a negative impact on their satisfaction. The results provide insights for retailers to include sustainable delivery options at the check-out, and contribute to decision making on urban planning and utilization of urban space for e-commerce activities, as both parcel lockers and pick-up points require urban space.

1. Introduction

Technological developments such as the broadening availability of connectivity and mobile devices have led to an increase in e-commerce, especially in online business-to-consumer (B2C) sales (Mangiaracina, Marchet, Perotti, & Tumino, 2015; Nguyen, de Leeuw, & Dullaert, 2018; Savelsbergh & Van Woensel, 2016). This growth has been fueled by online retailers (such as Amazon in the US and Bol.com in the Netherlands) introducing online business models, and traditional retailers investing in multi- and omnichannel models (Saghiri, Wilding, Mena, & Bourlakis, 2017; Tokar, Williams, & Fugate, 2020; Vakulenko, Shams, Hellström, & Hjort, 2019b). This is a global phenomenon (Mangiaracina, Perego, Seghezzi, & Tumino, 2019) that has not escaped the Netherlands. Between 2016 and 2019, the number of parcels delivered in the B2C segments in the Netherlands increased from 152 million to 280 million, an increase of 84.2% (ACM, 2017; 2020b) with the COVID-19 pandemic further precipitating this trend. In 2020, 388,2 million parcels were delivered in the B2C segment, an increase of 37,8% compared to 2019 (ACM, 2021). Logistic Service Providers (LSPs) have been challenged to shift their emphasis from B2B to B2C (Joerss, Neuhaus, & Schröder, 2016) and meet the expectation of a new category of stakeholders, namely parcel recipients. Heightened recipient expectations of service level, convenience, and flexibility (Lim, Jin, & Srai, 2018), in combination with the small size of orders and their geographical dispersal have led to an increase in freight movements, largely in the last mile (Mangiaracina et al., 2019; van Loon, McKinnon, Deketele, & Dewaele, 2014). This increase is associated with negative impacts on social, environmental, and economical aspects of last mile delivery.

Retailers and LSPs are increasingly under pressure to improve the sustainability of their last-mile operations from a triple-bottom line perspective. From a social perspective, the last mile has a poor reputation in terms of labor conditions for drivers delivering parcels. The increased urban movements are also negatively affecting the livability of the cities. From the economic and environmental sustainability perspectives, the last mile of the supply chain is considered to be the most cost intensive (Gevaers, Van de Voorde, & Vanelslander, 2014) and the most polluting (Mangiaracina et al., 2019). This cost and environmental

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impact of the last-mile delivery can be improved from the supply side (Mangiaracina et al., 2015) as well as from the demand side (Agatz, Fan, & Stam, 2021; Ignat & Chankov, 2020). From the supply side, LSPs have turned to the use of electric vehicles to reduce emissions (Kin, Hopman, & Quak, 2021). However, other supply-side operational measures such as efficient routing and consolidation of parcels to reduce the number and frequency of trips (Savelsbergh & Van Woensel, 2016) need to be complemented by additional measures on the demand side. Specifically, consolidation of parcels can only be achieved if parcel recipients are stimulated towards the corresponding delivery options at check-out (Sallnäs & Björklund, 2020).

Extrinsic and intrinsic motivation can be used to spur customers towards pick-up points and other more sustainable parcel delivery options (Agatz et al., 2021). Commonly used extrinsic motivators are financial incentives such as price surcharges for next day delivery, or price discounts for selecting a larger time window. These financial incentives are controversial as price surcharges, also known as price partitioning (Barker & Brau, 2020), can be perceived as unfair (Xia, Monroe, & Cox, 2004). Furthermore, customers are used to what they perceive as being "free" deliveries (Allen et al., 2018) and clearly prefer them (Nguyen, de Leeuw, Dullaert, & Foubert, 2019). Conversely, price discounts are not preferred as they erode retailer margins (Agatz et al., 2021). Non-financial incentives, based on customers' intrinsic motivation and values, have been proposed as an alternative way to mitigate the risk of customer dissatisfaction (Buldeo Rai, Broekaert, Verlinde, & Macharis, 2021). However, delivery price remains a crucial attribute both pre- and post-purchase as it shapes customers' choice of parcel delivery option (Nguyen et al., 2019) and affects their perception of logistic service quality (Barker & Brau, 2020).

In the hypercompetitive online retailing industry, retailers are however reluctant to steer customers towards more sustainable but less desirable delivery options, fearing negative consequences for customer attraction and retention (Barker and Brau, 2020). To remain competitive, online retailers have made efforts to cater to customer demands for free and fast delivery. The prevailing wisdom is that customers like to receive their parcel within a day, without having to pay for delivery (Buldeo Rai, Verlinde, & Macharis, 2019; Nguyen et al., 2019). So, while extrinsic motivation (in the form of financial incentives) appears to be the most effective way to steer customers towards delivery options that will increase the sustainability of the last mile, it carries the risk of negatively affecting customer evaluations. Intrinsic motivation (in the form of non-financial incentives) has been assumed to be a suitable alternative to steer customers towards more sustainable delivery options, without negative consequences on customer satisfaction (Buldeo Rai et al., 2021), however this has not been examined empirically. Further research is therefore needed to understand the effectiveness of financial and non-financial incentives in driving customer choice, in combination with their effect on customer satisfaction.

The purpose of this study is to examine the effect of financial and non-financial incentives on customer behavior and customer satisfaction in the last mile. Using two scenario-based experiments administered through two separate surveys, we examine (1) how customers can be stimulated to choose a more sustainable parcel delivery option, and (2) what the impact is on their satisfaction with the delivery options provided. In this paper, next day delivery at home is contrasted to parcel delivery options based on the principle of consolidation: delaying the delivery (survey 1) and delivering to a parcel locker or a pick-up location from where the customer has to pick up the parcel (survey 2). The insights into customer behavior and preferences regarding last mile delivery contribute to the ongoing debate between LSPs and retailers (Allen et al., 2018), improving last mile sustainability (Ignat & Chankov, 2020), and to future research modeling customer behavior in the last mile (Kokkinou & Cranage, 2011).

In section 2, literature supporting the study's conceptual framework is presented, followed by a description of the methods used to test it in section 3. The study findings are subsequently detailed in section 4 and discussed in section 5. Conclusions are summarized in section 6.

2. Conceptual framework

In this section, we first present the delivery options selected for this study, and their relationship with customer satisfaction. Subsequently, we review the interventions retailers and LSPs have available to steer customers towards these delivery options. Next, we examine the relationship between these delivery options and customer satisfaction. Finally, we review other interventions and factors explaining the choice and satisfaction with the delivery options by the e-commerce customer, who is also the receiver of the parcel delivery.

