The Influence of Shopping Carts on Customer Behavior in Grocery Stores

By Udo Wagner, Claus Ebster, Ulrike Eske and Wolfgang Weitzl

This study reports on a new procedure for tracking the in-store behavior of customers, observed in two grocery stores located in a metropolitan area of a capital city in Europe. Shopping paths were gathered utilizing disguised human observations recorded on a tablet computer, which enabled the collection of both customer purchases and the locations where the shoppers stopped or parked their carts. The two stores differed with respect to their rather traditional and more modern layouts. This research focuses on the impact of store design on patrons’ shopping cart parking behavior. Customers navigated more freely and conveniently in the modern store. Essentially, it was found that shopping cart parking behavior mediates the relationship between in-store movement and purchase behavior. In particular, shoppers parking carts during their store visit tended to buy more. This effect was more pronounced in the modern, free-flow store layout. In addition, the study presents the typical patterns of shopping behavior in different store areas. The findings are relevant from both a managerial and a methodological perspective.

1. Introduction

A recent article in The New York Times discusses how US retailers increasingly rely on cell phone tracking and other non-reactive methods to observe shoppers inside their store (Clifford/Hardy, 2013). In particular, the article highlights the importance that retailers place on in-store behavioral data because that data allows them to compete more effectively with online retailers, which routinely collect a wide variety of behavioral data when consumers visit their e-commerce websites.

The collection and analysis of in-store behavior data is, however, not a recent phenomenon. For many decades, marketers have relied on in-store observations to understand and thus influence shopping behavior. For example, in-store observation can be used to (1) analyze shopper orientation in a store (Groeppel-Klein/Bartmann, 2009); (2) identify the predominant paths shoppers take inside a store (Larson/Bradlow/Fader, 2005); (3) compare shoppers’ level of exposure to various in-store visual media (Sorensen, 2003, 2009); (4) capture the in-store interactions between parents and their children (Ebster/Wagner/Neumueller, 2009); (5) measure customer traffic in different parts of a store (Newman/Yu/Oulton, 2002); and (6) analyze the effects of clockwise or anti-clockwise walking patterns in a store (Groeppel-Klein/Bartmann, 2009).
However, to the best of our knowledge, no study has explored how consumers interact with a shopping aid frequently found in supermarkets, namely, the shopping cart. Yet the results of proprietary research do indicate that shopping aids, such as carts and baskets, are relevant factors in explaining consumer in-store behavior (Underhill, 2009). In addition, retail managers strongly have confirmed the significance of shopping carts on purchase patterns. Clearly, the latter are influenced by other store environmental triggers as well.

The aim of this pilot study is to investigate the role of shopping carts on in-store behavior. Specifically, there are two research questions:

RQ1: What is the effect of parking shopping carts on the relationship between in-store movement and purchase behavior?

RQ2: Does store design moderate these relationships?

The paper focuses on grocery stores because shopping carts are of particular importance in this specialized store environment. The limited evidence available in the literature reveals a need for an exploratory approach. Section 2, therefore, presents the conceptual considerations of the research questions. Section 3 returns to the empirical study to address measurement issues. Two constraints influenced the choice of how to track in-store shopping unobtrusively: First, the restrictive legal situation in Europe prohibits methods such as cell phone tracking, and secondly, budget considerations limit the use of sophisticated tracking technologies (e.g., radio frequency identification technology [RFID] chips in shopping carts). Thus, this study adapts an innovative, albeit unobtrusive (human) observation procedure to fit these retail requirements. Section 4 delivers the results of the empirical project carried out in two different supermarkets. Section 5 concludes by interpreting the results from both a managerial and a theoretical perspective, identifies the limitations of the study, and discusses potential issues for further research.

2. Conceptual considerations

The focus of this study is on the role of the shopping cart in supermarkets. Retailers provide carts to their patrons to facilitate their shopping. In particular, shoppers use carts to temporarily store products before purchasing them at the checkout counters. Customers also use carts for convenience, that is, some customers prefer to deposit personal belongings in their carts rather than carry them. In addition, shopping carts allow patrons to touch merchandise with their hands, which might be deemed important by many (see, Peck/Childers, 2003). Yet shopping carts do hinder movement in the store by reducing walking speed and flexibility of walking direction. Therefore, the frequency of the parking of shopping carts depends on whether there are accompanying advantages or disadvantages for doing so. Unfortunately, these drivers are not directly observable, and moreover, they depend on such factors as the time pressure customers face when shopping, the number of shoppers present in the store at a given time and the perceived crowding they can induce, a fear of pickpockets, and the environmental characteristics of store and time. Effects of crowding can operate in opposite directions. On the one hand, with many shoppers present, individual space does become limited, so parking shopping carts somewhere in the store may help regain shopper mobility; on the other hand, leaving a cart unattended might prove risky in crowded areas especially when personal belongings are stored in a cart. Furthermore, the parked shopping carts of other shoppers can be perceived negatively if those carts restrict movement or access to racks of merchandise. Even worse, they may distract customers from buying, known as the butt-brush effect, a retail consumption phenomenon wherein shoppers do not like to be touched, brushed or bumped in and, therefore, will stop making purchases there to avoid such inconveniences (Underhill, 2009).

