

12th International Conference on Transport Survey Methods

Home Deliveries and Their Impacts on Travel: Capturing Shopping Behavior and Attitudes towards Shopping in a Travel Behavior Skeleton Approach

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Abstract

Attractive options such as home delivery services (e-commerce) may shift the travel for shopping purposes to a more voluntary activity. Research is faced with the question which (latent) characteristics of people might indicate a higher potential to use home delivery services as a substitute for individual travel. Therefore, an appropriate survey instrument is needed which in its function fully depicts both individual travel and particular shopping behavior. Further, it should be supplemented by psychological aspects relating to shopping behavior and shopping-relevant transport modes. This work presents an extensive literature review and a survey approach which has been exploratively tested.

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Peer-review under responsibility of the International Steering Committee for Transport Survey Conferences (ISCTSC)

Keywords: Survey approach, attitudes, shopping behaviour, travel skeleton

1. Introduction

Electronic commerce (e-commerce) provides consumers with new opportunities to meet their demand for goods of different kind and it can significantly contribute to reduce people's need for travel. In repeated national household travel surveys such as the "Mobility in Germany" (MiD) or the "German Mobility Panel" (MOP) changes in travel key figures could be observed in recent years, even in the period before the Covid19-pandemic. For example, the average number of trips per day shows a slight tendency towards a decrease, in particular for men and younger persons with 3.5 and 3.1 trips per day in 2002 and 2017, respectively (infas 2019). A substitution of individual shopping trips by delivery of goods might be one possible explanation amongst others and is therefore set to the focus of research.

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Based on early research of Salomon (1986), Mokhtarian (2002) introduced four hypothesis regarding the effects of e-commerce on travel behavior: substitution implies that physical trips are replaced or shortened, complementarity prevails if additional trips are created, modification describes the changing of spatial and temporal travel patterns and neutrality is present if the use of home deliveries and travel behavior are not interrelated. These hypotheses and the growing market of e-commerce were the beginning of a series of empirical studies dealing with shopping behavior. However, the large number of investigations available differ methodologically and in their focused objectives (Rotem-Mindali and Weltevreden 2013). Further, they are built up on different data that are based on various survey concepts, which highly influences the results received (Cao et al. 2010). These findings are supported by the conclusions of Weltevreden (2007) and Cao (2009): they claim to complement empirical surveys about shopping, which mainly concentrate on shopping behavior, with attitudes towards shopping and multiple dimensions of travel behavior (e.g., mode choice for shopping purposes).

Since attitudes and norms are of importance to understand travel behavior (Dijst et al. 2008; Kroesen et al. 2017), their explanatory potential regarding travel behavior for the shopping purpose also attracts the attention of researchers (Cao and Mokhtarian 2005). For example, evidence for the adoption of online-shopping being rather related to individual's experiences than to their socio-demographics can be found (Goldsmith and Goldsmith 2002; Hernández et al. 2011). Furthermore, a positive attitude towards shopping in-store promotes trip making (Lee et al. 2017) and a positive attitude towards online shopping therefore might indicate a higher potential to use home delivery services as a substitute for travelling by oneself. Concluding, the attitudes of people towards shopping are a relevant aspect in the investigation of home deliveries and their impacts on travel.

Considering multiple dimensions of travel behavior is relevant, since shopping behavior is a specific and relevant part of individual's overall travel in everyday life. Therefore, it is essential to go one step beyond the sole consideration of travel for shopping purposes. For example, general car use in everyday life is relevant to investigate in the context of shopping behavior, since the car is a relevant means of transport for shopping purposes (Mattioli et al. 2016; Mackett 2003). However, it has to be emphasized that people are dependent on their private car for several other reasons, such as their attitudes towards the car or for reaching destinations of other activities (Behren et al. 2018). It is a hypothesis in research that the delivery of goods by third-parties can function as potential supplement for car-free households or support a car-free lifestyle. As a result, it is relevant to collect information about people's car use patterns in everyday life and their attitudes towards different means of transportation. This will contribute to get an impression on how open-minded people might be to forgoing car use in general and if the use of delivery services can serve as new option that in the long-term even might affect the future of car ownership.

Obviously, for appropriate analyses an integrated picture of people's travel and shopping behavior and a wide range of attitudes towards modes and shopping must be captured. It becomes clear that in this context the challenge to achieve the scientific objective lies in the availability of such data. The body of literature in the context of online shopping and its influence on individual travel is large; however, findings and interpretations mainly focus on aspects of content rather than on the type and quality of data needed to address the research questions. By now, a detailed evaluation of different survey concepts in this context is to our knowledge still missing. Further, an appropriate survey instrument is required that, on the one hand, captures the overall longitudinal travel behavior of individuals and, on the other hand, also integrates attitudes towards shopping and towards different means of transportation.

Addressing this gap, the paper is structured as follows: first, we give an extensive tabular overview on the related literature – based on the situation pre-Covid. We therefore provide a classification of studies into four groups based on their applied survey concepts and research context. Second, we describe the development and application of a new theoretical and empirical robust survey concept. In its function, it is capable to generate appropriate data to investigate the relationship between the use of delivery services, self-performed trips regarding shopping purposes, also in terms of individual travel patterns in general. In particular, the attitudes of people towards different means of transport as well as online shopping and shopping in general are considered to understand behavior patterns towards shopping travel. Third, we present the results, since the instrument has been tested for comprehensibility and applicability by implementing it online and collecting data from a sufficiently large sample. This part contains some initial descriptive analyses and a common factor analyses to identify latent variables from the involved attitudes. Finally, we discuss our results and the limitations of this work and draw a conclusion including a reference to further research.

We have to mention, that the review of literature as well as the development of our survey concept has been based on the state of the art and the situation pre-Covid and is basically mainly methodologically oriented. As shown by

different studies e-commerce was greatly accelerated by the spreading of the virus (Bhatti et al. 2020). E-commerce allowed customers to avoid the risks of an infection and to overcome the closure of shop. This resulted in a substantial change in mobility and travel (e.g. Villa, Monzon 2021). However, this bulk of literature we will not address in this article.

2. Literature Review

The literature examines the topic of e-commerce from multiple perspectives and the body of studies in this context is continuously growing. As preliminary work for this study, we have conducted an extensive systematic literature review and provide a subdivision of existing research in four groups by extending the work from Cao (2009):

- Meta-analysis about shopping studies
- Empirical shopping studies
- Shopping in the context of travel behavior studies
- Shopping studies incorporating attitudes

The following sections provide further insights into these subgroups. This overview does not claim to be exhaustive but includes the most relevant studies or links to studies in these fields. As a result, the basic state of research according to the authors' knowledge is adequately represented.