2.1. Sustainable delivery options

Last mile delivery is frequently described as the least sustainable part of the supply chain (Mangiaracina et al., 2019), though this is not easy to quantify (Buldeo Rai, Verlinde, & Macharis, 2019; van Loon et al., 2014, 2015). The actual impact of a home delivery is difficult to estimate as many factors affect both costs and carbon emissions, including the number of parcels delivered per trip (also known as drop density), length of the delivery window, return policy, and rate of delivery failure (van Loon et al., 2014). Furthermore, many studies do not consider the sustainability of the last-mile delivery per se, but to what extent the sustainability impact differs from a product bought in a brick-and-mortar store. The consequences of the last mile delivery depend partly on whether online shopping substitutes a physical trip to the store or not (van Loon et al., 2014). In a case study of an omnichannel footwear retailer, Buldeo Rai, Mommens, Verlinde, and Macharis (2019) showed that the first scenario, only online shopping, generated the lowest impact, while a scenario where an online purchase complemented by a physical trip to the store to examine the product had an impact on CO_2 emissions eight times higher. Thus, while last mile home delivery is not necessarily more polluting than a purchase at a physical store, its absolute impact remains substantial in terms of the triple bottom line. Despite the difficulty of estimating the true impact of a last mile home delivery, there is consensus that there are ways to reduce its absolute impact by reducing freight movements, for example through innovative solutions such as (ground) drones, trunk delivery, robots and crowdsourced delivery (Mangiaracina et al., 2019). Another widespread avenue to reduce freight movements relies on the principle of consolidation.

Consolidation entails grouping as many deliveries as possible together to increase drop density and reduce the number of trips (Allen et al., 2018; Buldeo Rai et al., 2021). Two widespread solutions based on the principle of consolidation are delaying the delivery and delivering the parcel to a locker or pick up point from where a recipient will pick it up. Delaying delivery to customers allows LSPs to bundle deliveries to optimize routing, increase drop density, and consequently increase vehicle utilization (Buldeo Rai et al., 2021). An example from practice can be found from Amazon; as a sustainability option they propose their customers use 'Amazon Day' to consolidate deliveries (Aboutamazon, 2023). Parcel lockers and pick up locations are two forms of collection-and-delivery points, used as secondary locations for customers to pick up their parcel (Janjevic, Winkenbach, & Merchán, 2019). At pick up points, parcels can be retrieved from staffed counters within shops such as supermarkets and hardware stores during shop opening hours. Conversely, parcel lockers are an unattended form of storage that relies on self-service technology to allow customers to autonomously pick up their parcels (Vakulenko et al., 2019b). Parcel lockers and pick up locations allow the aggregation of customer demand, thus replacing many delivery locations by a single one, reducing costs, distances driven, delivery time per stop and vehicle dwell time (Ranjbari, Diehl, Dalla Chiara, & Goodchild, 2023). Collection-and-delivery points also solve many of the issues arising from failed delivery attempts. However, unlike home delivery,

collection-and-delivery points require customer involvement in the value creation process (Vakulenko, Hellström, & Hjort, 2018) as they need to invest resources in the pick-up process. Customers need to make time to travel to the collection-and-delivery point. Depending on their mode of transportation, customers may also need to invest financial resources (e.g., ticket for public transportation or fuel when using their own car). In the case of parcel lockers, customers also need to invest a modicum of skills and knowledge, and they need to perform part of the service themselves.

From an environmental perspective, the evidence regarding the impact of using collection-and-delivery points is mixed. When collection-and-delivery points are located far from residential areas, customers are more likely to pick up their parcel by car (Song, Guan, Cherrett, & Li, 2013), reducing the benefits of consolidation (Niemeijer & Buijs, 2023). When customers pick-up their parcel by bike or on foot, or when they combine the pick-up with another trip, the sustainability impact of delivery-and-collection points is greatly improved, and substantially better than next day home delivery (Buldeo Rai, Verlinde, & Macharis, 2019; Niemeijer & Buijs, 2023). In a Dutch recent study, Thuiswinkel.org concluded on based on figures from TNO (2020) that parcel delivery at a collection point is potentially the most sustainable option. If at least 50% of parcels are delivered to a collection point, a CO_2-reduction of 17% can be achieved in combination with a reduction in the number of transport movements. This does require consumers to walk or cycle to pick up their parcel from the collection point, otherwise the CO_2 savings will be negated.

Despite the mixed evidence, for the purpose of this study, delivery at home will be considered as less sustainable than delivery options based on the principle of consolidation. The two options based on the principle of consolidation: delaying the delivery (survey 1) and picking the delivery up from a parcel locker or pick-up location (survey 2), will be considered as more sustainable. Based on this premise, we investigate the following research question: *how can customers be stimulated to choose a more sustainable parcel delivery option? (RQ1)*.

2.2. Satisfaction with delivery options

As the last mile delivery experience plays an important role in customers' overall satisfaction (Hult, Boyer, & Ketchen, 2007; Vakulenko, Shams, Hellström, & Hjort, 2019a), retailers and LSPs are very careful to trade-off their operational needs with customer service expectations (Allen et al., 2018). LSPs operate as a go-between between retailers and customers with each party in this relationship motivated by different and somewhat conflicting objectives. The reduced costs and emissions of the delivery options are attractive to the LSPs. However, retailers are more preoccupied with customer satisfaction, as customer satisfaction is an important driver of customer re-purchase intentions (Mittal & Kamakura, 2001) and loyalty (Kumar, Pozza, & Ganesh, 2013), also in the context of logistics (Rao, Goldsby, Griffis, & Iyengar, 2011).

Two mechanisms explain how information available to customers prior to purchase can affect their post-purchase satisfaction: the disconfirmation paradigm and the concept of perceived value. According to the disconfirmation paradigm, customer (dis)satisfaction occurs when customers' pre-purchase expectations are (not) met (Churchill & Surprenant, 1982). Customer satisfaction thus links pre-purchase processes with post-purchase outcomes. In the context of e-commerce, overall customer satisfaction is affected by retailer-related factors (e.g. product quality) and LSP-related factors such as satisfaction with the order fulfillment process (Rao et al., 2011) and interaction with the delivery driver (Masorgo, Mir, & Hofer, 2023). In addition to these service experience factors, customer satisfaction is affected by factors that affect pre-purchase expectations, such as price and timeliness of delivery. Similarly, the concept of perceived value helps explain why providing customers with choices can increase their satisfaction (Flores & Vasquez-Parraga, 2015), by better tailoring the service to their needs. As customers attach varying value to different delivery options based on attributes such as price, timeliness and convenience (Gawor & Hoberg, 2019), providing customers with choices will affect their satisfaction with the set of options provided.