The research questions posed here do suggest that we consider the effects of parking shopping carts as a mediating construct that influences the relationship between in-store movement and purchase behavior. In addition, store design probably moderates these relationships. Fig. 1 presents these conjectures graphically. We acknowledge that this conceptual model neglects other drivers of purchase behavior and shopping cart parking but we refer to the exploratory character of this pilot study which seeks to generate some introductory and first insights into this rather unresearched area by keeping the analyzed relationships simple.

2.1. Considerations regarding RQ1 – Parking carts as a mediating variable

The most basic relationship (a) in Fig. 1 hypothesizes that patrons who spend more time in a store or walk longer distances, etc. will purchase more often. They probably do so because their shopping demand (e.g., the length of their real or virtual shopping list) depends on their needs and also personal circumstances. This factor is particularly relevant because here we are analyzing utilitarian goods, i.e., groceries. Typically, customers who stay longer in a store walk longer distances within that store, scrutinize merchandise more thoroughly, and are less goal oriented. In line with environmental psychology (e.g., Mehrabian/Russell, 1974) this behavior implies that they are more exposed to in-store stimuli that might stimulate impulsive buying or remind them to buy products most consumers need, but have not thought of buying when entering the store.

Arguing along the same lines, we also assume that shoppers who stay in the shop longer are more likely to park their carts more often (i.e., relationship (b) in Fig. 1).
This pattern might emerge even more often when considering those customers who need more time for buying than the typical shopper. They stay longer because they enjoy browsing through the assortment of products or the different departments, try (e.g., touch) a greater variety of products, need more time to navigate the store, etc. Naturally then, they probably park their carts more frequently. The situation might become different, however, when personal belongings are stored in the cart. In this case shoppers may refrain from leaving their carts unattended to shop.

As Underhill (2009) points out, shoppers are more likely to make a purchase in a store when their hands are free. When shoppers enter a store without a shopping cart or a shopping basket, they tend to select additional products only as long as their hands can hold them. Therefore, he recommends that retailers locate shopping aids, such as baskets or carts, in different areas of the store to stimulate additional purchases. Temporarily parking one’s cart might also combine the convenience of unrestricted movement with the ease of freeing one’s hands when they are overloaded. Thus, we expect to see a positive relationship between parking one’s cart and the number of purchases such a shopper makes (see relationship (c) in Fig. 1).

### 2.2. Considerations regarding RQ2 – Store design as a moderating variable

Among other variables, modern store design seeks to improve store atmosphere, both for utilitarian and hedonic shopping environments. A pleasant retail environment contributes to the comfort and the well-being of patrons, which in turn induces these patrons to stay longer in the store than necessary (e.g., Kreft, 2002; Mikunda, 2009). Therefore, we expect that the relationship between the time required for shopping and the number of purchases is less well established for the more modern designed stores (i.e., moderating effect (a’) in Fig. 1).

The way a certain area of a store (e.g., the fruits & vegetables department) is designed can enhance the shopping experience and also facilitate the flow of customers. This would be the case if the layout of this store area is clearly structured, if the store aisles are wide, and if store design elements are used to allow the shopper to easily store, process and retrieve information about the store from memory (Ebster/Garaus, 2011). However, the shopping experience might counterbalance such effects. By shopping regularly in a store, a shopper’s learning processes will operate, and customers become familiar with the location of items they purchase frequently even when there are overloaded or unclear store designs (see Garaus/Wagner, 2013).

As has been shown in the literature, crowding negatively impacts shopping behavior because of the information overload that consumers tend to experience under high density conditions (Eroglu/Machleit, 1990). These can lead the shopper to experience an external locus of control. Locus of control (Rotter, 1990) describes the extent to which a consumer feels in control of the environment. While locus of control has been considered a personality variable, the actual environment, such as a crowded store space, can also influence each shopper’s locus of control. Specifically, a high level of perceived retail crowding can decrease shopping satisfaction (Machleit et al., 2005). In a well-designed store, consumers feel more comfortable, enjoy browsing through the assortment of items to a greater extent and perceive less crowding. Therefore, we assume that the relationship between the time required for shopping and the frequency of parking the shopping carts is stronger for the modern designed stores (i.e., moderating effect (b’) in Fig. 1).