2.1. Meta-analysis about shopping studies

Meta-analysis about shopping studies are conceptual studies in the context of online shopping and its impact on individual travel. They summarize the literature, make conclusions about relevant findings, present conceptual approaches, and derive statements for future research. Noteworthy are earlier work of Mokhtarian (2004), Visser and Lanzendorf (2004), Cao and Mokhtarian (2005), as well as Cao (2009) and the work of Rotem-Mindali and Weltevreden (2013) which is slightly more recent. Overall, the conceptual studies explain relevant framework conditions such as differences in definitions, e.g., for the online shopper and the impacts on the transport system. Further, they summarize present advantages of shopping online and in-store, introduce the fragmentation of the shopping process, and derive impacts on individuals at different temporal horizons, e.g., in the short-, mid- and long-term. Some of these conclusions had been used as basis for the conceptualization of the empiricism of shopping studies.

2.2. Empirical shopping studies

Empirical shopping studies are quantitative and have collected and analyzed shopping-related survey data. The associated surveys mainly concentrate on shopping behavior (e.g., online and in-store shopping) and socio-demographics. The analyses in these studies are highly focused on these quantifiable effects of e-commerce on individual travel for shopping purposes on trip-level. However, empirical shopping studies in general prioritize to the results in terms of changes in mobility behavior according to the four hypotheses.

In our literature review, we aim to introduce the survey concepts and aggregate related studies based on the same sample data. A previous overview on such empirical shopping studies is provided by Cao (2009) and Weltevreden (2007). Since the topic of e-commerce has recently become more relevant, we have updated the overview and supplemented it with further relevant studies (Table 1). The overview is based on the survey data that has been used for the analyses in the single studies.

For completeness, a few qualitative studies in this area are to be mentioned, since they also contribute to research in the mentioned context (Ibrahim 2003; Wiese et al. 2015; Wiegandt et al. 2018). Using interviews, these examine the determinants of shopping and mode choice for shopping, as well as life stages and how they relate to belonging to a particular shopper type.

Table 1: Overview of empirical shopping studies[†]

Reference	Data	Thematic focus	Att. Tech.	Method of analysis
Lenz et al. (2015)	Shopping panel data (n=1,945), Germany, 2003 and 2007	Changing physical shopping behavior (trips) due to starting to buy online	NO NO	Descriptive analysis
Rotem-Mindali and Salomon (2007); Rotem-Mindali and Salomon (2009); Rotem-Mindali (2010)	Face-to-face interviews (n=486), Tel-Aviv, Israel, 2004	Consumers' choice to buy online and impact of information technology on shopping travel behavior	NO YES	Descriptive analysis; pre-analysis such as binary logit regressions; ordinal logit regressions
Weltevreden and van Rietbergen (2007); Weltevreden and Rotem-Mindali (2009)	Online shopping survey (n=3,074), The Netherlands, 2006	Impact of city center attractiveness on shopping trips; Quantification of the impact of e-commerce on trips for shopping	NO NO	Multinomial logistic regression, binomial logistic regression; descriptive analysis
Ren and Kwan (2009)	Online shopping survey (n=392), Columbus Metropolitan Area, Ohio, US, 2000	Impact of geography on e-shopping adoption	NO YES	Logistic regression, negative binomial regression, linear regression
Maat and Konings (2018)	Personal survey (n=534), Leiden, The Netherlands, 2014	Spatial accessibility or innovation as reason for online shopping dependent on products	YES YES	Binary logit model, Fractional logit models
Papola (2006)	Revealed and Stated preference (n=319), England, Holland, Italy, Greece and Israel, 2010	Prediction on the number of trips for shopping and non-work-related activities in the future influenced by e-shopping	YES NO	Regression model
Hsiao (2009)	Personal interviews with stated preference questionnaires (n=300), Taiwan, 2002	Choice between online shopping and physical store shopping	NO NO	Binary logit
Schmid et al. (2016)	Stated preference experiments (n=339), Zurich, Switzerland, 2015	Choice between online shopping and physical store shopping	YES NO	Integrated Choice and Latent Variable model, Descriptive analysis

Notes: Att. = Psychological items regarding attitudes, Tech. = Psychological items regarding tech-savvy, YES = available, NO = not available

However, the interest of research exceeds this simple quantification and requires a more generalized understanding of the context of people using home deliveries and their general travel behavior (Cao 2009). Most surveys in the context of shopping behavior research record the shopping behavior with a high degree of detail, but neglect to fully capture the travel behavior of individuals. In addition, the samples of empirical shopping studies are often limited due to the data; in many cases data originate from samples that are solely recruited from people who have adopted online-shopping (Rotem-Mindali and Weltevreden 2013) or data collection is limited to very specific spatial environments (Shi et al. 2019; Lee et al. 2017; Goldsmith and Goldsmith 2002). For this reason, the following section deals with studies performed in the context of travel behavior. In addition, only some of the studies have incorporated attitudes towards shopping into their survey concept. The role of attitudes will be discussed in detail in the section after next.

2.3. Shopping in the context of travel behavior research

An alternative to studies with sole focus on shopping travel is the use of a travel behavioral framework, which extends the collection of data with information of trips for other purposes than shopping and therefore more

[†] Studies earlier than 2007 were not listed since Weltevreden 2007 provides an extensive overview until then.

comprehensively captures the travel patterns of individuals. The advantage of this is the possibility to derive statements on activity-based shifts and multidimensional effects on travel induced by individual's use of e-commerce. In related literature this framework is mostly mapped by the application of travel diaries. Table 2 gives a summary on surveys with such a framework.

In the context of travel behavior, one of the first studies in this field was presented by Gould and Golob (1997). For their empirical data base they developed and applied a 2-day activity diary involving travel and in-home activities with a duration of at least 30 minutes. Their results indicate that time savings for shopping travel due to home shopping could be converted to other activities. This kind of study can be evaluated as hybrid solution, since it is an empirical shopping study that has integrated a travel diary. Further examples are the studies of Farag et al. (2007) with a 2-day travel diary or Douma, Wells (2004) with a 4-day travel diary.