LSPs and retailers jointly influence the pre-purchase factors affecting customer satisfaction, namely the price of delivery options (Tokar et al., 2020) and timeliness of delivery. Through a series of scenario-based experiments, Tokar et al. (2020) investigated customer response to LSP and delivery price changes and found that customers generally were not accepting of price changes, resulting in decreased purchase intention. Consequently, the prevailing wisdom is that charging customers for delivery will result in decreased satisfaction. In addition to competing on price, retailers (and by extension LSPs) compete on timeliness of delivery. To compete with brick-and-mortar stores, online retailers often promise their customers next day delivery at no additional cost (Allen et al., 2018) even though customers seem to be willing to wait once informed of the sustainability benefits of waiting longer (Ignat & Chankov, 2020). This creates a dilemma for LSPs who need to meet cost and emission objectives, but also need to ensure that the service delivery expectations set by retailers at check-out are met. Steering customers towards more sustainable alternatives through financial and non-financial incentives might affect their pre-purchase expectations and consequently their overall satisfaction. Therefore, customer satisfaction with delivery options was included in this study as an outcome relevant to the ongoing debate between online retailers and LSPs when deciding which financial and non-financial incentives to employ. The following research question is addressed: *what is the impact of offering price and timeliness options on customers' satisfaction with the delivery options provided? (RQ2)*.

2.3. Non-financial incentives

Non-financial incentives can be used to motivate customers to choose a more sustainable delivery option. Several non-financial incentives have been examined, including the order in which delivery options are presented (Buldeo Rai, Mommens, et al., 2019) and making the sustainable option the default option (Sallnäs & Björklund, 2020). These incentives rely on the principle of nudging, which seeks to create the conditions or environment in which the socially desirable course of action requires less effort (French, 2011). Another way to apply nudging is to create social pressure. This has been investigated through two other non-financial incentives, namely appealing to customers' social norms and giving customers the option to share their choice of sustainable delivery on social media (Buldeo Rai et al., 2021). By engaging contextual factors, these incentives (Kostadinova, 2016; Peattie, 2010) have been relatively successful at encouraging customers to select sustainable delivery alternatives in a specific situation. However, for customer behavior to change permanently, different interventions are needed that appeal to more individual-level characteristics.

An important factor affecting whether customers will engage in a desired behavior is their knowledge (Kostadinova, 2016). Knowledge is a pre-requisite for intention to behave in an ecological way (Kaiser, Ranney, Hartig, & Bowler, 1999). As the current level of customer knowledge about the sustainability of delivery options is low (Buldeo Rai, Verlinde, & Macharis, 2019), the most effective non-financial incentive remains to provide customers with this knowledge (Buldeo Rai et al., 2021; Ignat & Chankov, 2020). Labeling more sustainable delivery options as 'green' has been shown to be more effective at stimulating customers' choice of the more sustainable delivery option by appealing to their intrinsic motivation (Agatz et al., 2021; Buldeo Rai et al., 2021). Knowledge becomes more effective when it is coupled with specific behavior. In the context of delivery choice in the last mile, it may be effective to inform customers about the sustainability of each delivery option. Such knowledge should stimulate customers to choose the more sustainable alternative. From a customer satisfaction perspective, as customers become aware of the sustainability implications of each delivery option, they may be inclined to see more expensive

or inconvenient delivery alternatives more positively, increasing the perceive value of the alternatives, and leading to higher satisfaction with the delivery options offered at check-out.

Therefore, we hypothesize:

(H1a). providing information about sustainability will increase the likelihood that a customer will select the sustainable delivery option (i.e. waiting for delivery or picking up from a parcel locker).

(H1b). providing information about sustainability will increase customer satisfaction with delivery options.

2.4. Financial incentives

Delivery price is a controversial topic in the context of the last-mile delivery. The delivery price is considered to be the most important driver of customer delivery choice in the last mile (Buldeo Rai, Verlinde, & Macharis, 2019; Nguyen et al., 2019). To compete with brick-and-mortar stores, retailers frequently choose to not make the price of delivery explicit, and instead choose to absorb part of it in the selling price (Allen et al., 2018; Tokar et al., 2020). This has resulted in customer habituation, and customers preferring free delivery to other choices (Buldeo Rai, Verlinde, & Macharis, 2019; Nguyen et al., 2019; Tokar et al., 2020). Conversely, in the context of grocery home deliveries, it is common practice for customers to pay for the delivery, suggesting that customers' expectations may be malleable at the product category level.

This malleability of customers' price expectations is related to the concept of 'reference price', the standard against which customers evaluate prices of transactions and which is formed through prior experiences (Mazumdar, Raj, & Sinha, 2005). Customers use a reference price in combination with other contextual factors to form expectations for future transactions. If the price asked exceeds their reference price with no appropriate justification, customers may perceive it to be unfair, and will be dissatisfied (Xia et al., 2004). In the context of last mile parcel delivery, customers have been conditioned to expect delivery above a certain amount to be free (Buldeo Rai, Verlinde, & Macharis, 2019; Nguyen et al., 2019). Retailers charging for delivery can thus be perceived negatively.

The price of delivery can be used to incentivize customers to select a more sustainable parcel delivery option. This form of financial (dis) incentive can be presented as a surcharge or as a discount. In the context of grocery home deliveries, Agatz et al. (2021) framed delivery price differences as a discount. From a price fairness perspective, framing effects are important as the reference price effects are asymmetric. Loss aversion causes customers to be more sensitive to higher prices than expected (as compared to lower prices), and experience more negative emotions (Mazumdar et al., 2005). A price surcharge is thus more likely to lead to customer dissatisfaction. An advantage of using a price surcharge as opposed to a discount is that it preserves margins for retailers. While price surcharges do not necessarily lead to dissatisfied customers if customers perceive the surcharge to be justified (Mazumdar et al., 2005), the framing of the surcharge needs to be tailored to the retailer's customer base and business context (Barker & Brau, 2020). Given the highly competitive environment in which retailers operate, and the corresponding small margins that this entails, we chose to present financial incentives as a surcharge. We therefore hypothesize that:

(H2a). a surcharge for next-day home delivery will increase the likelihood that a customer will select the sustainable delivery option (i.e. waiting for delivery or picking up from a parcel locker)

(H2b). a surcharge for next-day home delivery will decrease customer satisfaction with the delivery options.