A poorly designed store can lead to a perception of crowding and a perceived lack of control (Hui/Bateson, 1991). Grossbart et al. (1990) find that perceived crowding leads to a lower number of purchases. In contrast, a modern, free-form design, where shelves and displays are placed in free-flowing patterns and the layout facilitates shoppers’ navigation of their shopping carts, enforces command of control and consumers are less reluctant to leave their shopping carts unattended. In this kind of layout, shoppers are less rushed, feel more comfortable, and tend to make more unplanned purchases (Ebster/Garaus, 2011). Therefore, we anticipate that the relationship between the frequency of carts being parked and the number of purchases is stronger for modern designed stores (i.e., moderating effect (c’) in Fig. 1).

### 3. Method

The intention of this research project is to track the movement and shopping behavior of consumers in different supermarkets. As such, the applied research method needed to fulfill three requirements. First, the applied technology must be able to track the movement of individual shoppers. Recent studies have mainly focused on
tracking consumers with RFID technology. For example, Hui/Bradlow/Fader (2007) use data generated from the PathTracker, which is based on RFID technology. In that study, a small RFID tag was affixed to each shopping cart, and it emitted a uniquely coded signal every few seconds. The generated signal was then picked up by antennas positioned throughout the store. This approach enabled the researchers to pinpoint the precise locations of the shopping cart over time.

However, this approach also has its limitations. Shoppers often will park their shopping carts to move through a store freely. Another limitation is the relatively high implementation costs of such systems for exploratory research. Secondly, individual shoppers must be traceable throughout the entire store. Video surveillance is available in most retail stores today; however, not all systems are capable of covering the entire store adequately. Furthermore, access to this video material is often limited for data privacy reasons. Third, the applied research method has to ensure that forms of customer behavior (e.g., purchases, product contacts) other than precise movement data (e.g., walking speed) could be recorded.

In line with these aspects, the project at hand applies a disguised observation method and introduces a novel form of behavioral data collection. During an observation period that was about three weeks, a well-trained team of five observers followed shoppers on their trips through two large supermarkets. Both stores belong to the same major grocery retail chain in a European country, carry about the same assortment of products, and have approximately the same size of total sales areas. The outlets were located in different parts of a capital city, so their target groups were different. In addition, the stores’ architectural designs varied. Whereas a traditional design characterized the first store (e.g., long aisles, rectangular arranged shelves), the second store was rebuilt recently and now reflects a more modern store layout according to the management of this retail chain (e.g., landmarks, spacious aisles, shelves arranged in free-flowing patterns, lower height of shelves). Fig. 2 illustrates the floor plan of both stores. The more spacious department for fruits & vegetables (1 in Fig. 2) in the modern store is striking. In addition, the departments with high sales rates – namely, frozen food & dairy products (2 in Fig. 2) and meat & sausages (3 in Fig. 2) – were located at different positions in the traditional and modern store.

Shoppers were selected at the entrance of both outlets using systematic random sampling. Members of the research crew were told to follow shoppers through the store. Because the aim of the study was to gain insight into customer shopping behavior with a shopping cart, only shoppers that pushed a cart qualified for the sample. Only the paths of single customers were tracked because shopping behavior can differ when customers are accompanied by another person (e.g., family members,
friends). In applying this selection procedure, 197 shoppers in the traditional store and 209 shoppers in the modern store met these criteria and were tracked from the time of their store entry to their checkout.

The observers covertly followed the selected shoppers and unobtrusively recorded their shopping path and behavior with a tablet computer and a new shadowing tool. Arsenal Research, a behavioral science institute (see Millonig/Gartner, 2008), originally implemented this software to track pedestrian movements. This application adequately captures human behavior in real environmental settings. For tracking these retail customers, the code was further adapted to capture various facets of in-store shopping behaviors. Essentially, the shadowing software enables the plotting of individual shopping paths on a digitized shopping floor plan that is displayed on a tablet screen in real time. The software is sufficiently user friendly that the observers can operate it easily after limited training. In addition, the software enables a recording of certain events during the shopping trip as well as the situational in-store conditions, and observable demographics of the tracked persons. Therefore, this research could collect (1) in-store shopping path data (with and without shopping carts); (2) purchases (with and without shopping carts); (3) frequency, places, and duration of parked shopping carts. Just stopping one’s cart to place a selected product directly in the shopping cart was not considered to be “parking the cart”; rather patrons had to separate from their cart significantly (at least 3 meters) or leave it for a longer time unattended (more than 10 seconds) to be considered as “parking the cart”. Further, (4) walking speed; (5) shopping duration; (6) calendar date and time of day; (7) handbags carried in the shopping cart; and (8) gender and age were tracked based on an approximation by the observers.