Data of household travel surveys (HTS) had been also used to estimate impacts of e-commerce on the overall travel behavior. Basically, traditional HTS represent a suitable alternative to empirical shopping studies, since they focus on people's overall travel behavior and survey in large samples. Some of them have expanded their questionnaire with a few questions about online shopping. In the following, relevant examples are introduced: Corpuz and Peachman (2003) added questions to the Sydney Household Travel Survey about the frequencies the internet was used to purchase or order goods or services in the last month and the main means of transport people would have most likely used for a trip to the shop instead; Ferrell (2005) used the San Francisco Bay Area Travel Survey about time use to ask the respondents regarding the amount of time spent, e.g., for online shopping and also for traveling; Zhou and Wang (2014) used the National Household Travel Survey data in the U.S. for structural equation models (SEM) which includes few questions on the frequency of online shopping and web use besides a 1-day travel diary; Farag et al. (2003) combined data from the 1-day travel diary in the Netherlands National Travel Survey with separately collected data regarding shopping behavior by using the information about the respondents' place of residence and sociodemographic criteria to bring the independent data sets together; Hoogendoorn-Lanser et al. (2019) complemented the Netherlands Mobility Panel with questions about the frequency of internet use to search for information or purchase 21 different types of products. Further, a detailed report regarding the product people had purchased in their last online order were questioned. Concluding, it is state-of-the art for HTS to use travel diaries with a scope of one to three days.

A more extended data collection is presented by Ding and Lu (2017) and Spurlock et al. (2020). The former applied a GPS-based method to capture the mobility behavior over a 7-day period in the greater area of Beijing and combined this recording with questions regarding in-store and online shopping behavior. With their approach they were able to investigate the relations of online and in-store shopping to the overall travel behavior of individuals, represented for example by trip chaining patterns and time spent for other leisure activities. However, attitudes are missing and have been pointed out for further research from the authors. Spurlock et al. (2020) introduced data from a web-based survey as part of the WholeTraveler Transportation Behavior Study. Herein the questions related to a variety of demographic, preference, life history, and personality and psychological factors as well as technology adoption and interest. However, their analyses are designed to quantify the number of trips savings while the use of the psychological factors is not included. As a result, these two studies have to be highlighted, since a more holistic approach is used and the view on mobility is extended.

As a result, although some HTS have been expanded with shopping-related questions, an in-depth analysis of causal relationships between the delivery of goods and individual travel is still lacking. The main limitation of this kind of surveys results from a lack of detailed information on shopping-related aspects. This is due to both shopping travel behavior and especially online shopping are usually of secondary importance within HTS. Although some recent travel behavior studies made contributions to extend their questionnaire, they nevertheless miss to incorporate attitudes so far. However, these were identified as relevant to the adoption of online shopping (Cao and Mokhtarian 2005; Weltevreden 2007). Moreover, traditional travel behavior surveys, which are applied with travel diaries, are very time-consuming and associated with a high burden for the respondents (Nakamya et al. 2007). The scope of HTS is already sufficiently comprehensive so that an expansion with additional questions is hardly within the possible range of feasibly acceptable burden for the respondents. Finally, since online shopping and also shopping in stores is an infrequent activity a short-term travel diary is not appropriate to adequately capture shopping activities and relate them to the overall travel behavior. Casas et al. (2001) also concluded that longitudinal data is required to answer whether online shopping does substitute for traditional shopping trips or not.

Table 2: Overview on travel-related frameworks to investigate shopping behavior

Reference	Data	Thematic focus	Att. Tech.	Method
Gould and Golob (1997)	<i>Hybrid</i> : Shopping survey with a 2-day travel diary (n=7,000), Portland Metropolitan Area, U.S., 1995	Substitution of shopping trips	NO NO	Descriptive analysis
Farag et al. (2007)	<i>Hybrid</i> : Shopping survey with a 2-day (weekend) travel diary (n=826), The Netherlands, 2003	Relationship between online shopping and shopping trips	YES YES	SEM
Douma, Wells (2004)	<i>Hybrid</i> : Online shopping survey with 4-day travel diary (n=446), Minnesota, U.S., 2001	Patterns between internet use and shopping trips	NO NO	Descriptive analysis
Ding and Lu (2017)	<i>Hybrid</i> : GPS-based 7-day activity travel survey + questionnaire on socio-demographic characteristics (n=791), Shangdi area of Beijing, 2012	Relationship between online shopping, in-store shopping and overall travel behavior	NO NO	SEM
Casas et al. (2001)	1-day travel diary of the household travel survey of residents of Sacramento (n=9,132), California, U.S., 1999	Impact of Shopping Via Internet on Travel for Shopping Purposes	NO NO	Descriptive analysis
Corpuz and Peachman (2003)	1-day travel diary of the Sydney Household Travel Survey (HTS) (n=6,785), Sydney, Australia, 2000	Impacts of internet usage on travel behavior	NO NO	Descriptive analysis
Farag et al. (2003)	1-day travel diary of the Netherlands National Travel Survey (NTS) (n=130,000), 1998, combined with an e-shopping dataset by Multiscope (n=2,190), 2001, The Netherlands	Impacts of the use of online-shopping on personal travel behavior	NO NO	Descriptive analysis
Ferrell (2004), Ferrell (2005)	1-day travel diary of the Bay Area Travel Survey (BATS) (n=14,563 households), San Francisco, 2000	Effects of online shopping on shopping travel behavior; Peoples activities considering time use	NO NO	Own models; SEM
Zhou and Wang (2014)	1-day travel diary of the National Household Travel Survey (NHTS) (n= 283,054), U.S., 2009	Relationship between online shopping and shopping trips	NO NO	SEM
Hoogendoorn-Lanser et al. (2015), Hoogendoorn-Lanser et al. (2019)	Mixed: Shopping survey + Netherlands Mobility Panel (NMP) (n=1,711), The Netherlands, 2013	Impacts of e-commerce on overall travel behavior; Fragmentation of shopping process	NO NO	Descriptive analysis
Spurlock (2020)	Online survey as part of the WholeTraveler Transportation Behavior Study (n=1,045), Bay Area California, US, 2018	Influence of socio-demography on household shopping trips	YES YES	Multinomial Logit Results

Notes: Att. = Psychological items regarding attitudes, Tech. = Psychological items regarding tech-savvy, YES = available, NO = not available

2.4. Shopping studies incorporating attitudes

Finally, the literature already refers to a considerable number of studies addressing attitudinal questions referring to shopping behavior (Table 3). Psychological items are used for different applications such as the segmentation of “shopping types” (Swinyard and Smith 2003; Mokhtarian et al. 2009) or for modelling behavioral structures, e.g. with SEM (Zhou and Wang 2014). The former deal with the identification of suitable attitudes for the identification of factors and subsequent segmentation purposes; the latter have mainly to be classified into the context of empirical shopping research.

