



Impact of different shopping stages on shopping-related travel behaviour: analyses of the Netherlands Mobility Panel data

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Abstract

From the moment e-shopping emerged, there have been speculations about its impact on personal mobility. A fair amount of research has already been carried out on Internet shopping itself as well as on its consequences for mobility. Most studies focus on the overall impact of online shopping on personal mobility. However, little is known about how personal shopping mobility can be characterised when differentiating its constituent stages, being browsing/orienting, comparing, selecting and purchasing products, and how this is affected by e-shopping. This will be the main topic of this paper. We will investigate this using recently collected data from the *Netherlands Mobility Panel* [in Dutch: Mobiliteit-sPanel Nederland (MPN)]. It is the unique combination of reported shopping trips in the three-day travel diary, the large amount of personal and household characteristics combined with the detailed information from the e-shopping questionnaire that enables us to perform this research. Using factor analysis, we explore the underlying factors related to the browsing and selection behaviour prior to the purchase of a product. Using these factors as a starting point, we apply cluster analysis resulting in three homogeneous groups of shoppers with different pre-purchase shopping behaviour. The groups differ clearly with respect to personal and household characteristics, in the frequency with which they buy and sell products online and in their perception of (dis-)advantages of online shopping. Once relevant groups have been distinguished and characterised, differences in shopping-related mobility between them are studied in two different ways. Firstly, we analyse statements from shoppers on how their shopping-related mobility has changed. Secondly, we analyse shopping trips reported in the three-day travel diary. Only one group, which consists of shoppers that rely on the Internet to search for product information, compare prices and get new product ideas, states that their shopping-related travel behaviour has changed since they started shopping online. Approximately 50% of all shoppers experienced no difference in their shopping mobility. The analysis of actual shopping mobility using the travel diary data showed only minor differences in shopping-related travel behaviour between the identified groups. Finally, we fit a multi-variate linear regression model of shopping trip distance to determine if (e)-shopping characteristics influence trip distances. The frequency with which people shop online as well as some stated changes in shopping-related travel behaviour (shopping in a similar manner and shopping longer) turn out to influence non-grocery

shopping trip distance. No significant influence could be found of shopping cluster membership on shopping trip distances.

Keywords E-commerce · Netherlands mobility panel · B2C · Longitudinal survey · Travel behaviour · Shopping stages

Introduction

From the moment e-shopping emerged, there have been speculations about its impact on personal mobility. The Netherlands, together with the UK, Denmark, Germany and Sweden, belongs to a group of countries with a relatively large number of online shoppers. As of 2013, 10.3 million Dutch people (61%) had shopped online at least once in the last year; 7.5 million of them (45%) did so in the last quarter of that year (Statistics Netherlands 2014a). Questions about the impact of e-shopping on mobility become even more relevant due to media coverage on the sharp increase in turnover of Internet purchases and the increasing number of consumers who shop on the Internet. The global online retail market showed a 14.8% average annual growth from 2007 to 2012, while the total retail growth was just a 0.9% over the same period (Cushman & Wakefield 2012). In Europe almost one out of three consumers purchased goods and services over the Internet in 2013 (Ecommerce Europe 2014).

A fair amount of research has already been carried out on Internet shopping itself as well as on its consequences for mobility. For a comprehensive overview of studies on the impact of e-shopping on personal transport we refer to Rotem-Mindali and Weltevreden (2013). They present an overview of empirical research performed over the last two decades, supporting different hypotheses on the impact of the Internet on shopping-related mobility. These hypotheses vary from the assumption that personal mobility is likely to decrease, to the assumption that there will be no impact, or even an increase in personal mobility. Rotem-Mindali and Weltevreden argue that the differences in research findings can partly be explained from differences in data collection approach and in analysis approach. Part of the studies for example only consider substitution effects, while others also take complementary, modification and neutrality effects into account.

The impact of online shopping on mobility also largely depends on how online shopping is defined. It is evident that there are many more e-shoppers if they are defined as using the Internet either to search for information online or to purchase online (e.g., Casas et al. 2001; Dixon and Marston 2002; Farag et al. 2006b, 2007; Tonn and Hemrick 2004), than if the more restrictive definition of purchasing online is applied (e.g., Ward 2001; Cao et al. 2012; Kenyon 2010). Also the implications for mobility can be quite different.

We argue that the Internet has brought about changes in all aforementioned stages of the shopping process. This process of browsing/orientating, comparing, selecting and purchasing products has become increasingly disjointed, both in time and place. Internet for example offers prospective buyers of flat-screen TVs the possibility to search for general product information and make preliminary selections at any time of day, but the Internet does not offer the possibility of actually personally experiencing the differences in picture quality among the various TVs. For this, prospective buyers must still visit a traditional store, for which they must also take into account the store's opening hours. It is moreover not uncommon for people planning to make purchases to first seek advice and information in traditional stores before subsequently purchasing the product online

at a lower price. In such cases, although the product was ultimately purchased online, the buyer still makes a trip to a traditional store.

Most studies focus on the total impact of online shopping on personal mobility. However, little is known about how personal shopping mobility can be characterised when differentiating its constituent stages, being browsing/orienting, comparing, selecting and purchasing products, and how this is affected by e-shopping. This will be the main topic of this paper. Orienting and purchasing goods and services will be a multi-channel activity in the future, even more than today. For instance in 2020, 80 to 90% of all consumers is expected to still visit traditional stores to fit and buy clothing. At the same time 52% of all purchases are expected to be done online (www.emerce.nl). The question of the impact of the different stages of shopping on personal mobility becomes even more important.

In this paper, we provide insights into how browsing/orienting, comparing and selecting products influence shopping-related mobility. We investigate this using recently collected data from the *Netherlands Mobility Panel* [in Dutch: MobiliteitsPanel Nederland (MPN)]. We distinguish groups of shoppers, that browse and select products using the Internet and traditional stores in different ways, by applying cluster analysis. We envisage that due to differences in browsing, comparing and selecting, these groups will also differ in shopping-related travel behaviour. Before applying the cluster analysis, we explore the underlying factors related to browsing and selection behaviour prior to the purchase of a product using factor analysis. After the cluster analysis, we determine the characteristics of the identified groups of shoppers. Once relevant groups have been distinguished and characterised, we study how differences in shopping-related mobility are perceived by shoppers themselves and determine how actual shopping-related mobility have changed. Finally, we fit a multi-variate linear regression model of shopping trip distance to determine if online shopping characteristics, such as the frequency with which someone shops online and the way in which the Internet is used prior to a purchase, influence shopping trip distance.

The paper is organised as follows. In the “[Theoretical background](#)” section we unravel the shopping process and look at people’s motivation for shopping. “[Data used for the analyses](#)” section shortly describes the Netherlands Mobility Panel data used in the analyses. “[E-shopping frequencies](#)” section discusses how frequent people use the Internet for purchasing products, selling products, and searching product information. In “[Browsing and selecting online and in traditional stores](#)” section, we focus on the role the Internet and traditional stores play prior to a purchase in comparing prices, looking for product reviews, searching for product information, getting new product ideas, touching/seeing products and comparing them. In “[Factors relevant to pre-purchase shopping](#)” section we further investigate this by exploring the underlying factors related to browsing and selection behaviour prior to the actual purchase of a product (factor analysis). We use these underlying factors in cluster analysis (presented in “[Identifying and characterising groups of shoppers](#)” section) to identify different groups of shoppers. Besides identifying these groups, we also characterise them in terms of personal and household characteristics, e-shopping frequency, and perception of (dis)advantages of online shopping. In “[Stated changes in shopping-related travel behaviour](#)” we take a look at stated changes in shopping-related travel behaviour between the identified groups of shoppers. In “[Actual shopping mobility](#)” section we study actual differences in shopping-related travel behaviour between these groups. Finally in “[Regression analysis results: impact of online shopping on shopping trip distances](#)” section we present the results of the multi-variate linear regression of shopping trip distance. The paper ends with conclusions (“[Conclusions](#)” section).

Theoretical background

Before we present our analyses, we first take a closer look at people's motivation for shopping ("Shopping motivation" section) and at the different stages in the shopping process ("Stages in the shopping process" section). Various terms are used for shopping on the Internet; the most frequently used terms are *e-commerce*, *e-shopping* and *online shopping*. "Shopping" in this paper comprises both *B2C* (a sales transaction between companies and consumers) and *C2C* (consumer-to-consumer) e-commerce, all stages of shopping, and both online and in-store shopping.