For further support, a research assistant accompanied each observer during the tracking. This procedure was especially advantageous during crowded shopping hours and helped also the observers stay undiscovered. This research assistant collected further data using personal communication for a subset of the tracked shoppers. He or she approached some of the tracked customers after they checked out and asked them to complete a short questionnaire (e.g., their weekly shopping behavior, demographics, store atmospherics, and the functionality of shopping cart).

4. Data analysis

4.1. Descriptions of the stores analyzed

Data collection took place over 17 subsequent trading days, during both morning and afternoon hours. The capacity of the computer’s battery limited the observations to approximately four hours in a row (9 a.m.–1 p.m. and 2 p.m.–6 p.m.). In total, the sample consists of 406 usable cases. Tab. 1 provides an overview of that data.

The upper panel of Tab. 1 shows that the two stores are fairly similar in terms of customer gender (two-thirds are women) and age; on average, customers spend about the same amount of time (=20 min) in the grocery store. Considerable variance exists in the time spent shopping, i.e., very short visits last only a few minutes, and long visits last more than one hour. The two stores also differ greatly in terms of patrons’ behaviors regarding parking their shopping carts (lower panel of Tab. 1). Approximately half the customers in the traditional store do not leave their carts unattended, whereas only one-quarter do so in the modern store. These shoppers consistently park their carts more frequently on average (2.82 vs. 1.64); at that time, these customers search for products, serve themselves (e.g., weighing vegetables), check for expiration dates of food, collect several similar items before putting all of them into their carts, and so forth. Approximately 66% of the shoppers in both outlets also use their carts for carrying their personal belongings.

The right columns of the lower panel of Tab. 1 report purchase behavior. Consumers in the modern store stay

<table>
<thead>
<tr>
<th>Type of store</th>
<th>Women</th>
<th>&lt;40</th>
<th>Age group</th>
<th>&gt;60</th>
<th>Open checkout cashiers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>40-60</td>
<td></td>
<td>range</td>
</tr>
<tr>
<td>traditional</td>
<td>65%</td>
<td>34%</td>
<td>42%</td>
<td>24%</td>
<td>3-9</td>
</tr>
<tr>
<td>modern</td>
<td>66%</td>
<td>39%</td>
<td>39%</td>
<td>22%</td>
<td>2-10</td>
</tr>
<tr>
<td>n</td>
<td>197</td>
<td>209</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time spent shopping</td>
<td>19 min</td>
<td>21 min</td>
<td>54%</td>
<td>74%</td>
<td>1.64</td>
</tr>
<tr>
<td>Parking shopping carts</td>
<td>at least once</td>
<td>on average</td>
<td>8.51</td>
<td>10.72</td>
<td>1.13</td>
</tr>
<tr>
<td>Average number of purchases</td>
<td>total</td>
<td>without</td>
<td>shopping cart</td>
<td>-2.07</td>
<td>-4.19</td>
</tr>
<tr>
<td>z, t-Test</td>
<td>&lt;.01</td>
<td>&lt;.01</td>
<td>&lt;.01</td>
<td></td>
<td>&lt;.01</td>
</tr>
<tr>
<td>p-level</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Descriptive data of the sample
somewhat longer (i.e., 21 min) and buy two additional items on average (i.e., 10.72). The percentage difference is even more pronounced in terms of the number of purchases without shopping carts, which is in accordance with the more frequent parking of carts in the modern store. The two rows at the bottom of Tab. 1 report the results of appropriate statistical tests for differences between the traditional and the modern store and as it turns out, all differences are statistically significant at the 5 percent level.

As mentioned previously, a convenience subsample (58 shoppers in the traditional and 72 shoppers in the modern store) of observed shoppers was interviewed. The results reported subsequently apply to both types of stores. More than 50% of the respondents purchased there once a week, and 94% of the sample found it easy to navigate. Almost all (93%) perceived the width of the aisles as adequate and evaluated the functionality of the carts positively (98%) and as clean (81%). Only 7% of the observed shoppers indicated that they noticed someone was following them through the store, a clear indication of the unobtrusive and non-reactive nature of the data collection method employed.

4.2. Measurement

Since section 2 argues at a conceptual level, Fig. 1 represents the model by using latent constructs. Subsequently, we describe the measurement approach as follows:

- **In-store movement behavior – \( ST \)**
  - The distributions of shoppers in the two stores with respect to gender and age are quite similar. Nevertheless, in-store movement behavior might depend on demographic properties. To account for such differences and to differentiate from common purchase patterns we compute the differences for the time spent in the store and the expected time required to complete the shopping list given (i.e., number of purchases x median time required for one purchase per age group and gender). Thereby we obtain the surplus of time customers spent in the store given personal demographics and demand. There is no statistically significant difference with respect to the mean of this surplus time in the two different stores.