2.5. Product value

Customer's willingness to pick up a parcel depends, among other factors, on product value (Lee & Whang, 2001; Pan, Kuo, Pan, & Tu, 2013; Yuen, Wang, Ng, & Wong, 2018). Specifically, as product price increases, customers, customers' service expectations increase in parallel. This results in a decrease in willingness to pick up parcels or wait for delivery for higher-value products. Furthermore, customers might be less accepting of delivery charges for a higher-priced product (Pan et al., 2013; Vakulenko et al., 2018), leading to a decrease in satisfaction with the delivery options. This gives support to the following hypotheses:

(H3a). a higher-priced product will decrease the likelihood that a customer will select the sustainable delivery option (i.e. waiting for delivery or picking up from a parcel locker).

(H3b). a higher-priced product will decrease customer satisfaction with the delivery options.

2.6. Attitude towards the environment

In the context of last mile delivery, Buldeo Rai et al. (2021) called for more research on the role that customers' attitude towards sustainability plays in their delivery choice. Previous research has shown that customers differ in their environmental consciousness and sustainable behavior (Kostadinova, 2016). Customers with a more positive attitude towards the environment, also frequently referred to as eco-conscious consumers (Agatz et al., 2021), are more likely to engage in sustainable consumption (Chen, 2020; Kaiser et al., 1999). Borin, Lindsey-Mullikin, and Krishnan (2013)Borin, Lindsey-Mullikin, and Krishnan (2013) found that green strategies had no impact on customers who did not report a positive attitude towards the environment.

Thus, we hypothesize that:

(H4a). a more positive attitude towards the environment will increase the likelihood that a customer will select the sustainable delivery option (i.e. waiting for delivery or picking up from a parcel locker).

(H4b). a more positive attitude towards the environment will increase customer satisfaction with the delivery options.

There is evidence to suggest that there is a reinforcement effect between customers' knowledge of sustainability and their attitude towards the environment. Agatz et al. (2021) found that such 'eco-conscious' customers were more likely to select alternatives labelled as sustainable. Thus, about delivery options, we hypothesize:

(H4c). a more positive attitude towards the environment will strengthen the impact of information about sustainability on the likelihood of selecting the sustainable delivery option (i.e. waiting for delivery or picking up from a parcel locker).

2.7. Familiarity with parcel lockers

Customers' willingness to actively participate in last mile delivery greatly depends on the convenience offered by such option. For example, product size will determine whether customers are willing and able to carry a product as customers are more likely to pick up a product from a parcel locker if the product is easy to carry (Vakulenko et al., 2018; Yuen et al., 2018). In recent years, LSPs have invested in parcel lockers and pick up locations, increasing their availability. For example, in the Netherlands, 63% of households are located at walking distance of a parcel locker or pickup location (ACM, 2020a; 2020b). Agatz et al. (2021) found that as choices became less convenient, customers became less sensitive to both financial and non-financial incentives to use them. A location within walking distance is important, as the travel mode customers use to pick up their parcel determines environmental impact (Niemeijer & Buijs, 2023; TSL, 2021).

Parcel lockers are becoming increasingly available yet remain a relatively new self-service technology for many customers. Customer can be motivated to try a new technology if they perceive it will save them time, effort, and will be easy to use. Conversely, they will be less

likely to try it if they perceive it as being risky (Curran & Meuter, 2005). This is consistent with Vakulenko's (2019b) findings that customers are suspicious of new innovations and their expectations are shaped by previous experiences. People are more likely to use a technology they are familiar with. Therefore, we hypothesize that:

(H5a). familiarity with parcel lockers will increase the likelihood that a customer will select the sustainable alternative (i.e. waiting for delivery or picking up from a parcel locker).

(H5b). familiarity with parcel lockers will increase customer satisfaction with the delivery options.

The conceptual framework for the study is summarized in Fig. 1.

3. Materials and methods

Scenario-based experiments (also known as 'vignette experiments') were used to test the study hypotheses (Buldeo Rai, Verlinde, & Macharis, 2019; Eckerd, 2016; Kokkinou & Cranage, 2011). We replicated the experimental setup developed by Buldeo Rai et al. (2021), namely imitating a shopping basket in the survey software Qualtrics (Agatz et al., 2021; Buldeo Rai et al., 2021). In the context of last mile parcel delivery, Tokar et al. (2020) used a similar approach to investigate customer response to changes in carrier and delivery price. Using their approach, we conducted two experiments, each focusing on choosing between next day home delivery and a more sustainable delivery method: 1) waiting longer for delivery (survey 1) and 2) picking up from a parcel locker or pick-up location (survey 2). These two potential interventions were tested in two separate surveys, as the options presented can dramatically influence how each is perceived, known as a carry-over effect. We aimed to avoid that different interventions would influence each other, and thus isolated them into separate surveys. Each experiment consisted of a 2 (sustainability information: yes/no) x 2 (surcharge for next day delivery: yes/no) x 2 (product price: high/low) between-subjects design. In the following section we describe the sampling approach, survey design, and choice of measures.

3.1. Sample

Participants were students at a midsize University of Applied Sciences in the Netherlands. While students are a specific demographic group, they have been recruited to participate in similar experimental studies (Agatz et al., 2021) and their age group overlaps with the 18–45 age group selected by Buldeo Rai et al. (2021) as representing the most frequent online buyers. A census approach was used, with all university students being invited by e-mail to participate in the survey. To avoid carry-over effects, 1st and 2nd year students were invited to participate in survey 1 (fall of 2020), while 3rd and 4th year students were invited to participate in survey 2 (spring of 2021). The recruitment e-mail explained the purpose and voluntary nature of the research and included a link to a Qualtrics survey. The survey was programmed in such a way that participants were randomly assigned to only one of the eight possible scenarios, to avoid carry-over effects and to ensure approximately equal numbers of participants in each condition.

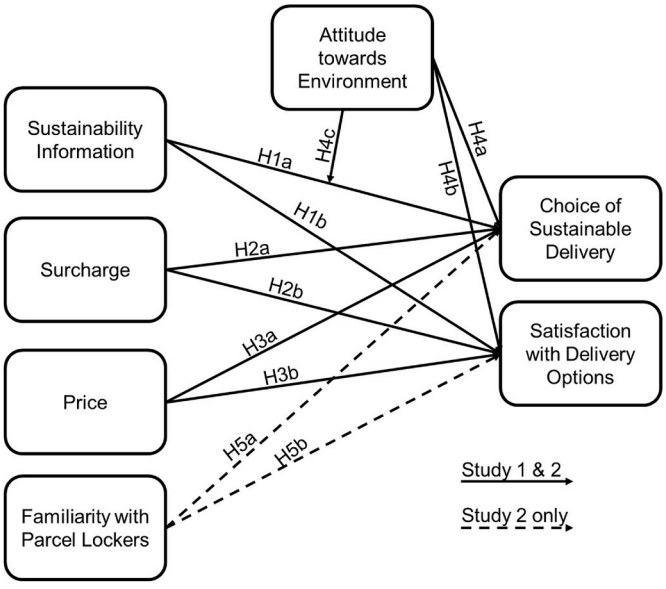

Fig. 1. Conceptual framework.