Shopping motivation

Shopping, and specifically browsing (getting new product ideas or determining the specifics of a certain product he/she might want to acquire) might be done in a *utilitarian* or *goal-oriented* way, where the consumer is looking for a specific product, or in an *experiential* or *hedonic* way, where the consumer is looking for fun in the shopping experience (Wolfinbarger and Gilly 2001; Park et al. 2012). In 2001, many online shoppers were goal-oriented; in fact, 71% of respondents who filled out an online questionnaire stated they were more utilitarian than experiential shoppers (Wolfinbarger and Gilly 2001). However, it is well possible that this share has changed in the past 14 years, among other things due to the rise of *online malls*: portals where online shoppers can browse for products across different brands and online stores.

The shopping goal (utilitarian/goal-oriented or experiential/hedonic) determines much of the shopping process. For instance, experiential shoppers (enjoying the process of browsing and selecting) more frequently visit stores (physical and online) and make more impulse purchases (Novak et al. 2003), whereas utilitarian shoppers (searching for a specific product) often prefer convenience, availability of information and absence of interaction with sales representatives (Wolfinbarger and Gilly 2001).

Other motivations related to the characteristics of desired goods might also have an impact on the desire to buy a new or second-hand item. Giout and Roux (2010) describe four types of shoppers for second-hand goods: *polymorphous enthusiasts*, who enjoy browsing for cheap items and value the uniqueness of certain second-hand items; *thrifty critics*, who prefer to be frugal shoppers; *nostalgic hedonists*, who enjoy browsing for nostalgic and unique items; and *specialist shoppers*, who selectively search for specific goods through second-hands outlets.

Stages in the shopping process

Shopping, whether it is (partly) performed using Information and Communication services (ICT) or offline, comprises a number of subtasks, or stages, which could be fragmented in space and time (Couclelis 2004). Generally, a distinction is made between the pre-purchasing and purchasing stages of shopping, which are also often called information searching and purchasing of a product (e.g., Farag et al. 2007; Levin et al. 2005; Mokhtarian 2004). Some authors also explicitly mention the after-purchasing stage of shopping (e.g., Couclelis 2004; Rotem-Mindali and Salomon 2007), in which a product is obtained and possibly returned.

A distinction of three stages, that are pre-purchase, purchase and after-purchase, might not be a detailed enough subdivision of the total shopping process when studying

multi-channel or multi-modal shopping and related mobility effects. Online shopping, especially for those who enjoy the experience of shopping, may be associated with multiple visits and impulse buys (Wolfenbarger and Gilly 2001). Apparently, in the pre-purchasing stage a number of sub-activities is performed, leading online shoppers to visit e-stores more than once. Without a more detailed distinction between subtasks, part of the mobility effects might be lost in generalisation. Couclelis (2004) introduces a listing of 12 subtasks of the shopping process, ranging from becoming aware of a need or want, to purchasing a product and possibly seeking after sales service (Table 1).

Many of these subtasks, if not all, can be performed both offline/in-store and online/on the Internet. However, some can be clustered into larger groups, based on the expected mobility effects. In this paper, we distinguish the following five main stages in a shopping chain:

- Browsing for potential products (including becoming aware of a need or want);
- Selecting a specific product (seeking advice and inspecting the alternatives between products and vendors);
- Purchasing the selected product (including the activities of ordering and paying);
- Obtaining the purchased product (including tracking the order status, if ordered), and
- (Possibly) returning the purchased product.

Each of these stages may be impacted by the Internet in their own way, and each potentially implies travel.

Online, in-store and multi-channel shopping

A number of studies have tried to determine aspects that influence whether shoppers prefer to use the Internet or shop in-store. For instance, Rohm and Swaminathan (2004) propose a typology of shoppers and their preferences to shop either online or in-store (offline), based on shopping motives and consumer preferences. Their typology is based on different reasons consumers might have for shopping (either online or in a store), such as the immediate possession of purchased goods (e.g., Shaw 1994) or social interaction with a sales representative (Alba et al. 1997). Rohm and Swaminathan (2004) state that people's main motivation for shopping may have implications for their preferences regarding online shopping

Table 1 The different (sub)tasks of the activity of shopping, after Couclelis (2004)

1.	Become aware of need or want
2.	Gather information about options
3.	Search/browse
4.	Seek advice/expert help
5.	Inspect alternatives
6.	Decide on item to be purchased
7.	Decide on vendor
8.	Purchase (order/pay)
9.	Track status (if an order)
10.	Get item to base (usually home)
11.	(Eventually) return/exchange item
12.	Seek post-sales service

and consequently their (online) shopping behaviour: Some aspects that consumers value remain difficult to find in online shopping, whereas other aspects are easier found online. An example of the former is the ability to see and touch products, personal interaction with sales representatives, and socializing aspects (Mokhtarian 2004). On the other hand, online shopping provides a virtual infrastructure, which allows for better ways of obtaining and filtering information (e.g., Lynch and Ariely 2000), to the extent that information seeking may become a motive for variety seeking consumers or those that strongly value the accessibility to information people to shop online (Rohm and Swaminathan 2004). The authors classify four types of online shoppers: those that are primarily motivated by convenience of online shopping, those that are motivated by variety seeking, those for which the combination of both is the main motivation, and those that are not oriented towards shopping in an offline store (Rohm and Swaminathan 2004).

A typology distinguishing between general preferences for online and offline shopping might suggest that shoppers completely perform all their shopping activities either online or in a store. However, the choice to shop online or offline is not at all binary. People increasingly use multiple modes for a single transaction; this is often referred to as *multi-channel shopping* (e.g., Farag et al. 2007; Ward and Morganowsky 2002) or *multi-modal shopping* (Wolfenbarger and Gilly 2001). Aspects affecting channel choice in the selecting stage may differ from those in the browsing stage or in the purchasing stage, as the activities differ significantly. For instance, the Internet enables consumers to search for information in a structured and less limited way: one can relatively easy collect product information and make comparisons between products offered by different providers (Rowley 2000). The information need about a product may therefore affect certain consumers' preference to browse and search either online or in-store. The same goes for other preferences, such as specific time constraints or the price of a product, which might impact the preference for using the Internet for the purchasing-stage of shopping (Rotem-Mindali and Salomon 2007).

Concluding, preferences and motives may influence the way in which (online and offline) shopping is undertaken, and the available channels may play different roles in the different stages of shopping. This complex interaction and the related mobility effects are the focus of our analyses and of the remainder of this paper.

Data used for the analyses

Before presenting our results, we first describe the data from the *Netherlands Mobility Panel* [in Dutch: MobiliteitsPanel Nederland (MPN)] that we used in our analysis.

The Netherlands Mobility Panel

The MPN is a state-of-the-art household panel, which main objectives are to establish short-run and long-run dynamics in travel behaviour of individuals and households, and to determine how changes in personal and household characteristics and in other travel-related factors (e.g., economic crisis, reduced taxes on sustainable transport, changes in land-use or increased availability and use of ICT) correlate with changes in travel behaviour (see Hoogendoorn-Lanser et al. 2015).

Starting July 2013, respondents 12 years or older from 2500 complete households recorded their travel data using a three-day travel diary. For each respondent, the diary

provided information about all trips (stages) the respondent had taken (transport modes, trip purposes, travel companionship, delays, parking costs). Over the next 4 years, this will be repeated at least yearly with the same respondents. At the same time, different questionnaires were filled out offering a large amount of background information on respondents and their households.

These research instruments contain useful information on (e)shopping behaviour and/or shopping mobility. The personal questionnaire provides us with detailed information about respondents' Internet activities. For sixteen different Internet activities, varying from online shopping to online gaming, to teleconferencing and to e-health respondents were asked about the frequency with which they are engaged in each of them (> 4 days per week, 1–3 days per week, 1–3 days per month, 1–3 days per quarter, less than once per quarter/never). For this paper purchasing and selling of products, and searching for product information were the relevant activities. In this generic frequency-related question, no distinction was made between product types. In the travel diary 23 trip purpose types were distinguished. In the travel diary, a distinction was made between non-grocery and grocery shopping. An additional questionnaire specifically focussing on e-shopping provided us with detailed information on respondents' e-shopping behaviour and consequences for their personal shopping-related mobility (see "[Questionnaire about online shopping](#)" section).