- **Cart parking behavior – \( CP \)**
  - Frequency of parking carts during a shopping trip by customer \( t \) in the store.

- **Purchase behavior – \( PP \)**
  - Number of products purchased by customer \( t \) in the store.

- **Store design – \( DE \)**
  - A binary variable indicating the traditional or modern store, respectively.

A lack of data requires testing the conceptual model for the whole shopping trip rather than for a certain sales department within a store. Section 4.4 provides selected descriptive results on individual in-store areas.

### 4.3. Analysis of the research questions

First, we transform our conceptual model (see Fig. 1) into the simultaneous equation system [1] to allow testing the mediating role of parking shopping carts by regression analysis. Since store design is a binary variable, we estimate [1] for the two types of stores separately.

\[
CP_t = \alpha_1 + \gamma_1 \cdot ST_t + \text{error}_1 \tag{1}
\]

\[
PP_t = \alpha_2 + \beta_2 \cdot CP_t + \gamma_2 \cdot ST_t + \text{error}_2
\]

with:

\[
\alpha_1, \alpha_2, \beta_2, \gamma_1, \gamma_2 \text{ parameters}
\]

Inspection of [1] reveals this is a recursive equation system. Johnston (1984, pp. 467-469) proves that recursive systems can be estimated by employing OLS to the structural equations and that the parameter estimates resulting therefrom will have the desirable properties of consistency, asymptotic normality, and efficiency; moreover, they will also have the usual small sample properties. Strictly speaking, \( CP \) and \( PP \) are discrete variables, and hence, the OLS-assumption of continuous errors is violated. However, the domains of \( CP \) and \( PP \) are quite large which warrants the use of OLS.

We calibrate regression parameters over the sub-samples for the two stores; Tab. 2 shows the results (to make the magnitude of the estimates directly comparable, we present standardized regression coefficients). All parameter estimates are plausible and statistically significant; the fit of the model is satisfactory. Notably, \( \hat{\gamma}_1 \) (i.e., reflecting the most basic relationship between surplus of time and number of purchases) is the largest parameter estimate and mirrors the fact that the relationship between surplus of time and number of purchases is of utmost importance. Next we conduct mediation tests on \( (\hat{\gamma}_1, \hat{\beta}_2) \) due to Sobel (1982) and Iacobucci (2012):

\[
\text{\texttt{zMediation}}_{\text{traditional}} = 2.64 \quad p < .01 \quad \text{\texttt{zMediation}}_{\text{modern}} = 3.99 \quad p < .01 .
\]

These results imply that the frequency of parking shopping carts partially mediates the relationship between surplus of time and number of purchases and confirms our suppositions concerning RQ1.

When comparing the regression parameters across stores we also find that our suppositions concerning RQ2 are substantiated: \( \hat{\gamma}_1^{\text{traditional}} < \hat{\gamma}_1^{\text{modern}}, \hat{\gamma}_2^{\text{traditional}} < \hat{\gamma}_2^{\text{modern}}, \hat{\beta}_2^{\text{traditional}} < \hat{\beta}_2^{\text{modern}} \). By an appropriate use of dummy variables, we estimate [1] for the whole data set (e.g., by replacing \( \gamma_1 \) with \( (\gamma_1 + \delta_1 \cdot DE) \), \( DE \) is the dummy variable distinguishing between the traditional and the modern store layouts, \( \delta_1 \) denotes the moderation effect of store design on \( \gamma_1 \); \( \delta_1 \) and \( \delta_2 \) are set accordingly). Subsequently, we investigate \( \hat{\delta}_1, \hat{\delta}_2 \) to find that the moderation effects are statistically significant for a type I error of five percent for all cases. We do concede that thereby we do not establish a causal effect of store design because of the descriptive character of our data.