The focus of the literature review regarding shopping attitudes in this study is on psychological items and their application in different research settings, since different attitudinal constructs were derived from explorative studies on attitudes towards shopping (Swinyard and Smith 2003; Mokhtarian et al. 2009). For example, the enjoyment of shopping is a common constructs to explain in-store shopping behavior (Lee et al. 2017). Additionally, normative

attitudes are relevant for shopping in local stores: shoppers with a greater awareness for the local economy were more likely to frequently shop in the downtown area (Lee et al. 2017). Further, the social or personal norm was found to be relevant for the adoption of online shopping. Chang et al. (2005) found attitudes towards online shopping had a positive impact on the intention of its use. Finally, there is evidence that the adoption of online shopping is not that much related to socio-demographics but to experience with shopping on this channel (Hernández et al. 2011; Goldsmith and Goldsmith 2002).

Table 3: Studies investigating attitudes in the context of shopping behavior

Reference	Data	Thematic focus	Methodology & Results
Goldsmith and Goldsmith (2002)	CAWI with students (n=566), U.S., 2000	Distinction of consumers on the basis of attitudes	EFA, 25 items, 6 factors
Swinyard and Smith (2003)	CAWI (n=1738), U.S., 2001	Identification of shopping type by using attitudes with focus on online shopping	Cluster analysis, PCA, 38 items, 6 factors,
Rohm and Swaminathan (2004)	CAWI (n=429 online shoppers, n=101 offline shoppers), Northeast U.S., unknown	Distinction of consumers on the basis of shopping motivations	EFA, 18 items, 4 factors
Mokhtarian et al. (2009)	CAWI (n=966), Davis and Santa Clara, Northern California, U.S., 2006	Identification of shopping type by using attitudes, e.g. towards shopping in-store and online as well as technology and travel in general	EFA, 42 items, 13 factors, cluster analysis
Bagdoniene and Zembyte (2009)	CAWI (n=277), Lithuania, 2007	Identification of factors motivating or demotivating respondents to shop products/services online	PCA, 12 items, 10 factors
Walczuch and Lundgren (2004)	PAPI with U.S. students (n= 149), The Netherlands, unknown	Psychological aspects of consumer trust in e-retail	Regression analysis, 9 items, 1 factor
Hsu et al. (2006)	CAWI with students (n=201), Taiwan, 2001, 2002, and 2003	Intention to continue to shop online	SEM (TPB); CFA, 34 items, 11 factors
Cao et al. (2010), Cao et al. (2012), Cao (2012)	CAWI (n=539), Minneapolis-St. Paul metropolitan area, 2008-2009	Impact of online shopping on in-store shopping; Interactions between online searching, online buying and in-store shopping; additionally considering the steps of the process	Ordered response models, SEM, and binary logit model each including psychological factors; EFA, 15 items, 4 factors
Hernández et al. (2011)	CATI (n=255), Spain, 2009	Influence of sociodemographic aspects on online shopping behavior	SEM (TAM); CFA, 20 items, 7 factors according to TAM
Lee et al. (2017)	CAWI (n=2,043), Davis, California, US, 2000	Relationship between online and in-store shopping frequency	Ordered response models including psychological factors; EFA, 28 items, 6 factors
Joewono et al. (2019)	PAPI (n=520), Indonesia, 2017	Relation between the built environment and in-store shopping activities and mode choice in developing countries	Classification analysis; PCA, 18 items, 5 factors
Xi et al. (2020)	Face-to-face interviews with Internet users (n=881), Nanjing, China, 2015	The interaction between e-shopping and store shopping	SEM; EFA, 17 items, 5 factors

Notes: EFA = Factor Analysis, PCA = Principal Component Analysis, CFA = Confirmatory Factor Analysis, SEM = Structural Equation Modelling, CAWI = computer-assisted web-interview, PAPI = paper-and-pencil interview, CATI = computer-assisted telephone interview

Summarizing, the literature review has shown that an extended body of literature dealing with the issue of online shopping and its impact on individual travel exists. The overview clearly points out that there is still a need for further research, especially with regard to the collection of appropriate data. In summary, the following results can be suggested:

- empirical shopping studies do not capture travel behavior in the required scope;
- studies on the basis of travel diaries do capture mobility in a too short period (only few days);
- extensive HTS with integrated questions on shopping behavior do not collect enough data about shopping;
- many studies still do not include attitudes towards both shopping in-store and online.

Finally, conceptual studies have identified relevant characteristics and problems when conducting research in this field but the consideration of their results is often missing as input for research designs. As a result, we contribute to this within this paper and present a proposal for a feasible multidimensional survey instrument.

3. Methodology

In this section, we present our methodological survey approach and some initial results out of the empirical data we have collected to investigate individuals shopping activities and its relationship to travel behavior. The focus in this study lies on the extension of an established survey concept, the travel skeleton approach, with shopping-related questions including behavior and attitudes. Therefore, this basic concept will be briefly introduced in the following, while a more detailed description is devoted to the extension.

3.1. *The travel skeleton approach*

The collection of a comprehensive picture of travel behavior was realized by means of a travel skeleton approach. Inspired by the German Mobility Panel (MOP) as a longitudinal travel diary over one week, the travel skeleton can be evaluated as a “pseudo-longitudinal” approach. This is achieved by a design that provides a method to capture the typical travel behavior of individuals via face-to-face interviews. Respondents were asked to give their personal assessment of their individual travel behavior instead of recording explicitly single trips as in a travel diary. The skeleton contains questions regarding distinct activities such as work, leisure, chauffeuring, errands and shopping in a “typical” week. This concept presents an alternative to time-consuming longitudinal travel diaries and efficiently captures everyday travel of individuals on a broader framework. Since the respondent burden is reduced compared to travel diaries, the skeleton could be extended with further relevant questions, such as long-distance travel and psychographic characteristics. The latter, for example, was realized by a standardized set of well-tested and internationally accepted items derived from the Theory of Planned Behavior and further mode-related attitudes (Hunecke et al. 2007). For a more detailed description of the approach, we refer to Magdolen et al. (2019) or v. Behren et al. (2018).