It is the unique combination of reported shopping trips in the three-day travel diary, the large amount of personal and household characteristics combined with the detailed information from the e-shopping questionnaire that enables us to perform the research that is presented in this paper.

Questionnaire about online shopping

This section shortly discusses the additional questionnaire aimed at providing greater insights into how people use the Internet to select, browse, purchase and finally obtain products, and what impact this process has on their personal shopping-related mobility. In order to determine if respondents were eligible to answer this set of follow-up questions, frequency with which they used the Internet to purchase products/services, sell products or search for product information was mapped.

Besides frequency with which respondents purchased different types of products on the Internet during the preceding 3 months, for the last purchased item(s) the processes of selecting, browsing, purchasing and obtaining, and returning products are mapped in detail, and the way in which both the Internet and traditional stores play a role in each of these stages. Thereby, 21 different types of products were distinguished. Differences in product types were not taken into account in the analyses presented in this paper.

The respondents were subsequently asked the following questions about the last product they had purchased in their last online order:

- What was the product;
- Was the product new or second-hand;
- Was the product bought from a private seller or online store;
- How did the respondent come in possession of the product;
- If the product was picked up, who picked the product up, what distance was travelled to do this, and what transport mode was used;

- If a product was returned: how was the product returned, who ultimately returned the product, to where, what distance was travelled and what transport mode used to return the product;
- Would a product be purchased if that product was not available online, and if so, how would the product be purchased.

Additionally, the respondents were presented with numerous suppositions aimed at gaining insights into their online shopping experiences and the ways in which the Internet and traditional stores played a role in product purchases (both online and in traditional stores). Respondents were also asked about the ways in which online shopping had changed their shopping behaviour and the associated mobility.

Data used in the analysis

For the MPN, TNS NIPO (a Dutch commercial survey company) has drawn a representative sample from its existing Internet panel (NIPObase). In 2013, 6126 people completed the personal questionnaire, of which 3996 also completed the three-day travel diary. The MPN consists of 1978 households, in which all members completed both the personal questionnaire and the travel diary (Olde Kalter et al. 2014). Of these 6126 respondents 3646 stated that they used the Internet at least 1–2 times per quarter for purchasing, selling products and/or for searching for product information. As mentioned before, the purchasing, selling and searching frequencies were defined for all product categories together.

From this group, 1711 respondents were randomly selected to receive the follow-up questions on online shopping. To be sure that the respondents were truly frequent e-shoppers, the e-shopping questionnaire contained a control question about online purchasing frequency. 1484 respondents stated that they had in fact made an online purchase during the past 3 months, and they subsequently answered the comprehensive set of questions about online shopping. This set contains 11 suppositions that are concerned with the way consumers use the Internet and traditional stores prior to the purchase of a product. 343 respondents answered ‘does not apply’ to at least one supposition and were excluded from the analysis. 1231 respondents were used in the analysis of these suppositions (component and clustering analysis). 833 of these 1231 respondents completed the three-day travel diary as well and are therefore selected in the analysis of shopping-related mobility.

Most analyses presented in this paper only include people, who indicated that they had purchased/sold products and/or searched for product information online for at least 1–2 days per quarter, because this group is of interest with respect to changes in shopping related mobility. The characteristics of the different samples as well as their representativeness are discussed in the next sections.

Descriptive statistics of personal and household characteristics

This section presents descriptive statistics of respondents included in the full sample ($N=6126$) and in the sample of e-shoppers that filled out the additional e-shopping questionnaire ($N=1231$). As could be expected, personal and household characteristics differ between both samples (Table 2). For example, more women shop online than men do. Instead of thoroughly discussing the differences between both samples, in the next section we focus on the question whether the presented results can be generalized and to which population.

Table 2 Main characteristics of the respondents included the full sample (N=6126), and in the sample of frequent e-shoppers (N= 1231)

	N=6216	N= 1231
<i>Gender</i>		
Male	44.8	47.1
Female	55.2	52.9
<i>Age</i>		
<24 years old	7.5	11.5
25–34 years old	17.2	20.2
35–44 years old	18.9	21.8
45–54 years old	18.6	18.8
55–64 years old	18.3	14.1
65+ years old	19.5	13.6
<i>Educational level</i>		
No or low education	15.6	16.2
Medium education	48	41.0
High education	36.4	42.7
<i>Working hours</i>		
< 12 h	3.0	2.0
12 to 30 h	14.7	17.2
30 h and more	36.4	42.7
No contract	46	38.1
<i>Driver's license</i>		
Yes	90.8	88.9
No	9.2	11.1
<i>Public transport card</i>		
Yes	31.5	29.4
No	68.5	70.6
<i>Immigrant</i>		
Yes	7.9	8.7
No	92.1	91.3
<i>Degree of urbanization</i>		
Heavily urbanized	48.4	46.3
Moderately urbanized	23.3	24.4
Rural	28.3	29.3
<i>Household type</i>		
Single	27.4	23.6
Couple, no children	37.4	30.0
Couple, with children	31.1	40.0
Other	4.0	6.4
<i>Children < 12 years old</i>		
Yes	17.6	24.3
No	82.4	75.7
<i>Number of cars in household</i>		
0	13.6	13.9
1	49.2	43.3
>1	37.2	42.8

Representativeness

An important question to answer is: To what extent can the results presented in this paper be generalized? As we questioned frequent e-shoppers are studied how they use stores and the Internet to get new product ideas and search for information, the ideal population considered is that of frequent Dutch e-shoppers. No demographic data is directly available about Dutch e-shoppers, but Statistics Netherlands (2014b) provides the percentage of people 12 years or older that have made at least a purchase online in the last 3 months, overall, and by gender, age, education and ethnic background categories. Crossing this information with the distribution of the total Dutch population on these categories—gender, age and education (Statistics Netherlands 2014c)—the distribution of the Dutch e-shopper population can be obtained and compared with the sample population in order to assess its representativeness.

In order to analyse whether there are significant differences in terms of the personal characteristics, we performed Chi square tests with a confidence level of 95%. We performed these tests for the personal characteristics gender, age, education level and the number of working hours per week. From the Chi square tests it follows that both samples do not differ significantly ($p=0.05$) in terms of gender, age, education level and working hours.

E-shopping frequencies

Before we focus in more detail on browsing for and selection of products, we first determine how often respondents in fact use the Internet for purchasing products, selling products, and searching product information. In this analysis no distinction was made between product types, since purchasing frequencies per product type only known for those who filled out the e-shopping questionnaire (not for all respondents). Furthermore, we study whether there are differences in searching, purchasing and selling between groups defined by age, gender, level of urbanisation, personal income, and educational level. To this end, we analyse answers to questions about the frequency of the different stages of online shopping that were included in the main personal questionnaire ($N=6126$).

91% of the respondents indicated they had used the Internet over the last 3 months at least once for either buying some products or searching product information. 73% stated that during the previous quarter they had made one or more purchases online. 43% indicated that they had sold something online in the same period, while 89% said they had searched for products or services online. Browsing and (eventually) selecting online are more common than actually purchasing products online. This not only applies to the number of people purchasing products or searching for product information online, but also to the frequency with which this occurs.