We noted earlier that shopping carts might also be used to carry personal belongings during a shopping trip, and
Table 2: Estimates for simultaneous equation system, full data set

### Traditional store

<table>
<thead>
<tr>
<th>Equation 1: Surplus of time ($\hat{\gamma}_1$) → Frequency of parking carts *</th>
<th>Modern store</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ \hat{y}_1 ]</td>
<td>[ \hat{y}_1 ]</td>
</tr>
<tr>
<td>.33</td>
<td>.40</td>
</tr>
<tr>
<td>.01</td>
<td>.01</td>
</tr>
<tr>
<td>R²=.11</td>
<td>R²=.16</td>
</tr>
<tr>
<td>F=24.17</td>
<td>F=38.86</td>
</tr>
</tbody>
</table>

### Equation 2: Surplus of time ($\hat{\gamma}_2$), frequency of parking carts ($\hat{\beta}_2$) → Number of purchases *

<table>
<thead>
<tr>
<th>[ \hat{y}_2 ]</th>
<th>[ \hat{\beta}_2 ]</th>
<th>[ \hat{y}_2 ]</th>
<th>[ \hat{\beta}_2 ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>.59</td>
<td>.17</td>
<td>.49</td>
<td>.30</td>
</tr>
<tr>
<td>&lt;.01</td>
<td>&lt;.01</td>
<td>&lt;.01</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>R²=.45</td>
<td>R²=.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F=79.29</td>
<td>F=81.41</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Only standardized regression coefficients are reported.

Table 3: Estimates for simultaneous equation system, split data set

### Traditional store

Only customers without belongings kept in carts are considered

<table>
<thead>
<tr>
<th>Equation 1: Surplus of time ($\hat{\gamma}_1$) → Frequency of parking carts *</th>
<th>Modern store</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ \hat{y}_1 ]</td>
<td>[ \hat{y}_1 ]</td>
</tr>
<tr>
<td>.14</td>
<td>.59</td>
</tr>
<tr>
<td>.24</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>R²=.02</td>
<td>R²=.35</td>
</tr>
<tr>
<td>F=1.41</td>
<td>F=35.84</td>
</tr>
</tbody>
</table>

### Equation 2: Surplus of time ($\hat{\gamma}_2$), frequency of parking carts ($\hat{\beta}_2$) → Number of purchases *

<table>
<thead>
<tr>
<th>[ \hat{y}_2 ]</th>
<th>[ \hat{\beta}_2 ]</th>
<th>[ \hat{y}_2 ]</th>
<th>[ \hat{\beta}_2 ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>.64</td>
<td>.12</td>
<td>.51</td>
<td>.22</td>
</tr>
<tr>
<td>&lt;.01</td>
<td>&lt;.01</td>
<td>&lt;.01</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>R²=.45</td>
<td>R²=.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F=27.32</td>
<td>F=26.01</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Modern store

Only customers with belongings kept in carts are considered

<table>
<thead>
<tr>
<th>Equation 1: Surplus of time ($\hat{\gamma}_1$) → Frequency of parking carts *</th>
<th>Modern store</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ \hat{y}_1 ]</td>
<td>[ \hat{y}_1 ]</td>
</tr>
<tr>
<td>.39</td>
<td>.32</td>
</tr>
<tr>
<td>&lt;.01</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>R²=.15</td>
<td>R²=.10</td>
</tr>
<tr>
<td>F=21.87</td>
<td>F=15.55</td>
</tr>
</tbody>
</table>

### Equation 2: Surplus of time ($\hat{\gamma}_2$), frequency of parking carts ($\hat{\beta}_2$) → Number of purchases *

<table>
<thead>
<tr>
<th>[ \hat{y}_2 ]</th>
<th>[ \hat{\beta}_2 ]</th>
<th>[ \hat{y}_2 ]</th>
<th>[ \hat{\beta}_2 ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>.56</td>
<td>.21</td>
<td>.50</td>
<td>.32</td>
</tr>
<tr>
<td>&lt;.01</td>
<td>&lt;.01</td>
<td>&lt;.01</td>
<td>&lt;.01</td>
</tr>
<tr>
<td>R²=.45</td>
<td>R²=.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F=50.06</td>
<td>F=55.20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Only standardized regression coefficients are reported.
this act might trigger shopping cart parking behavior. Therefore we split our sample and analyse the data for customers who did not keep personal belonging in their carts and those who kept personal belongings in their carts separately. Tab. 3 presents these results. Again, all parameter estimates are plausible, and most of them are statistically significant; with the exception of the data for customers without belongings being kept in their carts in the traditional store, the fit of the model is satisfactory. Mediation tests yield the following results:

without belongings kept in carts:

\[ z_{\text{Mediation traditional}} = 0.89 \text{ n.s.} \]
\[ z_{\text{Mediation modern}} = 1.80 \text{ } p < .10; \]

with belongings kept in carts:

\[ z_{\text{Mediation traditional}} = 2.42 \text{ } p < 0.05 \]
\[ z_{\text{Mediation modern}} = 2.98 \text{ } p < .01. \]

Therefore, carts partially do mediate in-store behavior even when the potential influence of belongings kept in carts is considered. Please notice that \[ \hat{\gamma}_1 \] without traditional and \[ \hat{\beta}_2 \] without traditional are not significant, and, therefore, \[ z_{\text{Mediation without}} \] is not significant as well.