It must be mentioned that the travel skeleton approach has been developed explicitly as a compromise to close the gap between the amount of different topics and resulting questions transport researchers want to address within only one survey (and one interview) and the reasonableness scope of a questionnaire for the respondents. Therefore, a compact instrument with to a certain degree simplified information not including comprehensive details was developed. However, the survey takes the opportunity to include a reasonable amount of different aspects interesting for researchers.

3.2. *Extension with shopping behavior and shopping-related attitudes*

The given concept was carefully adopted and supplemented by shopping-related questions with the aim to create an approach that helps to better understand the shopping behavior in the context of individuals’ overall travel patterns. Therefore, in particular, questions addressing the following aspects were integrated: the number of shopping activities including trips and deliveries during the past two-week period (as exactly as possible against the background of the expected limited ability to remind oneself) as well as an assessment on the shopping frequency within categories within a typical week, e.g., the assessed typical number of trips for the purposes ‘in store’ (window-shopping in the inner city), visit of specialist shops (e.g. furniture stores, hardware stores) and further errands (small shopping, post-office). Relating aspects such as the distance and the use of the means of transport for these trips were integrated. The individual evaluation of shopping facilities within the residential environment was also collected.

Adaptation to services, such as e-commerce and the delivery of goods, is determined by obvious motives. However, additional explanatory potential can arise by taking individual attitudes into account (see section 2.4). Based on the extended literature review, in particular individual's attitude towards online shopping and shopping in stores as well as their tech-savviness in general were additionally considered for this extended survey approach. For the inclusion of these psychological aspects the skeleton approach was complemented with a set of psychological items.

For the compilation of this item set the findings from previous research have been refined and insights from some semi-structured interviews with individuals have been used as theoretical basis. In this context, according to Mokhtarian and Salomon (1997), people's attitudes toward online shopping and shopping in general are of essential importance. For this reason, we included items representing positive and negative attitudes towards shopping online and in-store. Besides the enjoyment of shopping, as highlighted in the literature section, further aspects were found to be relevant determinants for the use of home delivery services, e.g. the price and time pressure as well as the trust in online retailers. Additionally, the interviews and also literature found social norms and values regarding shopping to be significant. Furthermore, for the use of services such as the online purchasing of goods, a certain tech-savviness is a necessary precondition. Some concepts for the requesting of tech-savviness in relation to shopping and travel behavior can be found in literature (Swinyard and Smith 2003; Farag et al. 2007; Rotem-Mindali and Salomon 2007; Cao et al. 2012; Lee et al. 2017). In the respect of shopping behavior, only few authors already questioned attitudes towards technology/ tech-savviness. In doing so, this enables to generate compact information regarding individual's intention to use these services.

In summary, a set of additional 27 psychological items regarding the attitudes towards shopping, delivery services and technology was compiled. Table 4 gives an overview on the statements and the references on which the inclusion of items is being based on. In the questionnaire a Likert scale from 1 ('does not apply') to 5 ('apply') has been implemented.

Table 4: Psychological shopping items (indicators) used in the study

Description	Items	Questions	Items based on references
Positive attitude towards delivery services (PDS)	I_1^{PDS}	Carrying purchases home when walking or bicycling is a hassle.	Swinyard and Smith (2003), Lee et al. (2017), individually created
	I_2^{PDS}	I like that no car is necessary on online shopping.	
	I_3^{PDS}	I like having merchandise delivered to me at home.	
	I_4^{PDS}	I'm used to transporting things myself.	
Negative attitude towards delivery services (NDS)	I_1^{NDS}	I don't like the delivery problems and returns when shopping online.	Adjusted according to Swinyard and Smith (2003)
	I_2^{NDS}	I dislike shipping charges on the internet.	
	I_3^{NDS}	I don't like waiting for products to arrive.	
Positive attitude towards shopping in-store and in general (INS)	I_1^{INS}	Even if I do not end up buying anything, I still enjoy going to stores and browsing.	Swinyard and Smith (2003), Mokhtarian et al. (2009), Cao et al. (2010), Lee et al. (2017)
	I_2^{INS}	I like shopping.	
	I_3^{INS}	Shopping is usually a chore for me.	
Sensitivity for time use and prices (T)	I_1^T	It is important to me to get the lowest prices when I buy things.	Swinyard and Smith (2003), Mokhtarian et al. (2009), Lee et al. (2017), individually created
	I_2^T	I am too busy to shop as often or as long as I would like.	
	I_3^T	Having goods delivered saves time.	
Trust in online retailers (TR)	I_1^{TR}	It is risky to buy over the internet.	Goldsmith and Goldsmith (2002), Adjusted according to Walczuch and Lundgren (2004)
	I_2^{TR}	I trust e-retailers with respect to contact data and my credit card information.	
Positive attitude towards technology and innovation (PTI)	I_1^{PTI}	I like to track the development of new technology.	Mokhtarian et al. (2009), Lee et al. (2017)
	I_2^{PTI}	New technologies bring at least as many problems as it does solutions.	
	I_3^{PTI}	I am generally cautious about accepting new ideas.	
	I_4^{PTI}	I prefer to see other people using new products before I consider getting them myself.	
	I_5^{PTI}	I like a routine.	
Ability to use technological applications (A)	I_1^A	I'm good at finding what I want on internet.	Adjusted according to Swinyard and Smith (2003), individually created
	I_2^A	Internet ordering is hard to understand and use	
	I_3^A	I find it easy to learn the use of a new app on the smartphone.	
Personal and social norm (NORM)	I_1^{NORM}	I don't like it when parcels are handed to my neighbours.	Individually created according to Hunecke et al. (2007) and on basis of a qualitative preliminary study.
	I_2^{NORM}	People who are important to me think it is good if I shop in retail stores instead of on the internet.	
	I_3^{NORM}	Due to my personal values I feel personally obliged to shop as less as possible on the internet.	
	I_4^{NORM}	It is important to me to support local retailers through my shopping decision.	

However, it can be assumed that the attitudes towards modes also have an influence on in-store or online shopping, since accessibility of shops and thus different distances are relevant depending on the mode. For example, it is not possible to reach the furniture store outside the city (center) without a car. Therefore, attitudes towards modes need to be parallelly considered when investigating shopping behavior. The basic travel skeleton approach includes such items (see above section).

Altogether, the evolved survey approach incorporated underlying attitudes towards shopping and travel modes in parallel with typical travel behavior and the shopping frequencies. Fig 1. visualizes the contents of the developed survey concept and gives an overview of the approach.