With regard to purchasing, selling, and searching for information about products online, there are no differences between men and women, except for the fact that men search online for product information slightly more frequently than women. However, the differences between age groups are considerable (Fig. 1). Purchasing, selling and searching for information about products online follow the same pattern, only this is most often done by people aged 25 to 45 years old. Internet use for these purposes declines the older people are, and is also lower among adolescents. This pattern is comparable to that found by

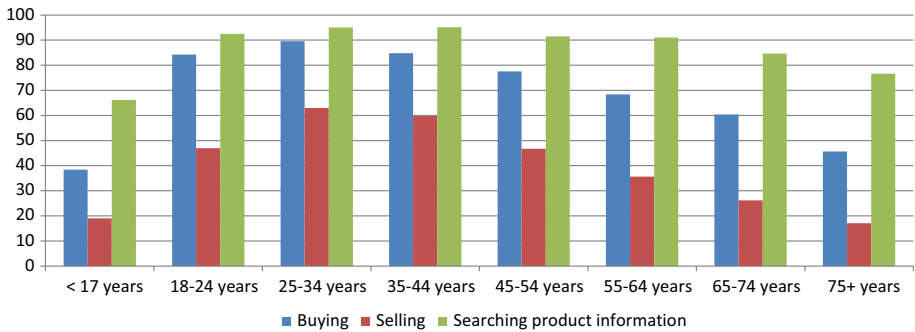


Fig. 1 Percentage of people per age group who have purchased, sold or searched for products online during the previous 3 months (N = 6126 respondents)

Statistics Netherlands (2014a), although the percentages for online shopping presented by Statistics Netherlands are slightly higher for the various age groups. In terms of numbers of online shoppers, no differences were found between heavily urbanised areas and lightly urbanised areas. Earlier research (I&O Research 2011; Farag et al. 2006a) showed that the forefront of online shopping was situated in larger cities. That this discrepancy would disappear had been expected (Weltevreden 2007). Also, no correlation was found between personal net income and the frequency online purchases. The frequency with which products are purchased online increases with educational levels.

Browsing and selecting online and in traditional stores

In the previous section we found that the large majority of people searched for products and/or services online. This raises the question to which extent and how traditional stores are used nowadays for browsing and selecting of products. We envisage that based on similarities and differences in browsing and selecting behaviour, we can distinguish different groups of shoppers. In this section, we take a closer look at how people browse and select products. We analyse eleven suppositions that are included in the e-shopping questionnaire and are concerned with the way consumers use the Internet and traditional stores prior to the purchase of a product. The suppositions are shown in Table 3. All suppositions start with the phrase “Before I buy this product in a store, ...” or “Before I buy this product on the Internet, ...”. The specific type of product was specified in the sentence. All suppositions had a 5-point Likert scale—ranging from ‘fully agree’ to ‘fully disagree’ and had the option to answer ‘does not apply’.

From the 1711 respondents that were randomly selected to receive the follow-up questions on online shopping, 1484 respondents answered the eleven suppositions. These respondents are all frequent online shoppers.

For many respondents (70–75%), the Internet plays a role prior to a product purchase (Fig. 2). This applies to purchases made in both traditional stores and online. More than half of the respondents used the Internet for getting new ideas, searching for product information, reading reviews, and comparing prices. Conversely, prior to purchasing a product online, people can also get product information by first visiting a traditional store. Certain percentages

Table 3 Results of the factor analysis that was performed on the eleven suppositions on browsing and selecting behaviour prior to a product purchase (N = 1231 respondents). (Color table online)

Suppositions	Factors		
	1	2	3
1 Before I buy this product in a store, I get ideas on Internet	0.277	0.054	0.875
2 Before I buy this product in a store, I search for product information on Internet	0.713	0.020	0.396
3 Before I buy this product in a store, I look at product reviews on Internet	0.811	0.110	0.195
4 Before I buy this product in a store, I compare prices on Internet	0.825	0.121	0.139
5 Before I buy this product on Internet, I get ideas on Internet	0.287	0.068	0.850
6 Before I buy this product on Internet, I search for product information on Internet	0.773	0.060	0.360
7 Before I buy this product on Internet, I look at product reviews on Internet	0.826	0.139	0.172
8 Before I buy this product on Internet, I compare prices on Internet	0.816	0.118	0.096
9 Before I buy this product on Internet, I want to see the product in a store	0.147	0.876	0.056
10 Before I buy this product on Internet, I go to store for advice	0.094	0.909	0.028
11 Before I buy this product on Internet, I compare products in store	0.090	0.909	0.056
% of variance	46.3	20.1	9.5
Cumulative % of variance	46.3	66.5	76.0
Eigenvalues	5.1	2.2	1.0

Extraction method: principal component analysis

Rotation method: Varimax with Kaiser normalisation. Rotation converged in five iterations

of these people prefer to first see a product in a store (29%), to compare various products in a store (29%), or to be advised by sales assistants in a store (20%).

It appears that people who state that they use the Internet in a certain manner prior to making an online purchase in fact use the Internet in the same manner prior to making a purchase in a traditional store (correlation is 0.9–1.0). This suggests that we might be able to identify groups of shoppers based on the browsing and selecting behaviour.

Gender is one of the characteristics in which such groups differ. Although the differences are not large, women use the Internet slightly more frequent than men do to get ideas for purchasing products. Men meanwhile use the Internet slightly more often than women to search for product information, to read reviews by other users/experts, and to compare prices. The extent to which a traditional store plays a preliminary role in online purchases is the same for both men and women.

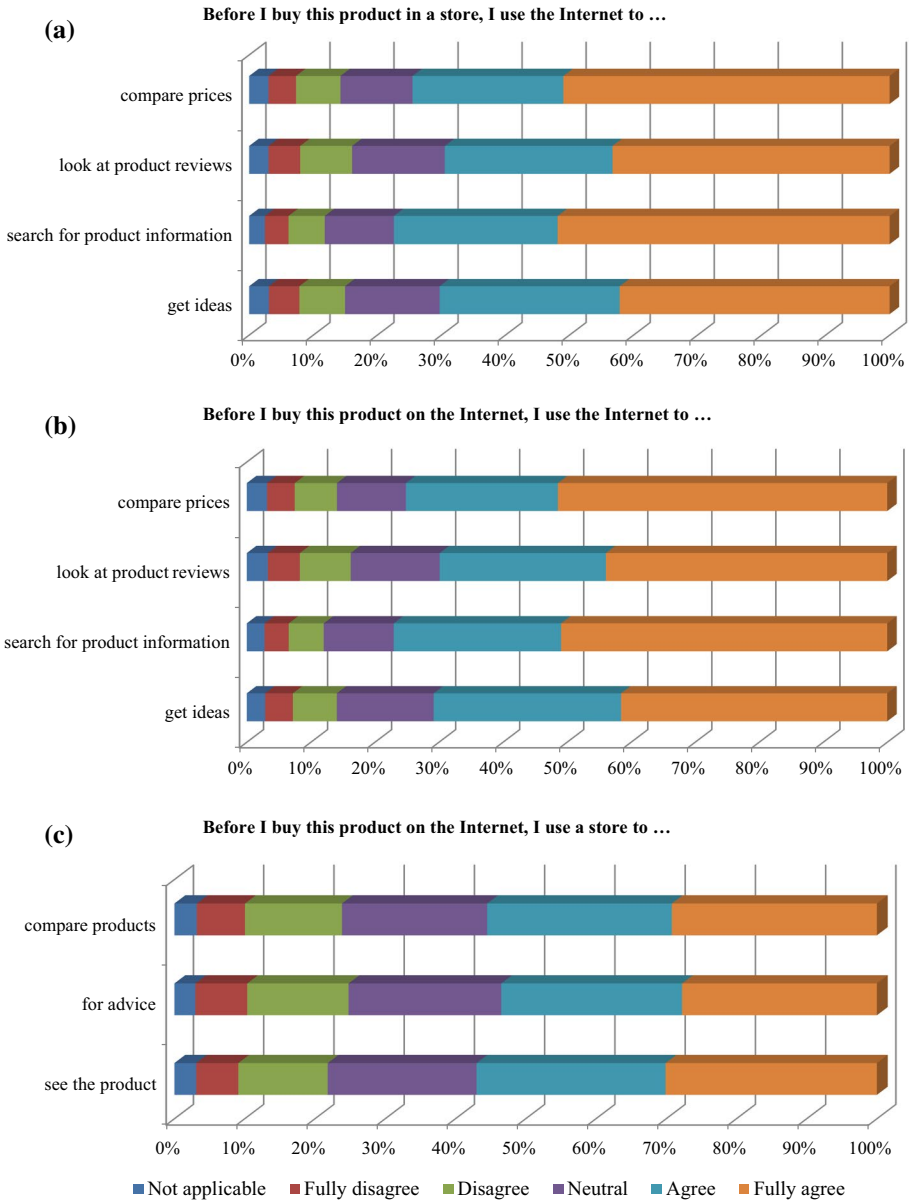


Fig. 2 a How people use the Internet prior to making a purchase in a traditional store; b how people use the Internet prior to making an online purchase; c how people use a traditional store prior to making a purchase online (N = 1484 respondents)

Factors relevant to pre-purchase shopping

In the previous section we found indications that different groups of respondents use the Internet and traditional stores differently before making a purchase. The browsing and

selecting of products takes place in a similar manner independent of whether the product is bought online or in-store. In this section we further investigate this by exploring the underlying factors related to browsing and selection behaviour prior to the actual purchase of a product. To understand how browsing and selecting either on the Internet or in-store relate to one another, factor analysis has been applied. In the analysis, we included the eleven suppositions introduced in the previous section. Respondents ($N=343$) who answered 'does not apply' to at least one supposition were excluded from the analysis. In total, data of 1231 respondents were used in the analysis.