To analyze the moderating effect of store design, we turn to Fig. 3 which displays the estimates (\[ \hat{\gamma}_1, \hat{\gamma}_2, \hat{\beta}_2 \]) graphically. Again, \[ \hat{\gamma}_2 \] plays a dominant role, and, moreover, \[ \hat{\gamma}_2 \] is larger for the traditional store. For the modern store, there is no influence for whether personal belongings are being kept in shopping carts or not kept there. By and large the postulated moderation effects also emerge for \[ \hat{\gamma}_1 \] and \[ \hat{\beta}_2 \]. There are interaction effects between store design and belongings being kept in carts for \[ \hat{\gamma}_1 \] and \[ \hat{\beta}_2 \] in the sense that the effect on patrons’ behavior appears more similar in the two types of store if shoppers carry personal belongings in their carts. Interestingly, the average number of times that customers park their carts (1.77 in the traditional, 2.39 in the modern store, respectively) is also more similar for those shoppers who kept personal belongings in their carts than for the other group (i.e., 1.40 vs. 3.71). Such a pattern would be intuitively appealing if the underlying reason for not leaving the cart unattended was a fear of pickpockets, which probably would not depend on store design. Unfortunately, the nature of the data at hand does not allow establishing any such causal link.

4.4. Findings on the individual sales departments

The method section exposed other kinds of data collected when observing customers. These tracking data are quite extensive and are typically analyzed using heat maps. However, heat maps are difficult to interpret when shown in black and white print, as is the case here. Therefore, we begin by providing more qualitative results on shopping paths achieved from the heat maps for the tracking data. Perhaps the most important result is that most patterns do not depend substantially on the type of store. Such patterns include the following: First, there is a high frequency of visiting the entrance area (fruits & vegetables) which is in accordance with managerial knowledge and the literature (e.g., Underhill, 2009, p. 44, calls this area a decompression zone). Second, shoppers typically move along aisles located near the walls of the store (Larson/Bradlow/Fader, 2005, refer to these as racetracks in that context). Third, shoppers also walk anti-clockwise (Groeppel-Klein/Bartmann, 2008). Fourth, quite a few patrons only visit the fruits & vegetables and frozen food & dairy products areas. The shortcut from this last area to the checkout area causes many zones to be skipped, especially in the traditional store (see Fig. 2). Fifth, areas located in the middle of both stores also commonly remain untouched. The selection of aisles frequently visited depends on the total time spent in the supermarket. Therefore, we cluster shopping paths according to the length of stay in the store. Tab. 4 presents the typical patterns observed for these shopping paths.
Time spent in the store | Patterns observed
--- | ---
<5 minutes | goal-oriented movement; targeted areas visited
5–10 minutes | movement along main aisles; targeted areas visited
10–25 minutes | movement along main aisles with short side trips to secondary aisles
25–45 minutes | movement along main aisles, some secondary aisles are walked through completely, center of the store is visited
>45 minutes | strolling through the whole sales area, longer visits in the center of the store

Table 4: Typical patterns of shopping paths

<table>
<thead>
<tr>
<th>Sales department</th>
<th>Frequency of patrons’ visits</th>
<th>Frequency of parked carts</th>
<th>Duration of parking carts</th>
<th>Frequency of purchases</th>
<th>Time spent by patrons</th>
<th>Patrons’ walking speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruits &amp; vegetables</td>
<td>high</td>
<td>high</td>
<td>long</td>
<td>many</td>
<td>long</td>
<td>slow</td>
</tr>
<tr>
<td>Frozen food &amp; dairy products</td>
<td>high</td>
<td>high</td>
<td>short</td>
<td>many</td>
<td>long</td>
<td>slow</td>
</tr>
<tr>
<td>Meat &amp; sausages</td>
<td>high</td>
<td>high</td>
<td>long</td>
<td>many</td>
<td>medium</td>
<td>moderate</td>
</tr>
<tr>
<td>Vinery</td>
<td>low</td>
<td>low</td>
<td>short</td>
<td>few</td>
<td>long</td>
<td>slow</td>
</tr>
<tr>
<td>Pet food</td>
<td>low</td>
<td>low</td>
<td>short</td>
<td>few</td>
<td>long</td>
<td>slow</td>
</tr>
<tr>
<td>New product offers</td>
<td>low</td>
<td>low</td>
<td>short</td>
<td>few</td>
<td>long</td>
<td>slow</td>
</tr>
<tr>
<td>Kitchenware</td>
<td>low</td>
<td>low *</td>
<td>short</td>
<td>few</td>
<td>long</td>
<td>slow</td>
</tr>
<tr>
<td>Cosmetics</td>
<td>low</td>
<td>low</td>
<td>short</td>
<td>few</td>
<td>long</td>
<td>slow</td>
</tr>
<tr>
<td>Textiles</td>
<td>low</td>
<td>low</td>
<td>short</td>
<td>few</td>
<td>long</td>
<td>slow</td>
</tr>
<tr>
<td>Checkout area</td>
<td>high</td>
<td>low</td>
<td>short</td>
<td>few</td>
<td>short</td>
<td>fast</td>
</tr>
</tbody>
</table>

* Typically, customers walk around in this area without their shopping cart.