After a reminder e-mail, 258 of 2900 1st and 2nd year students completed survey 1. The response rate of 8.90% was consistent with previous research. After removing surveys with excessive missing data and outliers, 226 remained for further analysis. The average age for this first sample was 19.76 (sd = 1.95), and 73.4% were female. 92% of respondents had ordered online at least once in the past month, with 20% having ordered at least 4 times. Similar procedures were followed for survey 2. After a reminder e-mail, 240 of 2600 (9.23%) 3rd and 4th year students completed survey 2. After removing surveys with excessive missing data, 228 remained for further analysis. The average age for this sample was 21.69 (sd = 1.9), and 62.7% were female.

3.2. Survey design and experimental manipulations

Both experiments were administered by means of a survey consisting of five parts. The first part was a short introduction to the study, including information about informed consent. Subsequently, participants were shown a shopping basket and given the choice between two delivery options, namely home delivery and the more sustainable option (see Fig. 2 for an example). In the third section, participants were asked about their satisfaction with the set of delivery options. The fourth section consisted of questions about the participants' attitude towards the environment. The final section included demographic questions.

Consistent with the 2 (sustainability information: yes/no) x 2 (surcharge for next day delivery: yes/no) x 2 (price: high/low) experimental design, participants were randomly shown one of eight shopping baskets in which the manipulations were embedded (see Table 1 for overview of the experimental conditions). The shopping basket that participants were shown contained a single pair of shoes. Hereby, we chose to use the same type of product category as Buldeo Rai et al. (2021) and Buldeo Rai, Mommens, et al. (2019). According to Buldeo Rai et al.'s (2021) preliminary investigation, apparel is a mature product category, and frequently used for e-commerce studies. In the context of our study, shoes were deemed as a realistically sized parcel to pick up from a parcel locker or pick-up location, even by bicycle, a dominant mode of short-distance travel in daily life in the Netherlands. Also, shoes were appropriate for our experiment as it was possible to vary prices.

After viewing the shopping basket, participants were presented with two delivery options. In both surveys, the less sustainable delivery option was next day home delivery, phrased as "delivered to your door tomorrow". In survey 1, the more sustainable service delivery option was waiting for delivery, phrased as "delivered to your door during the next three days." In survey 2, the more sustainable option was the use of a parcel locker or pick up point, phrased as "pick up from a pick-up point (e.g. shop) or parcel locker of your choice by foot or bike." An example is shown in Fig. 2.

Like Buldeo Rai et al. (2021), we examined the role of sustainability information. We used a positively worded message for the sustainable option. For survey 1, we used "SUSTAINABLE OPTION: By accepting a longer delivery period, you allow us to combine shipments, and help to reduce the impact of transportation on the environment." To ensure that the two options were presented in an equivalent, yet unbiased way, we also gave information about sustainability for the next day delivery option, namely: "By accepting the shorter delivery period, no combined

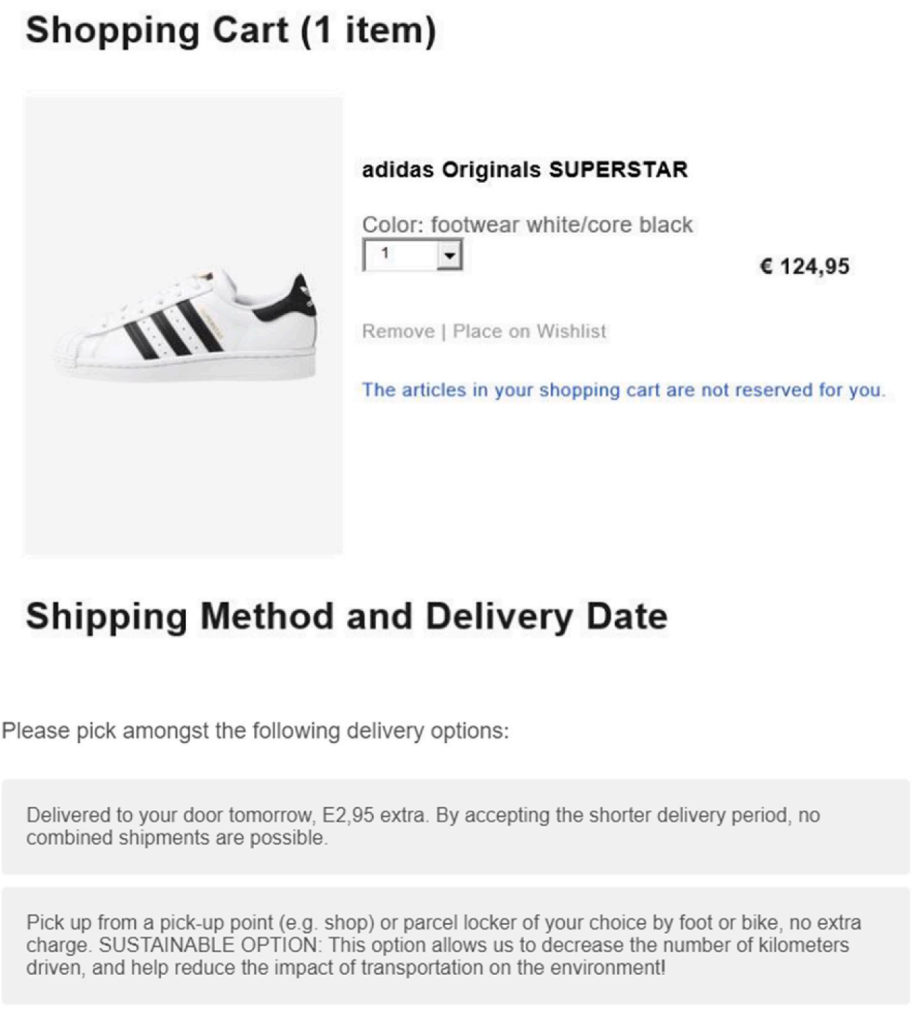

Fig. 2. Sample Experimental Scenario (Survey 2, Condition 8: Price: high, Information about sustainability: yes, Surcharge: yes).

Table 1
Overview of experimental conditions and proportion of respondents per condition who chose the sustainable alternative.