Table 3 shows the rotated factor loading matrix. For ease of interpretation, the largest factor loading for each variable is highlighted. The three factors that were extracted, explain 76% of the total variation in the data. As required, the eigenvalues corresponding with the three factors are all greater than one. Only factor loadings larger than 0.4 are considered, because loadings greater than 0.4 represent substantive values (Stevens 2002).

Suppositions 2, 3, 4, 6, 7 and 8 load highly on factor 1 (green). Factor 1, accounting for 46% of the total variation, represents 'searching product information online before purchasing a product'. Suppositions 9, 10 and 11 load highly on factor 2 (orange) and all seem to relate to 'seeing a product before buying it'. Factor 2 explains 20% of the total variation in the data. Finally, suppositions 1 and 5 load highly on factor 3 (red). Factor 3 explains 10% of the total variation in the data and represents 'getting ideas for new products online'. Note that the underlying factors 1 and 3 indeed relate to the role of the Internet prior to a purchase and are independent of where the actual purchase is made (either in-store or online). These factors will be used in the next section to identify different groups of shoppers.

Identifying and characterising groups of shoppers

In the previous section we identified three main underlying factors related to the browsing and searching behaviour. Using these factors as a starting point, is it indeed possible to distinguish homogeneous groups of shoppers with different pre-purchase shopping behaviour? And if so, what characterises these groups in terms of personal and household characteristics? In this section we answer these questions.

Factor segmentation can by itself be used to form groups of respondents. This means that each respondent will be assigned to the factor, which she or he had the highest and most positive score. However, factor segmentation might fail to capture the multi-faceted nature of individuals. For example, people might have both a preference for 'searching product information online before purchasing a product' and a preference for 'getting ideas for new products online'. Therefore, we perform a *K-means cluster analysis* to determine different groups of shoppers. Besides identifying these different groups, we also characterise them in terms of personal and household characteristics. Furthermore, we determine if these groups differ with respect of the frequency with which they buy and sell products online and with respect to their perception of advantages and disadvantages of online shopping.

Distinguishing shopping clusters

K-means cluster analysis is used to identify groups of respondents with similar patterns of browsing and selecting behaviour. *K-means cluster analysis* is an iterative procedure that divides the population into *K* different clusters. Each case (respondent) is assigned to the

cluster for which its distance to the cluster mean is the smallest. The squared Euclidean distance, which is the sum of the squared distances over all variables, is used to determine the similarity between cases. The use of the Euclidean distance in the cluster analysis requires equal units of measurement for the different variables. In this case, cluster analysis is applied on the three factors identified in the previous section. The factors all have a zero mean and a standard deviation of one. The *K*-means cluster analysis procedure in SPSS is used.

In a *K*-means cluster analysis, the number *K* of clusters needs to be specified in advance. Based on the statistical output and the interpretability of the results, we chose the solution consisting of three clusters. The three clusters have more or less equal sizes (248, 396 and 587 respectively). The results of the final cluster analysis are presented in Table 4.

Based on the results from the factor and cluster analysis, three groups can be distinguished concerning people's shopping behaviour:

- Group 1: people in this group have a negative score for all three factors. These people do not search for product information (either online or in-store) before purchasing a product. They also do not search for new product ideas online.
- Group 2: people in this group have a positive score for factors 1 and 2, and a negative score for factor 3. These people search for information on the Internet as well as in a store prior to the purchase of a product. They do not search the Internet to get new ideas for products to buy.
- Group 3: People in this group have a positive score for factors 1 and 3, and a negative score for factor 2. For these people the Internet plays an important role before the purchase of a product, either to search product information but also as an inspiration for new products. Traditionally seeing a product before purchase is not important to them.

Personal and household characteristics of groups of shoppers

We further examined the respondents in the three groups with respect to some general personal and household characteristics. Do respondents in a group share certain personal and household characteristics and in which of these characteristics do they differ significantly from the general population? Table 5 shows the results. A cell is coloured green if the percentage of people having a specific characteristic within that cluster is

Table 4 Results of the cluster analysis that was performed on the respondents (N=1231 respondents)

Factor scores		Clusters		
		1	2	3
1	Searching online product information before purchasing a product	-1.58	0.34	0.44
2	Seeing a product before buying it	-0.22	0.42	-0.19
3	Getting ideas for new products online	-0.11	-0.88	0.64
% respondents		20	32	48
# respondents		248	396	587

Bold numbers represent the average scores for the factors on which the clustering was based

Table 5 Gender, age, level of urbanisation, income, educational level, personal net monthly income and household type of the three shopper groups (N = 1231 respondents). (Color table online)

	Total	Cluster		
		1	2	3
	100%	20%	32%	48%
Gender				
Male	47%	40%	46%	51%
Female	53%	60%	54%	49%
Age				
< 24 years old	12%	14%	10%	11%
25-34 years old	20%	19%	17%	23%
35-44 years old	22%	21%	21%	23%
45-54 years old	19%	22%	19%	17%
55-64 years old	14%	10%	16%	15%
65+ years old	14%	14%	17%	11%
Degree of urbanisation				
Extremely urbanised	18%	19%	17%	18%
Heavily urbanised	28%	27%	29%	28%
Moderately urbanised	24%	24%	26%	24%
Lightly urbanised	20%	22%	19%	20%
Non-urban	9%	8%	9%	10%
Household type				
Single	24%	31%	21%	22%
Couple no kids	31%	23%	33%	33%
Couple with kids	40%	41%	41%	39%
Single parent with kids	5%	4%	4%	6%

Table 5 (continued)

Other	0%	0%	1%	0%
Educational level				
No education or basic high school education	16%	19%	17%	14%
High school vocational training or high school preparatory education for polytechnic / university	51%	48%	51%	53%
Polytechnic or university degree	32%	33%	31%	33%
Net monthly personal income				
No income	11%	15%	10%	10%
€ 1,500,- or less	33%	28%	33%	36%
€ 1,501 - € 2,500	30%	27%	33%	30%
More than € 2,500	13%	16%	12%	12%
Unknown	13%	14%	13%	13%
Number of cars in household				
0	14%	16%	12%	14%
1	43%	44%	44%	42%
2	37%	35%	36%	39%
>2	6%	5%	8%	5%

Coloured cells refer to significant differences ($p < 0.05$)

significantly larger compared to the full population. Similarly, if the percentage of people is significantly smaller, a cell is coloured orange.

Cluster 1 contains significantly more women, singles, people from non-car-owning households and people with a low education. Cluster 2 contains significantly more elderly people, less singles (with or without kids) and people from households with a relatively high car ownership, while cluster 3 contains significantly more men, less people with a low education, more people between the age of 25 and 34 and more single parents. No clear conclusions can be drawn with respect to net monthly personal income. The level of urbanisation in each clusters is not significantly different from average level of urbanisation.