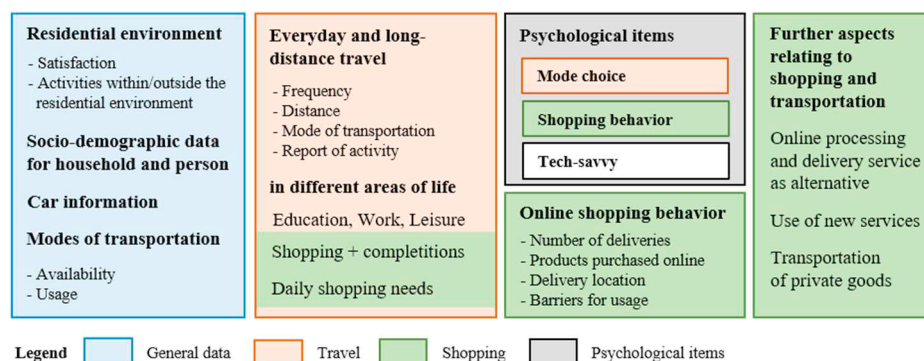


Fig. 1: Overview of the contents of the survey concept

3.3. Data collection and sample characteristics

Recruiting respondents for face-to-face interviews or extensive paper-and-pencil surveys as it is applied in the original travel skeleton approach and traditional diary-based travel surveys, respectively, is of obvious difficulty.

As an alternative, online surveys have a high potential to function as a more appropriate and efficient method for collecting data on travel behavior (Bayart and Bonnel 2012). Therefore, the survey instrument as described has been implemented as a computer-assisted web-interview (CAWI). Further, Table 1 has demonstrated that CAWI approaches are frequently used in the context of surveys on shopping behavior. This format makes the concept an essential tool for future research and enables further data to be generated efficiently and with comparatively little cost. Finally, the survey approach presented can be used for a wide range of research purposes since it covers the typical travel behavior of individuals and several extensions (cf. Fig. 1). For the already existing travel skeleton survey instrument of face-to-face-interviews (v. Behren et al. 2018; Magdolen et al. 2019) the proof of concept was already given. Besides the applicability of the integrated concept (travel, shopping and e-commerce) this study also aims on the proof of concept as a CAWI-survey, to allow for a more cost-efficient data collection with basically larger samples.

As a pretest and mainly to evaluate the adopted survey concept, data from a sample of city dwellers had been collected between February-2019 and March-2019. This sample has been generated as a convenience sample by sending the link of the CAWI-survey to friends and colleagues and motivating them to participate within a comparatively short period (approximately 2 weeks). Altogether 191 respondents completed the survey and 167 valuable observations remained after plausibility checks. The sample is characterized by gender balance, highly educated people and mainly young people (75 % under the age of 35). The occupational status contains a share of 54 % of full-time employed respondents and 30 % students. 41 % of the respondents have a car permanently available, i.e. they own a car or have a car in their households available for use.

4. Results

The explorative approach focuses on the data basis obtained and their usability to identify and explain observable trends regarding shopping and travel behavior of individuals. For this article, the 27 items regarding shopping are the main subject of investigation, in spite of the non-representative and biased character of the sample. In a second step, we present descriptive analysis to illustrate the applicability of the survey instrument.

4.1. Identification of attitudinal constructs

We first investigate the included items regarding their distribution of the answers of the indicators. This is summarized in Fig. 2. Overall, the distribution of the answers is reasonable for most of the items. This, in particular, counts for the new developed items addressing social and personal norms (I_{1-4}^{Norm}). As can be seen in the unbalanced ratio of red and green components, individual items were answered in the marginal areas of the scale, e.g., I_1^A , I_2^A , I_3^A , I_4^{PDS} and I_2^{NDS} . These items will make little contribution to explaining variance in behavior. The black components show an increased number of missing values for some items (e.g., I_2^{Norm} , I_2^{PDS}).

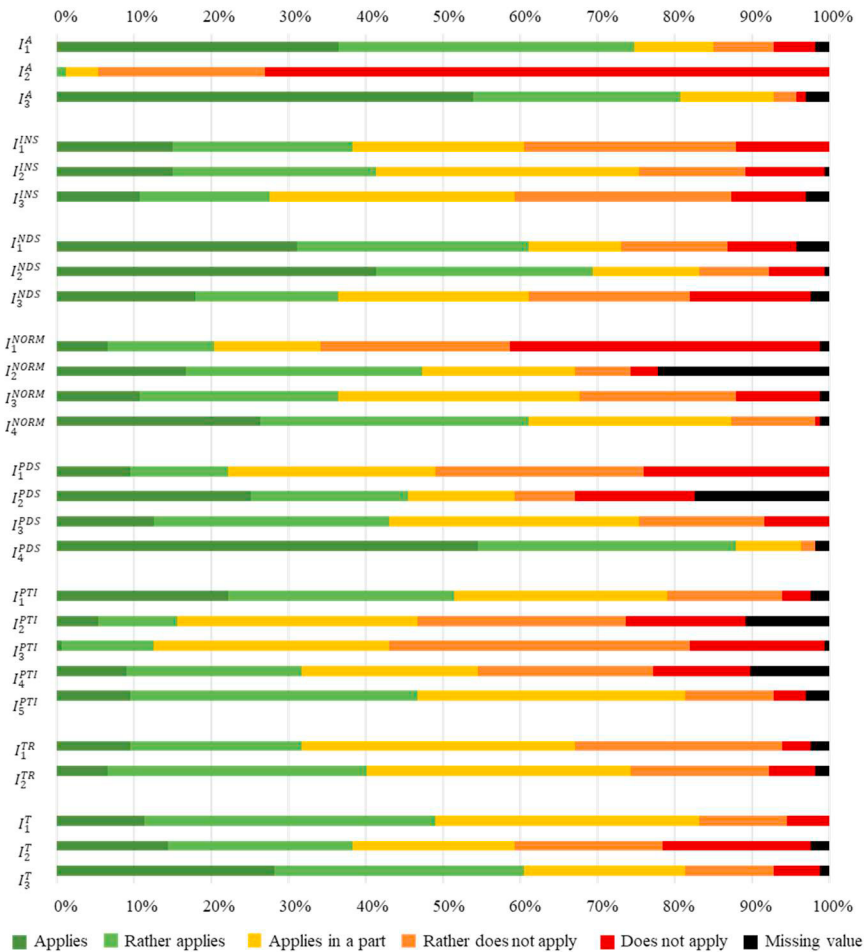


Fig. 2: Attitudes towards shopping (online and in-store) and technologies

Next, we conducted an exploratory factor analysis (EFA) to reduce the complexity of the collected data. For the analyses, due to a high amount of missing values for some items and inadequate communalities in the factor analysis, only a reduced item-set of 22 items was used. Totally, 118 observations were finally considered. Such comparatively small sample sizes are not unique in the existing literature and also provide valid and robust results (Steg 2005). The objective of the EFA is to verify the validity of the newly compiled item set in the applied context and to uncover latent variables (LV) in the structure. Adjustments in form of the exclusion of items of the analyzed set were made due to inappropriate values of the Kaiser’s measure of sampling adequacy (MSA) and communalities for single items. According to MacCallum (1999) the ratio for the number of variables and extracted factors in relation to the required