	Price	Information about sustainability	Surcharge	Percentage who chose to wait for delivery (Survey 1)	Percentage who chose to pick-up from parcel locker (Survey 2)
Condition 1	Low (64.95)	No	No	19.2%	23.3%
Condition 2	Low (64.95)	No	Yes (E2.95)	85.7%	69.6%
Condition 3	Low (64.95)	Yes	No	63.6%	41.9%
Condition 4	Low (64.95)	Yes	Yes (E2.95)	96.3%	75.0%
Condition 5	High (124.95)	No	No	13.6%	16.1%
Condition 6	High (124.95)	No	Yes (E2.95)	80.8%	65.5%
Condition 7	High (124.95)	Yes	No	61.5%	48.3%
Condition 8	High (124.95)	Yes	Yes (E2.95)	89.3%	55.6%

shipments are possible."

We extended Buldeo Rai et al.'s (2021) study in two ways, by (1) varying product prices, and (2) by introducing financial incentives in the form of a surcharge for next day delivery. The product prices used in our experiment (low was EUR 64.95 and high was EUR 124.95) were compared to prices offered by online retailers to ensure they were realistic prices for shoes. The price shown for the surcharge (EUR 2.95) was set based on a review of online retailers who charged for delivery.

3.3. Measures

To test our hypotheses, we included two dependent variables in our study, namely choice of delivery option and satisfaction with the delivery options provided. Choice of delivery option was presented as a

binary choice between the next day home delivery and the sustainable delivery option, simulating the choices that a customer would be given in a real shopping situation. Two items were used to measure satisfaction with the delivery options. Participants were asked to rate their satisfaction using a 5-point Likert scale anchored with very dissatisfied (1) and very satisfied (5) and to rate the delivery options provided using a 5-point Likert scale anchored with poor (1) and excellent (5).

Attitude towards the environment was measured using an existing 4-item scale l anchored with strongly disagree (1) and strongly agree (2) (Chen, 2020). Familiarity with parcel lockers was measured using a four-point scale consisting of the statements: "I have never heard of parcel lockers" (1), "I have heard of parcel lockers, but never seen one" (2), "I have seen parcel lockers, but never used one" (3), and "I have used parcel lockers before" (4).

4. Results

4.1. Survey 1: delayed delivery

The reliability of the attitude towards the environment and satisfaction scales were assessed using Cronbach Alpha and were found to be satisfactory (attitude towards the environment scale 0.835; satisfaction 0.816). The items were averaged to compute scale scores for each participant for attitude towards the environment (M = 3.87, sd = 0.71) and for satisfaction (M = 3.92, sd = 0.65).

Logistic regression was used to analyze the relationship between sustainability information, delivery surcharge, price, attitude towards the environment, and choice between next day delivery and the more sustainable option of waiting for up to three days. Logistic regression is particularly appropriate to investigate customer choice in the context of a scenario-based experiment when the outcome is binary (Kokkinou & Cranage, 2015; Thomas, Ueltschy Murfield, & Ellram, 2022). It permitted us to model the binary choice outcome even for multiple predictors including interactions, as required for Hypothesis H4c. Furthermore, the use of logistic regression makes the results appropriate for modeling in subsequent studies (Kokkinou & Cranage, 2011). Table 1 shows the proportion of participants in each condition that selected the sustainable alternative.

Model fit was assessed using a chi-square statistic comparing the model under study to a model with no predictors. The introduction of the study variables significantly reduced the −2 log-likelihood (-2LL) from 264.51 to 180.87 ($\chi 2 = 83.646$, $p < .001$). As the interaction term between attitude towards the environment and sustainability information (H4c) did not comprise a significant improvement in fit and was not retained in the final model. Several pseudo-R^2 measures (Hosmer-Lemershow R^2, Cox and Snell R^2, Nagelkerke R^2) were used to determine the practical significance of the final model as they reflect the amount of variation explained by the model (Hair, 1998). The Hosmer-Lemershow R^2 measure for this model was 0.316, Cox and Snell R^2 was 0.335 and Nagelkerke R^2 was 0.462.

It was found that, holding all other predictor variables constant, the odds of respondents selecting the sustainable alternative (namely waiting for up to three days) increased 18.51 times (95% CI [8.305, 45.766]) if they had to pay a surcharge for next day delivery (H2a) (see Table 2). Similarly, the odds of respondents selecting the sustainable alternative increased 6.51 times (95% CI [3.006, 15.173]) when they received information about the sustainability of the delivery (H1a). The odds of respondents selecting the sustainable alternative increased by 73% for each additional point on the attitude towards the environment scale (95% CI [1.043, 2.940]) (H4a). The effect of product price was not significant (p = .4135) (H3a). To model the probability that a customer will select to wait three days, the following equation can be applied:

$$p(W) = 1 / \left(1 + e^{-(-3.447 + 1.873x_1 + 2.929x_2 - 0.304x_3 + 0.551x_4)}\right)$$

where

- $p(W)$ is the probability that the customer will select to wait three days,
- x_1 is a dummy variable representing whether the customer received information about the sustainability,
- x_2 is a dummy variable representing whether the customer had to pay surcharge,
- x_3 is a dummy variable representing whether the customer saw a high or low price, and
- x_4 is a continuous variable representing a more positive attitude towards the environment.

Multiple regression was used to examine the relationship between sustainability information, surcharge, price, attitude towards the environment, and satisfaction with the delivery options provided. The model fit the data significantly better than a model with no predictors ($F[200, 4] = 3.641$, $p < .0001$, adj $R^2 = 4.923\%$). Asking customers for a surcharge for next day delivery had a small but significant negative impact on satisfaction with delivery options ($b = -0.3108$, $p < .001$), providing support for hypothesis H2b. None of the other variable effects were significant, and thus hypotheses H1b, H3b and H4b were not supported.

Table 2
Logistic regression results for Survey 1.

	B (SE)	95% CI		
		Lower	Odds Ratio	Upper
Constant	−3.447 (1.138)			
Sustain. Info (yes/no) (x_1)	1.873 (0.411)	3.006	6.508	15.173
Surcharge (x_2)	2.919 (0.433)	8.305	18.513	45.765
Price (low/high) (x_3)	−0.304 (0.372)	0.353	0.738	1.525
Att. Environment (x_4)	0.551 (0.263)	1.043	1.735	2.940

4.2. Survey 2: parcel locker or pick up point

The reliability of the attitude towards the environment and satisfaction scales was assessed using Cronbach Alpha and was found to be satisfactory (attitude towards the environment alpha = 0.864; satisfaction alpha = 0.829) A simple average was used to compute scale scores for each participant (attitude towards the environment (M = 3.81, sd = 0.74; satisfaction M = 3.74, sd = 0.7).