Table 6 Perceived advantages and disadvantages of online shopping in the three groups of shoppers (N = 1231 respondents). (Color table online)

	Total	Cluster		
		1	2	3
	100%	20%	32%	48%
Advantages of Internet shopping (% yes)				
I'm not restricted to opening hours	40%	50%	37%	38%
I don't have to go to a store	35%	42%	30%	35%
I have more choices	30%	29%	25%	34%
I have a more complete overview of products	23%	13%	22%	28%
It is easier to compare prices	39%	19%	42%	45%
I can buy products for lower prices	49%	37%	52%	51%
Products are delivered at home	47%	55%	47%	44%
Disadvantages of Internet shopping (% yes)				
I cannot hold a product and take a good look at it before I buy it	50%	46%	55%	47%
I have to pay online	8%	9%	10%	6%
I don't know when a product will be delivered	17%	20%	15%	16%
I want to have a product immediately; I don't want to wait for it	16%	17%	15%	17%
I have to be home for the delivery of products	33%	27%	33%	35%
I have to pay a fee to return products	35%	30%	33%	38%
I have to go out of the house to return a product	26%	21%	28%	26%
I have to go back to a regular store if something is wrong with a product	28%	18%	35%	28%

Coloured cells refer to significant differences ($p < 0.05$)

Perceived (dis-)advantages of online shopping per group of shoppers

Respondents were presented a number of possible advantages and disadvantages of online shopping and were asked to select at the most three of them. Table 6 shows the advantages and disadvantages respondents could choose from. Do respondents in a group experience similar advantages and disadvantages of online stopping and do they differ in that respect from the general population? How do the perceived advantages

and disadvantages of online shopping relate to the underlying factors of the different groups? Cells are coloured as in Table 5.

For all three groups, the perceived advantages and disadvantages of online shopping are in line with the main group characteristics found in “[Distinguishing shopping clusters](#)”:

- Respondents in group 1 are characterised by the fact that they don’t search for information either in-store or online before purchasing a product. The availability of a broader array of products to choose from does not seem to be important to this group. The main advantage of online shopping is the ease of buying from home (convenience seekers), that is not being restricted to opening hours, not having to go to a store and having the products delivered at home. Costs are less important to people in group 1 (less price conscious). They do not compare prices on the Internet or search the Internet to find out where a product can be bought at the lowest price. Also, having to pay when returning a product does not matter too much to them.
- Respondents in group 2 are characterised by the fact that they search for information on the Internet as well as in a store prior to purchase. These respondents appear to be more price conscious. To them, the main advantage of shopping online is being able to compare prices and buy products where they are cheapest. Visiting a store is also important to this group. Not being able to touch a product or take a look at it before purchase is seen as a disadvantage of online shopping. The same holds for not being able to go to a store if something is wrong with a purchased product. This is in line with the fact that not being restricted to opening hours or not having to go to a store are not considered as advantages of online shopping.
- Respondents in group 3 are characterised by the fact that the Internet is their main source of information about products and new product ideas. There is no need to see a product before it is bought or to get in-store advice. For them, the Internet offers them more choices and a better overview of products and facilitates price comparison and obtaining products at lowest prices. At the same time, having to pay for returning products is seen as a disadvantage. People in this group are price conscious and like a freedom of choice/variety of available products. Flexibility also seems to be important to them. Having to be at home for a delivery is considered to be a disadvantage.

E-shopping frequency of groups of shoppers

The respondents were asked how often they buy and sell products on the Internet and how often they searched for information about products and services online. Since this question was included in the main survey and not in the dedicated e-shopping questionnaire, no distinction was made between searching for product information, comparing prices, getting new product ideas and looking at product review (as was done in the eleven suppositions that we analysed in “[Factors relevant to pre-purchase shopping](#)” section). This should be kept in mind looking at the results presented in this subsection. Table 7 shows the results. The frequencies apply to all product categories. Cells are coloured as in Table 5.

Similarly to “[Perceived \(dis-\)advantages of online shopping per group of shoppers](#)” section, the results are in line with the main characteristics of each group:

- Respondents in group 1 are characterised by the fact that they don’t search for product information online or in-store prior to a purchase. When shopping, convenience is important to them. Indeed these respondents stated that they do not search for product

Table 7 Frequency with which people in each group of shoppers buy and sell products on the Internet or search for product information online (N = 1231 respondents). (Color table online)

	Total	Cluster		
		1	2	3
	100%	20%	32%	48%
Buying				
4 days per week or more	4%	4%	2%	5%
1 to 3 days per week	15%	15%	14%	17%
1 to 3 days per month	50%	48%	47%	53%
1 to 2 days per quarter	31%	34%	38%	25%
Selling				
4 days per week or more	4%	4%	3%	5%
1 to 3 days per week	7%	7%	8%	6%
1 to 3 days per month	21%	16%	22%	22%
1 to 2 days per quarter	26%	25%	26%	26%
less than 1 day per quarter or never	42%	48%	41%	41%
Searching product information				
4 days per week or more	31%	25%	25%	37%
1 to 3 days per week	43%	43%	44%	43%
1 to 3 days per month	20%	21%	25%	16%
1 to 2 days per quarter	5%	10%	5%	3%
less than 1 day per quarter or never	1%	2%	2%	1%

Coloured cells refer to significant differences ($p < 0.05$)

information multiple times a week. Also, they buy and sell products online less often. This might be related to the convenience aspect, implying that they only buy products online if needed (utilitarian shoppers).

- Respondents in group 2 are characterised by the fact that they search for information on the Internet as well as in a store prior to a purchase. Costs are important to them as well the possibility to visit a store. The importance of a store in the pre-purchasing stage also seem to imply that these respondents buy online less often. However, their online selling frequency is average. No conclusion can be drawn based on the search for product information. This might be due to the fact that for the specific question no distinc-

tion was made between searching for product information, comparing prices, and looking at product review on the one hand and getting new product ideas on the other hand.

- Respondents in group 3 are characterised by the fact that the Internet is their main source of information about products and new product ideas. They are cost conscious and prefer to have a broad variety of products to choose from. These respondents indeed search more often for product information online and also buy more often products online. Similar to respondents in group 2, their online selling frequency is average.

With the further characterisation of the identified groups of shoppers in terms of price consciousness, variety of available products, convenience and the importance of a shop in the shopping process, it appears that these groups closely resemble three out of the four groups of online shoppers distinguished by Rohm and Swaminathan (2004) (see also “[Theoretical background](#)” section).

Stated changes in shopping-related travel behaviour

The main research question to be answered in this paper is whether the different groups of shoppers, that we distinguished and studied in the previous section, have different shopping mobility patterns. To answer this question, we took two different approaches. In the next section we analyse shopping trips reported in the three-day travel diary, while in this section we take a closer look at changes in shopping-related travel behaviour stated by the respondents.

In the questionnaire, respondents were asked to compare their current shopping-related travel behaviour with that back in the day that they did not buy products online. The question is if—according to the respondents—their perceived shopping-related travel behaviour changed and if so what changed. Respondents could choose between the options shown in Table 8 (no restriction was placed on the number of options they were allowed to select).

Respondents in groups 1 and 2 more often stated that their shopping-related travel behaviour stayed more or less the same. Only the shopping-related travel behaviour of people in group 3 (the ones using the Internet to search for information and get new product ideas) did change, according to their statements. Part of these people shopped less often, while others shopped more often. Also, part of them stated that they shopped further from home.

The fact that shoppers in group 3 stated that they shop further away from home since they started shopping on the Internet, might be related to the fact that they more often browse the Internet for interesting, novel or unique items. When browsing online, potential consumers might become aware of the existence of sellers or items they were previously unaware of, possibly resulting in larger distances travelled and more trips made to obtain these unique items (Rotem-Mindali and Weltevreden 2013). This effect might even be increased if it concerns second-hand items, since these are more likely to be picked up personally by the buyer, leading to trips to otherwise unvisited locations, trips to locations that are often further away from the home address, and trips that are less likely to be chained for other purposes (Farag 2006). In the travel diary no distinction has been made between B2C and C2C shopping trips. Therefore, it is not possible to test this hypothesis. However, from the e-shopping questionnaire, we know that the frequency of C2C shopping is significantly smaller than that of B2C shopping.

Table 8 Stated changes in shopping behaviour in the three groups of shoppers (N=1231 respondents). (Color table online)

	Total	Cluster		
		1	2	3
	100%	20%	32%	48%
Shopping behaviour				
I shop similarly as before	33%	42%	37%	27%
I shop differently than before	67%			
I shop further from home	15%	10%	14%	18%
I shop closer to home	4%	5%	4%	4%
I shop the same distance from home	81%			
I shop less often	33%	29%	29%	37%
I shop more often	12%	11%	10%	14%
I shop as often as before	55%			
I shop shorter	12%	10%	12%	14%
I shop longer	2%	3%	2%	2%
I shop as long as before	86%			
I shop on different days and times	28%	25%	27%	29%
I shop on the same days and times as before	72%			
I use a different transport mode to go shopping	1%	0%	1%	1%
I use the same transport mode to go shopping	99			
I never shop in traditional stores any more	1%	0%	1%	1%
I still shop in traditional stores	99%			

Coloured cells refer to significant differences ($p < 0.05$)

Because of the stated changes in shopping-related travel behaviour, group 3 is potentially interesting when studying changes in shopping-related mobility. This holds specifically in future research when we will be able to compare changes in observed shopping mobility between 2013 and 2015 (MPN-waves 1 and 3) and relate that to changes in e-shopping characteristics (for example e-shopping frequency).