sample size to generate valid results is still acceptable. The results of the common factor analysis are shown in Table 5.

Table 5: Common Factor Analysis (CFA) - Varimax Rotated Factor Pattern

Factors	<i>Pro-deliveries</i>	<i>Technology-criticism</i>	<i>In-store</i>
Cronbach's Alpha	$\alpha = 0.66$	$\alpha = 0.73$	$\alpha = 0.68$
Indicators in CFA			
I_3^{PDS}	0.709		
I_1^A	0.561	-0.448	
I_1^T	0.546		
I_2^{TR}	0.444		
I_5^{PTI}	0.422	0.330	
I_1^{PDS}	0.405		
I_1^{PTI}	0.385	-0.319	
I_3^T	0.324		
I_4^{NORM}	-0.537		
I_3^{NORM}	-0.562		
I_3^{PTI}		0.635	
I_2^A		0.559	
I_2^{PTI}		0.535	
I_4^{PTI}		0.522	
I_1^{TR}		0.489	
I_1^{NDS}		0.409	
I_3^A	0.358	-0.559	
I_2^{INS}			0.859
I_1^{INS}			0.775
I_2^{NDS}	0.366		0.453
I_3^{NDS}			0.331
I_3^{INS}			-0.703
<i>Printed is the maximum loading of each item.</i>			
Criteria of extraction and quality for CFA			
<i>Criteria of extraction</i>	<i># Factors</i>		
Kaiser's criterion	3		
Scree-Test	3		
<i>Criteria of quality</i>	<i>Value</i>	<i>Pr > Chi-Square</i>	
Kaiser's measure of sampling adequacy (MSA)	0.696 > 0.60		
Bartlett's test of sphericity	$\chi^2 (231) = 798.979$	p***	
N = 118			

Three latent variables (LV) are identified: *Pro-deliveries* is based on the preference to receive goods deliveries and additionally includes aspects such as price sensitivity, confidence in online retailers and social norms; *In-store* describes the value of shopping in store as a leisure activity; *Technology-criticism* is characterized through a skeptical attitude towards new services and technological applications in general. Regarding the internal consistency of the

factor solution, minimum values of 0.70 for Cronbach’s Alpha are ordinary (Schecker 2014). A slight undercutting of this limit value is possible if the items do not measure the same in terms of content (Moosbrugger and Kelava 2012). Under these considerations, the values achieved for Cronbach’s Alpha in this study show sufficient values.

4.2. Descriptive analyses for evaluation of the instrument

Finally, the LVs identified must be interpreted in the context of individual's travel behavior. The questions arises, whether these LVs are basically suitable to make a contribution in explaining the substitution of shopping trips by home deliveries. Therefore, an initial analysis is presented here to support the evaluation of the survey design. As an example gender differences regarding the reported number of deliveries and shopping trips, in each case set into relation to the factors *In-store* and *Pro-deliveries*, are investigated (see Fig. 3 and Fig. 4).

For example, obvious gender-specific differences become visible regarding the enjoyment of shopping represented with the factor *In-store* (Fig. 3): women in this sample achieve values (-0,43 on average) meaning their joy of shopping is higher than those of men (0.40 on average). This allocation of the positive attitude towards in-store shopping is also represented in the higher number of observations to the left of the vertical axis for women (number of orange circuits). Referring to their behavior, women also reported slightly more trips for leisure shopping purpose than men which is visually expressed by larger circuits for women. In addition, different causes for the receiving of numerous deliveries (large circuits) emerge (Fig. 4): men who received many deliveries are rather on the right of the vertical axis meaning they do not like in-store shopping; women with a high numbers of deliveries rather relate to a positive attitude towards delivery services, meaning their attitude is oriented positively towards the receipt of deliveries.

Overall, these initial results have demonstrated that, in particular, the combined assessment of psychological aspects, especially under the use of the two LVs *Pro-deliveries* and *In-store*, can at least contribute to explain the observed travel and shopping behavior. And this allows also for cautious indications in which cases we can expect more a complementarity or rather a substitution. The investigation of gender differences is in line with findings from the literature: women enjoy shopping more than men, while men purchase more often online than women (Goldsmith and Goldsmith 2002); in-store shoppers are typically women, while online buyers can be characterized as young and well-educated men (Farg et al. 2003).