Logistic regression was used to analyze the relationship between the predictors, namely sustainability information, surcharge, price, attitude towards the environment, familiarity with parcel lockers, and the outcome of choice between next day delivery and the more sustainable option of picking up from a parcel locker or pick-up location. Table 1 shows the proportion of participants in each condition that selected the sustainable alternative.

The introduction of the study variables significantly reduced the −2 log-likelihood (-2LL) from 257.6572 to 226.8513 ($\chi 2 = 30.80583$, $p < .001$). As the interaction term between attitude towards the environment and sustainability information (H4c) was not significant, we chose to retain the trimmed model for further analysis and interpretation. The Hosmer-Lemershow R^2 measure for this model was 0.120, Cox and Snell R^2 was 0.153 and Nagelkerke R^2 was 0.204.

Holding all other predictor variables constant, the odds of customers selecting the sustainable option were 3.309 higher (95% CI [1,768, 6347]) if they were shown a surcharge for next day delivery, supporting hypothesis H2a (see Table 3). For each additional point on the attitude towards the environment scale, the odds of customers selecting the sustainable option increased by 48% (95% CI [1.010, 2.209]) and for each additional increment of familiarity with parcel lockers by 62% (95% CI [1.198, 2.233]), supporting hypotheses H4a and H5a respectively. There was no support for hypothesis H1a, namely that sustainability information increased the odds of customers selecting the sustainable alternative. To model the probability that a customer will

Table 3
Logistic regression results for Survey 2.

	B (SE)	95% CI		
		Lower	Odds Ratio	Upper
Constant	−3.560 (0.956)			
Sustain. Info (yes/no) (x_1)	0.514 (0.322)	0.894	1.672	3.163
Surcharge (x_2)	1.197 (0.325)	1.768	3.309	6.347
Price (low/high) (x_3)	−0.098 (0.322)	0.482	0.907	1.708
Att. Environment (x_4)	0.392 (0.199)	1.010	1.480	2.209
Familiarity with Lockers (x_5)	0.485 (0.158)	1.198	1.624	2.233

select to wait three days, the following expression can be applied:

$$p(PL) = 1 / \left(1 + e^{-(-3.560 + 0.514x_1 + 1.197x_2 - 0.098x_3 + 0.392x_4 + 0.485x_5)}\right)$$

where

- $p(PL)$ is the probability that the customer will select to use a parcel locker,
- x_1 is a dummy variable representing whether the customer received information about the sustainability,
- x_2 is a dummy variable representing whether the customer had to pay surcharge,
- x_3 is a dummy variable representing whether the customer saw a high or low price, and
- x_4 is a scale variable representing a more positive attitude towards the environment
- x_5 is a scale variable representing a greater familiarity with parcel lockers

Multiple regression was used to examine the relationship between sustainability information, surcharge, price, attitude towards the environment, familiarity with parcel lockers, and satisfaction with the delivery options provided. The model was significantly better than a model with no predictors ($F[180, 5] = 6.234$, $p < .000$, adj $R^2 = 12.39\%$). Asking customers for a surcharge for next day delivery had a significant negative impact on satisfaction with delivery options ($b = -0.58273$, $p < .000$), providing support for hypothesis H2b. None of the other variable effects were significant, and thus hypotheses H1b, H3b, H4b and H5b were not supported.

5. Discussion and implications

5.1. Discussion

B2C e-commerce sales are still increasing, with a corresponding increase in negative impacts on social, environmental, and economical aspects such as CO_2 emissions, city congestion, and driver stress. To address these issues, LSPs can implement supply-side solutions such as consolidation of deliveries, however this requires demand-side changes in customer behavior. The present study contributes to the ongoing debate on how retailers and LSPs can improve the sustainability of their last-mile operations from a triple-bottom line perspective by examining empirically how customers receiving parcels from online retailers could be influenced to choose for a more sustainable delivery alternative (RQ1), and how this affects their satisfaction with the parcel delivery options provided (RQ2).

We examined two delivery options that allow LSPs to consolidate deliveries (Allen et al., 2018; Buldeo Rai et al., 2021) and thus increase drop density and reduce the number of trips, namely making customers wait up to three days for their parcel (consolidation in time: survey 1) and asking customers to collect their parcel from a parcel locker (consolidation in location: survey 2). For both delivery options, consistent with previous research showing price to be the most important determinant of customer choice between delivery options (Barker & Brau, 2020; Gawor & Hoberg, 2019), we found that charging customers for next-day delivery was the most effective way to stimulate them to choose the offered more sustainable delivery option. Customers were 18 times more likely to be willing to wait for delivery, and 3.3 times more likely to pick up their parcel themselves when presented with a surcharge for next day delivery at home (delivered to their door). While this was expected, the magnitude of the effect showed that extrinsic motivation, in the form of financial incentives, remains an important tool to steer customers towards more sustainable alternatives and should not be dismissed out of hand as undesirable by retailers (Allen et al., 2018; Buldeo Rai et al., 2021; Tokar et al., 2020).

Consistent with the retailer narrative that delivery charges are undesirable, charging customers for next-day delivery led to a small but significant decrease in satisfaction with the delivery options considered in this study. This reduction in customer satisfaction is an important motivation for retailers to not consider financial incentives (Allen et al., 2018). Nevertheless, given the effectiveness of this intervention in the context of sustainable last mile delivery, ways to make it more acceptable to customers should be investigated. The literature on reference price formation (Mazumdar et al., 2005) suggests that customer reference prices are malleable. This is further evidenced by the fact that in different product categories such as attended grocery delivery, delivery surcharges are accepted (Agatz et al., 2021). Similarly, the literature on price fairness (Xia et al., 2004) suggests that if customers understand the motivations behind a delivery surcharge, they may accept it as fair. From this perspective, informing customers about the sustainability of delivery alternatives was expected to lead to a higher perceived value, and thus satisfaction with the delivery options provided, but this was not the case. Our findings thus show that sustainability motives are not sufficient to increase the acceptance of price surcharges. Further research is needed to examine how customers' reference price for parcel delivery charges can be influenced so that parcel delivery charges become acceptable to them. The reduction in satisfaction caused by the surcharge was greater when the alternative was to pick up a parcel from a parcel locker. Picking up a parcel from a parcel locker requires customers to invest time and effort in the process (Vakulenko et al., 2018). Customers thus had to choose between two alternatives that they may perceive as being costly or inconvenient, effectively decreasing their perceived value and increasing their cost (Agatz et al., 2021; Gawor & Hoberg, 2019).