Actual shopping mobility

In the previous section we focussed on changes in shopping-related travel behaviour as they are stated (and perceived) by the respondents. Only shoppers in group 3 stated that their shopping-related travel behaviour actually changed with increasing opportunities to shop online. In this section, we determine if there are differences in actual shopping-related mobility between the identified groups of shoppers using the travel diary data. Firstly, we focus on average shopping mobility per person per day. Secondly, we consider the average travel distance per shopping trip.

Shopping mobility per person per day

833 of the 1231 respondents, included in the cluster analysis, completed the three-day travel diary and are therefore selected in the analysis of shopping-related mobility. All weekdays and Saturdays are included in the analysis. Sundays are excluded, because Sunday openings of shops differ strongly within the Netherlands (ranging from opening on every Sunday in larger cities to no Sunday openings at all in more rural areas). In total 2156 (3*833–343) travel days are included in the analysis. The distribution of 833 respondents over the three clusters strongly resembles the distribution of the 1231 respondents considered the previous sections (cluster 1 = 20% vs. 20%, cluster 2 = 33% vs. 32%, cluster 3 = 47% vs. 48%).

Table 9 shows the average number of trips, average distance travelled and average time travelled per person per day (pppd) for shopping trips and for all trips (all trip purposes).

Table 9 Average number of trips, average distance travelled (km) and average time travelled (min) per person per day (pppd) for the three clusters (N = 2156 travel diary days) for shopping and all trip purposes

Cluster	Shopping			All trip purposes			
		# Trips Pppd	Distance travelled pppd (km)	Time travelled pppd (min)	# Trips pppd	Distance travelled pppd (km)	Time travelled pppd (min)
1 (435)	Mean	0.7	3.3	9.2	3.4	40.9	71.9
	SD	1.2	10.2	23.4	2.4	65.4	70.7
2 (722)	Mean	0.8	4.0	11.4	3.5	37.2	69.0
	SD	1.2	17.6	29.3	2.6	54.3	62.0
3 (999)	Mean	0.8	3.0	9.3	3.4	40.3	73.0
	SD	1.2	9.6	20.6	2.6	58.7	72.1
Total (2156)	Mean	0.7	3.4	10.0	3.4	39.4	71.4
	SD	1.2	12.9	24.4	2.6	58.7	68.6

Table 10 Average distance for shopping trips (N = 1648) and all trip (N = 7980) for the three groups of shoppers

Cluster	Shopping trip distance			Trip distance (all trip purposes)		
	N	Mean	SD	N	Mean	SD
1	318	4.8	8.8	1622	12.4	22.6
2	563	5.3*	12.7	2688	11.3	22.5
3	767	4.0*	8.0	3670	12.3	24.2
Total	1648	4.6	10.0	7980	12.0	23.3

Bold numbers represent the average scores for the factors on which the clustering was based

*Significantly different ($p < 0.05$)

There appear to be no significant differences ($p < 0.05$) in either of these variables. This holds for both shopping trips and all trips.

Average distance per shopping trip

From the travel diary data, the average trip distance is computed for shopping trips (N = 1648) and all trips (N = 7980) made by the 833 respondents that were included in the previous analysis. Again, shopping trips made on Sundays are excluded from the analysis.

Shopping trips of people in group 2 have the largest average distance, which is in fact significantly larger than the average distance of shopping trips of people in group 3 (see Table 10). People in group 2 have a preference of seeing products or getting advice in a store. They seem to be willing to travel further to reach a shop that suits that purpose. People in group 3 however prefer to look for product information and new ideas online. If they need to visit a store, they are less inclined to travel. Note that the average trip distance computed over all trips is slightly smaller for group 2 compared to the other groups [although the differences with groups 1 and 2 are not significant ($p > 0.05$)]. This is likely to be due to the fact that group 2 contains relatively more elderly people (see Table 5), as elderly people are known for having shorter average trip distances (KiM 2014).

Note that although a significant portion of travellers in group 3 stated that they shop further from home since they shop on the Internet, that their mean shopping distance is significantly smaller than the mean shopping distance of people in group 2. This is not necessarily a contradiction: shopping trips might even have been smaller in the past. Also, differences in shopping distances within this group might be large.

Regression analysis results: impact of online shopping on shopping trip distances

In the previous section we found that the mean shopping trip distance is significantly larger for shoppers in group 2 compared to group 3. This raises the question what determines the length of shopping trips. Can this entirely be explained from trip characteristics (e.g., transport mode used and travelling companionship), from personal characteristics (e.g., age, gender, net personal income and education level) and/or from household characteristics (e.g., household size and number of cars in a household)? Or—as suggested by the differences in shopping trip distance between groups 2 and 3—can it

partly be explained from the frequency with which someone shops online and the way in which the Internet is used prior to a purchase (shopping cluster)? To study this, several linear regressions have been applied to all shopping trips, non-grocery shopping trips and grocery shopping trips for all respondents as well as to respondents in each cluster separately.

In the regression analysis, a distinction was made between grocery and non-grocery shopping, since shopping mobility differs significantly between both types of shopping. For example, distances for grocery shopping are shorter than those for non-grocery shopping. In the clustering/factor analysis a similar distinction was not made. We envisage that a separate clustering/factor analysis for grocery shopping would not have provided useful results. Grocery shopping is more routine and does often not involve a search for product information prior to a purchase and the return of products afterwards.

We started with the same 833 respondents, that were included in the cluster analysis and completed the three-day travel diary. Several selection criteria were applied on travellers and trips that are finally included in the regression analysis. Since car is considered as one of the available transport modes in the analysis, only travellers > 17 years old having a driver's license are included. The underlying assumption is that drivers make the choice to go by car not their passengers. The analysis is restricted to shopping trips made on Mondays to Saturdays. If the same shopping trip was made more than once during the three diary days, this trip is only included once in the analysis (although the number of identical trips over the three diary days was minimal). Shopping trips made with transport modes other than car, public transport, bike and walk were excluded. Only outbound trips (shopping trips from home to a store) are included in the analysis to avoid double counting of trips. Also, a small number of outliers was removed from the data. These were grocery shopping trips with exceptional trip distances (> 30 km). The analysis has finally been applied to 823 shopping trips from which 482 and 341 are grocery respectively non-grocery shopping trips.

Table 11 shows final linear regression results estimated on all shopping trips, non-grocery shopping trips and grocery shopping trips. Many personal characteristics, like age and gender, appear to be of no influence. As could be expected, transport mode is an important explanatory variable of shopping distance. Compared to car, shopping trip distances are significantly longer if public transport (including train) is used, while shopping trip distances are significantly smaller when these trips are made by bike or on foot. No explanation can be given for the fact that the coefficient is larger for grocery shopping than for non-grocery shopping (counterintuitive result).

If someone travels together with others to go shopping, resulting shopping distances are significantly longer for non-grocery shopping trips. This might be explained from the fact that grocery shopping is mandatory, while non-grocery shopping can be mandatory but is also considered to be a social activity. Groceries are therefore more likely to be bought closer to home and without others. Having young kids in a household implies that non-grocery shopping takes place closer to home. This is in line with Harms (2008) who found that parents with young kids have less shopping time available. Also, people with a higher education (and often a higher household income) shop further away from home.

Online shopping behaviour influences shopping trip distances for non-grocery shopping but not for grocery shopping. This holds for the frequency with which people shop online (see also “[E-shopping frequency of groups of shoppers](#)” section) as well as for the stated changes in shopping-related travel behaviour (shopping in a similar manner and shopping longer). Membership of a shopping cluster appears not to have a significant influence on shopping trip distances.