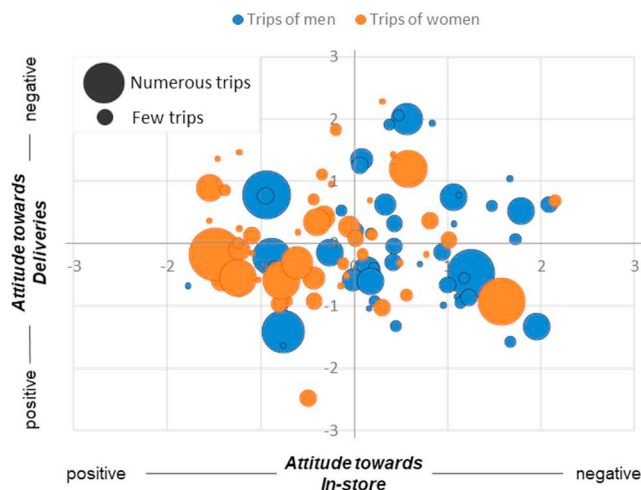


Fig. 3: Shopping trips of men and women in relation to their attitudes

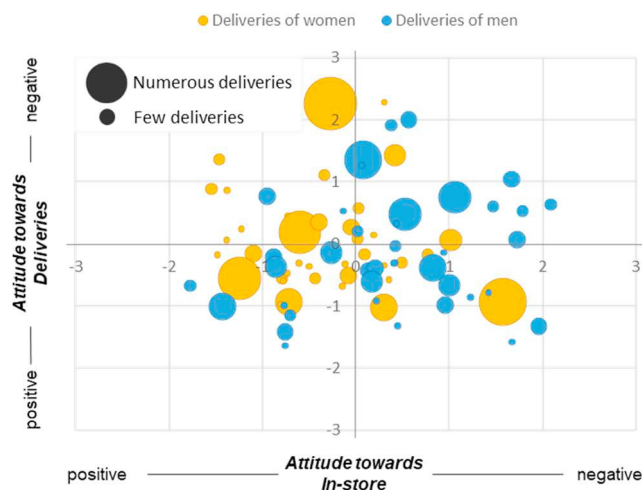


Fig. 4: Deliveries of men and women in relation to their attitudes

5. Discussion

The results of the previous section prove the applicability of the survey concept and the usability of the multidimensional data collected. In particular, the applicability of attitudinal constructs has been demonstrated. The basic functionality of the questionnaire mainly concerns the duration of the survey, since the majority of the participants spent between 21 and 35 minutes processing time. Consequently, a reduction of the scope of the questions for further applications is appropriate. Nevertheless, the effort required to complete the survey is acceptable in comparison to trip diaries and in terms of the amount of information that can be generated. On the other hand, a perspective development of a more detailed questionnaire including a more precise distinction of different kinds of delivered goods would be desirable and should be pursued. Therefore, the travel skeleton approach provides a suitable basis, since it must be considered as a compromise for a survey dealing with multidimensional aspects as well as different facets to be collected having regard to a reasonable response burden. A higher degree of detail might be feasible to integrate into this survey concept. However, this would directly affect the respondent burden and must be checked in terms of the resulting consequences.

Data significance is limited by the small size of the sample. However, within the scope of the factor analysis, the necessary sample size has already been proven to be sufficient.

Regarding the latent variables (LV), the literature detects both similar and partly different constructs. Attitudes towards shopping in general and the enjoyment of shopping are common factors used to explain shopping behavior (Frag et al. 2005; Lee et al. 2017; Mokhtarian et al. 2009). In the factor analyses of other authors similar aspects to the factor technology criticism usually fall under points such as risk, trust or ability to use the internet (Mokhtarian et al. 2009; Goldsmith and Goldsmith 2002; Swinyard and Smith 2003). Considering the great skewness of the I_{1-3}^A items and with regard to technological know-how as a relevant requirement for the adaption online shopping, the results indicate that this technical knowledge is largely available within the sample. This is in line with the findings from Hernández et al. (2011), who have previously shown that once individuals have attained the status of being experienced e-shoppers their behavior regarding online shopping is independently of their socio-economic characteristics. Additionally, the impact of social norm referring to the attitudes towards shopping has been identified as important for realized shopping travel in this study.

However, results contain indications that the items referring to two factors partly address different aspects: while the shipping costs in the factor pro-deliveries are perceived as disruptive by individuals, they could explain why people prefer to go to shops within the factor in-store. Although the item set has attempted to address a variety of aspects, the quality of some individual items is not sufficient to form a separate factor, i.e. feeling of time pressure.

Correspondingly to this, the ideas for further extensions and adaptations of the set are diverse. Using a separate study that focuses exclusively on surveying individuals about their attitudes towards shopping such as Mokhtarian et al. (2009) may be useful to identify relevant items and obtain factors that are even more consistent in terms of content. Nevertheless, the factor in-store provides an essential indication of individuals' preference to travel for shopping purposes and the presented item set already represents a possibility to generate suitable data for interdisciplinary research purposes.

6. Conclusion

This study presents an extensive literature review on surveying travel and shopping behavior and a new-developed integrated survey approach. This approach captures typical travel behavior in combination with extended information on online shopping behavior as well as attitudes regarding mode choice, shopping online and in-store, and technology. To our knowledge, an approach in this combination was not available in literature so far. In this study this approach was evaluated in terms of applicability as a CAWI-survey.

Factor analysis validated the newly compiled set of attitudinal questions regarding shopping and identified three latent variables: pro-delivery, technology criticism and in-store attitudes. I.e., each person in the sample has a negative or positive value for each of the three factors, these indicate how a person feels about the factor (e.g. home deliveries).

In some initial analysis, it was acknowledged that, in particular, the positive attitude towards shopping in-store can be seen as an essential cause for shopping trips, especially for women. Consequently, these items should be implemented into future survey concepts.

New findings and added value of this research result from the feasibility of the implication of the approach as a CAWI and the corresponding potential for detailed evaluations. Such an integrated approach on the basis of a travel behavior framework and including a wide range of underlying psychological aspects provides an essential option to collected appropriate data that is needed to investigate interrelations of travel behavior with shopping behavior in an interdisciplinary perspective. For example, the relevance for owning a private car could change: if the purpose of shopping is a central reason for ownership, this could in future become obsolete by the use of delivery services. Further, a subsequent use of more advanced examination methods is required, since the potential of the extensive data set has not yet been exhausted. The combined consideration of attitudinal factors a behavior points to interpersonal differences and will allow to identify distinct behavioral and attitudinal groups by using multivariate procedures in further research. For example, cluster analysis would offer the potential to classify shopping types based on behavior and relate them to their attitudes: By applying the items as described a segmentation into different groups have been performed based on a large and representative sample of urban dweller. Here a latent class approach was applied to classify shopping behavior types in relation to attitudes towards shopping and with other attitudinal components as orientation towards different transport modes (Bönisch et al. 2021).

Certainly, a limitation of the approach is the limited distinction between different kinds of goods and deliveries which should be addressed in further developments of the survey approach. Depending on the existing application of the travel skeleton approach, we can also provide spatial information via postal code. In the present case, this important aspect was not in focus. A preferable representation of different spatial types can better be put into practice by an online sample, e.g., CAWI, for which the applicability of the survey concept could be demonstrated. The availability of shopping and other infrastructure for daily life is differently available in various spatial contexts and is very likely to influence the behavior and the attitudes. These aspects could be analyzed based on a spatially well balanced sample. Since the main limitations in this study result from the comparatively small sample size, further research should focus on the extension of the concept to a larger sample. Therefore, the travel skeleton approach has been implemented as CAWI for a more extended data collection in Munich, however aiming on other aspects.

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