Providing information about sustainability stimulated customers to choose the more sustainable delivery option when the alternative was to wait. This is consistent with prior research that showed that knowledge enables a more sustainable pattern of customer behavior (Kostadinova, 2016). Nevertheless, providing information about sustainability did not have the same positive effect on customers choosing to pick up their parcel from a locker. In the latter situation, the sustainable choice was stimulated by a positive attitude towards the environment, supporting previous research showing that customers' intrinsic motivation for environmental action increased their willingness to engage in an action that supports their values, even if it requires more effort (Agatz et al., 2021).

When the more sustainable choice was for customers to pick up their parcel themselves, previous experience using parcel lockers was an important factor affecting customer choice. Parcel lockers are a relatively new technology, and thus unfamiliar to some customers which may remain suspicious of it (Vakulenko et al., 2019b). Customers may be reluctant to try parcel lockers as they perceive them to be difficult to use and risky (Zhou et al., 2020). In other contexts, studies have shown that customers may be willing to overcome their hesitations at using a new technology if it means that they will save time (Kokkinou & Cranage, 2015). Further research should investigate the trade-offs customers are willing to make between exerting extra effort, and acting in accordance with their values, specifically values regarding sustainability.

5.2. Practical and managerial implications

The study provides empirically based arguments to the ongoing debate in the hypercompetitive online retailing industry, whether retailers can steer customers towards more sustainable delivery options without compromising customer satisfaction. The study provides evidence that retailer customers can be influenced to choose the more sustainable delivery option, with limited negative impact on their satisfaction with the delivery options offered. While price surcharges remain an effective way to extrinsically motivate customers to choose a more sustainable delivery alternative, providing information about sustainability similarly motivates customers, but to a lesser extent. Providing information about sustainability does not however entirely mitigate the negative effects of price surcharges on customers' satisfaction with delivery alternatives provided. More research is needed to examine which information is most effective and how different delivery options should best be communicated, so that the customers' satisfaction with these options remains high. More communication between retailers and customers - possibly in the form of customer research - could help retailers make better use of financial incentives (Sallnäs & Björklund, 2020) in a way that preserve retailers' competitiveness (Tokar et al., 2020).

The financial (or pricing) incentives that are analyzed and discussed in this study primarily focus on the action of market actors such as retailers, LSPs and customers. However, last mile deliveries cause problems in urban areas for which modern cities need solutions to reduce external costs such as traffic congestion and pollution (Ranieri, Digiesi, Silvestri, & Roccotelli, 2018). From this perspective, pricing can be considered to a large extent a governmental responsibility. Furthermore, regulators also have the capacity to create a level playing field for retailers and LSPs. The effects of the reduction in customer satisfaction arising from price surcharges on the competitive position of LSPs and/or retailers can be mitigated if LSPs and/or retailers all have to concurrently engage in the practice. Transport pricing can thus be seen as a governmental instrument to establish a level playing field and fair competition within the different transport markets (Pahaut & Sikow, 2006). As a consequence, urban pricing, varying from area, cordon, distance-based, emission-based, or a combination of these, has already been introduced in many cities to reduce the number of vehicles in the city center or in specific city zones/time slots (Ranieri et al., 2018).

By modeling the trade-off between next-day delivery and customers picking up a parcel themselves, we provided insights in how individual choices could be influenced, and eventually could have downstream consequences for the perceived negative impacts of urban traffic in the neighborhoods. The study results provide insights in ways to affect choices on the demand side of e-commerce. Sustainable choices on the demand side may synergize with sustainable solutions on the supply side. LSPs' measures to operate more sustainably, for example by using zero-emission vans, can be even more effective if customers' choices allow the LSP to make more deliveries in fewer kilometers due to consolidation in time (delayed deliveries) or consolidation in place (parcel locker). Home deliveries – especially by vans - are often discussed as contributing to nuisance in neighborhoods due to increased traffic unsafety in areas where pedestrians, cyclists, and wheelchair users also use the same infrastructure (Ranjbari et al., 2023). This study provides insights in how residents could contribute to a reduction in delivery traffic in their own neighborhoods, given the option. Nevertheless, more research is needed, for example on the role of distance traveled (e.g., to the locker locations) in this trade-off.

5.3. Limitations

This study has several limitations. While several previous studies focused on young adults and students (Agatz et al., 2021; Buldeo Rai et al., 2021), this population is more price sensitive, possibly magnifying the effect of price incentives. Young adults also travel relatively more by bike or on foot, and might therefore be more open for the option to pick up their parcel on bike or foot than car-owners. Similarly, the study was conducted in the Netherlands, where distances are relatively small compared to other countries, and where residents are more used to traveling on foot or by bike. We therefore recommend that the study be replicated with a more diverse sample, both demographically and geographically.

Our study did not test attended and unattended service delivery options separately. Parcel lockers are a form of unattended self-service technology and therefore different psychological factors might be at play than for attended pick up locations. While both are forms of delivery-and-collection, they differ in terms of convenience and perceived risk, two important decision-making factors. Furthermore, in the Netherlands, neighbor deliveries are accepted widely as the most obvious option for non-successful deliveries, and thus limit the need for and consequently the familiarity with parcel lockers. Further research should examine these parcel delivery alternatives separately and disentangle the corresponding decision-making factors.

6. Conclusion

Customers' last mile delivery choices can be steered towards more sustainable options using financial and non-financial incentives. Financial incentives can be very effective at extrinsically motivating customers to choose for a more sustainable alternative. Further research is needed to examine how customers, currently conditioned to expect free next day delivery, can be led to accept delivery charges as the norm. This could be achieved through education about sustainability. Such a message could frame a price surcharge as fair, given the impact of next day delivery on the environment. Further research should also examine the impact of framing the price difference as a discount.

The present study modeled customer choice of service delivery as a binary choice. This is a first step towards modeling customer e-commerce ordering behavior, that can subsequently be used to model its impact on both individual travel behavior and urban logistics traffic. These insights can contribute to decision making on urban planning and utilization of urban space for e-commerce activities, as both delivery alternatives require urban space. Parcel lockers or pick-up points need to be located in neighborhoods at walking or cycling distance to be a sustainable delivery alternative.

CRediT authorship contribution statement

Alinda Kokkinou: Conceptualization, Methodology, Investigation, Formal analysis, Data curation, Writing – original draft, Visualization, Writing – review & editing. **Hans Quak:** Conceptualization, Investigation, Writing – original draft, Writing – review & editing. **Ondrej Mitas:** Conceptualization, Methodology, Validation, Writing – review & editing. **Albert Mandemakers:** Data curation, Investigation, Writing – review & editing.

Declaration of competing interest

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

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