Table 11 Linear regression results estimated on all shopping trips, non-grocery shopping trips and grocery shopping trips (dependent variable is shopping trip distance). (Color table online)

	All shopping trips (N=823)			Non-grocery shopping trips (N=341)			Grocery shopping trips (N=482)		
	Unst. Coeff.	Sig.	VIF	Unst. Coeff.	Sig.	VIF	Unst. Coeff.	Sig.	VIF
(Constant)	4.83	0.00		6.56	0.00		3.50	0.00	
PT vs. car	6.14	0.00	1.04	3.59	0.06	1.06	8.53	0.00	1.04
Bike vs. car	-2.96	0.00	1.29	-4.46	0.00	1.24	-1.88	0.00	1.33
Walk vs. car	-5.00	0.00	1.17	-7.00	0.00	1.14	-3.49	0.00	1.21
Travelling together vs. alone	1.61	0.00	1.18	2.51	0.01	1.20	0.68	0.11	1.19
Kids < 12 years old in household vs. none	-0.92	0.06	1.08	-2.38	0.02	1.16	0.11	0.80	1.08
High education vs. none of low	1.36	0.00	1.04	2.67	0.00	1.13	0.72	0.06	1.03
Frequent vs. non-frequent online shoppers	1.74	0.00	1.06	3.15	0.01	1.14	0.53	0.30	1.06
Shopping similarly vs. not	-0.29	0.52	1.07	-0.81	0.36	1.04	-0.03	0.93	1.11
Shopping longer vs. not	2.67	0.13	1.03	9.12	0.05	1.05	0.92	0.50	1.04
cluster 2 vs. cluster 1	-0.31	0.61	1.89	-1.42	0.23	1.91	0.44	0.42	1.97
cluster 3 vs. cluster 1	-0.49	0.39	1.92	-0.80	0.49	1.90	-0.22	0.67	2.00
R squared	0.18			0.21			0.21		

Green means $p < 0.01$, yellow means $p < 0.05$ and orange means $p < 0.1$

The variance inflation factor (VIF) quantifies the severity of multi-collinearity in the regression analysis

Online shopping frequency has a significant influence on non-grocery shopping trip distance, but not on grocery shopping trip distance. This might again be due to the fact that grocery shopping is mandatory and non-grocery shopping can be mandatory as well as non-mandatory. Consumers who search online for interesting products and bargains may become cognizant of the existence of retailers they were previously unaware of (e.g., Steinfield et al. 2001; Currah 2002; Boschma and Weltevreden 2005). As such, online searching may result in shopping trips that would not have occurred without the Internet and have increased trip lengths, as these interesting retailers are often not located in the vicinity of people’s homes (Mokhtarian 2004; Farag 2006). A small part of the non-grocery shopping trips in the sample probably relates to C2C e-commerce instead of B2C e-commerce. Buying from strangers entails the risk of a product not being sent or that the quality of the item does not match the buyer’s expectation (Yamamoto et al. 2004). Although sites like e-bay take locations of sellers and buyers into account (nearest seller is listed first), distances to private sellers are on average larger than those to traditional stores (Farag 2006). Grocery

shopping is mandatory and is therefore done in an easy way and often close to home. Therefore, it is likely that grocery shopping trip distance is not influenced by online shopping frequency. Further note that online shopping frequency mainly refers to non-grocery shopping. In the Netherlands, only 7% of all Dutch consumers have purchased groceries online (www.usp-mc.nl) and only 1% of the total sales in the food-sector is earned online (<http://www.sprout.nl/artikel/hier-ligt-online-omzet-voor-het-oprapen>).

With respect to the two suppositions about stated changes in shopping-related travel behaviour, it appears that people who stated to shop longer since they also shop online, have a longer shopping distance than those who indicated not to shop longer. If you intend to have a longer shopping spree, you might be inclined to travel further to do so.

When online shopping frequency is included as an explanatory variable, membership of a shopping cluster appears not to have a significant influence on shopping trip distances. At the same time, regression results are slightly better when online shopping frequency is included compared to the inclusion of shopping cluster membership. Furthermore, the estimation of separate linear regression models for each cluster did not provide additional information compared to the model estimated on all travellers (results not shown in this paper).

The regression results do not necessarily imply that shopping mobility does not differ between clusters of e-shoppers. In hind side, we question whether a regression analysis is the right technique to use. Also, other refinements might be necessary as well. Shopping is a complex process with possible complementarity and substitution effects appearing at the same time. In a regression analysis only the aggregated effect of these complementarity and substitution effects is considered. Furthermore, in-store shopping frequency is not included in the analysis, since that variable was not available in the 2013 MPN data. Inclusion of both in-store and online shopping frequency might lead to more distinctive clusters. Does for example a high frequency of online shopping always implies a low frequency of in-store shopping or not? Or can people both have a high frequency for online and in-store shopping? Finally, a classical clustering analysis assigns respondents to one single cluster. A latent clustering analysis provides more flexibility by assigning a cluster membership probability to each respondent for every cluster. These and other possible modelling improvements will be considered in future research.

Conclusions

The main research question in this paper was how personal shopping mobility can be characterised when differentiating its constituent stages, specifically browsing/orienting and selecting products, and how this is affected by e-shopping. To answer this question, we investigated this using recently collected data from the *Netherlands Mobility Panel* [in Dutch: MobiliteitsPanel Nederland (MPN)]. In order to determine this differentiated impact, we first identified homogeneous groups of shoppers with different pre-purchase shopping behaviour using a factor and cluster analysis. We did so, because we envisaged that differences in pre-purchase shopping processes, result in differences in shopping-related mobility. The identified groups differ considerably with respect to personal and household characteristics, the frequency with which they buy and sell products online and in their perception of (dis-)advantages of online shopping. Table 12 provides an overview of the group characteristics.

Table 12 Overview of characteristics of three identified groups of shoppers

Cluster	1	2	3
Use of the Internet prior to a purchase	Do not search for product information (either online or in-store) before a purchase Do not search for new product ideas online	Search for information online and in a store prior to a purchase Do not search for new product ideas online	Internet plays an important role before a purchase either to search product information and as an inspiration for new products Seeing a product in a store before a purchase is not important
Personal characteristics	More women More singles Lower education	More elderly people Less singles (with or without kids)	More men Less lower education More people between the age 25 and 34 More single parents
Household characteristics	More non-car-owning households	More households with a higher car ownership	–
Shopping preferences	Convenience seekers Less price conscious	More cost conscious Importance of a store prior to a purchase	Cost conscious Freedom of choice/large variety of available products flexibility
Online buying/selling frequency	Less often buy and sell products online	Less often buy online Online selling frequency is average	More often buy more products online Online selling frequency is average

Also differences in shopping-related mobility were found. According to the shoppers themselves, 50% (groups 1 and 2) did not change their shopping-related travel behaviour since they started shopping online. The other 50% (group 3) stated that their shopping-related travel behaviour had changed since they shop online. Part of them shopped less often, while others shopped more often. Also, part of them stated that they shopped further from home. The analysis of actual shopping mobility using the travel diary data showed only minor differences in shopping-related travel behaviour between the identified groups.

From the multi-variate linear regression results indicate that e-shopping characteristics influence trip distances. The frequency with which people shop online as well as certain stated changes in shopping-related travel behaviour (shopping in a similar manner and shopping longer) turn out to influence non-grocery shopping trip distance, but not grocery shopping trip distance. Membership of a shopping cluster appears not to have a significant influence on shopping trip distances. This might be due to the use of a regression analysis to model shopping mobility as we discussed in the previous section.

In most of the analysis presented in this paper (except for the regression analysis that distinguishes grocery and non-grocery shopping) we do not make a distinction between different product categories. In principle such a distinction can be made, since the necessary information is available. Looking at the last 3 months, people mostly bought books, shoes, clothes and underwear, theatre and cinema tickets, and trips online. Garden appliances, furniture and stock/options were only purchased by a small amount of people. Also, the number of people that bought groceries online is relatively low (8%) specifically compared to for example the UK and Germany. Since for certain product types the number of respondents will be too low, different product types need to be aggregated into larger groups in order to be useful in a more detailed analysis. Such an analysis is part of future research.

We may conclude that considering the different stages of online shopping separately indeed provides additional insights into the impact of online shopping on mobility.

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