Table 5: Patron’s behavior in different store areas – some tentative results

Tab. 4 indicates that in general the customers do not approach the central zone of the stores when visiting for a short time only. This is consistent with stores not placing their most frequently purchased product categories there. Yet managers of this studied retail chain were particularly interested in generating traffic in the middle zone because assortments there generated higher profit margins. Therefore, we concentrate on the influence of shopping cart use on customer behavior in certain specific sales departments (see first column of Tab. 5).

In general, duration of parked carts is rather short, but the corresponding distribution is highly skewed: whereas medians are at 23 sec and 25 sec for the traditional and modern stores, the means are 65 sec and 68 sec, respectively. Exceptionally long parking times occur in the meat & sausages and fruits & vegetables departments. Customers check expiration dates for the former product category and serve themselves (selecting, weighing, and wrapping products) for the latter category. Short cart parking times occur everywhere else, mainly because of facilitated handling (e.g., simply removing frozen food from refrigerators). A simple extrapolation based on the average number of parked carts and average parking time shows that patrons leave their carts unattended for approximately 9% and 15% of the time they spend in the traditional and modern stores, respectively.

The areas with high frequencies of parked carts roughly coincide with the areas of long parking duration times, frozen food & dairy products being the notable exception. Customers park their carts in the spacious regions between, for example, self-service areas or along the main aisles or highly frequented paths in the store. They stay in the proximity of their shopping carts and walk short distances without carts only (e.g., entering a secondary aisle for some steps). Of note, however, is that for both types of stores, zones with a low frequency of visits and parked shopping carts attract customers for a longer time (when they are visited), and thus patrons’ walking speed is slower in these zones. In accordance with Larson/Bradlow/Fader (2005, 2006), walking speed becomes faster along the main aisles and near the checkout areas. Tab. 5 summarizes the findings on different aspects of customer behavior per department area. Note that these results apply to both store types.
5. Conclusions

The fundamental goal of this study was to better understand the movement process of customers who shop with a cart and their in-store behavior in terms of stopping and/or separating from their cart. In two grocery stores located in a European capital, we gathered these shopping paths using disguised human observations recorded on a tablet computer. The results reveal considerable heterogeneity across customers with respect to use of shopping carts. The frequency with which carts are parked partially mediates the relationship between the time spent in the store and the number of purchases. In addition, the design of a store (traditional vs. modern) has a moderating effect.

5.1. Managerial implications

Although this pilot study is exploratory in nature, it offers several relevant insights into consumer behavior at the point of sale:

- First, the frequency of parking carts is influenced by the amount of time spent in the store and in turn that triggers the frequency of purchases. Providing in-door space for temporary parking of shopping carts might, therefore, increase customer convenience and buying intensity.

- Second, depending on the product category involved, shoppers park their carts more or less frequently. In general, most shoppers do not leave their shopping carts unattended when shopping for general groceries. The parking of shopping carts in a supermarket does, however, become considerably more frequent and longer when consumers shop for fruits & vegetables and meat & sausages in those departments.

- Third, the results here also underscore the importance of carefully designing a store layout. Approximately half the shoppers in the store with the traditional layout never left their carts unattended, whereas three-quarters of shoppers did in the store with the more modern, free-flow layout. In line with Mehrabian/Russell’s (1974) model, we interpret this as approach behavior that can lead to more spontaneous purchases, as indicated by the sales figures gathered in this study. Retailers should thus provide more incentives to their customers to increase store traffic in the center of a store, which can become “dead zones” otherwise. Such zones can become even more problematic because the relevant assortments there include high-margin products.

- Finally, in terms of in-store shopping behavior, the results of this study further emphasize that supermarkets should not be treated as homogeneous environments. As Tab. 5 shows, consumer behavior differs considerably for various departments, and thus retail strategies intended to influence specific shopping behavior should be adapted to these specific departments.

5.2. Theoretical implications

From a methodological perspective, observational methods that focus on tracking shopping carts instead of shoppers (e.g., Hui/Bradlow/Fader, 2007; Hui/Fader/Bradlow, 2009) might lead to considerable measurement problems. The results of this study show that shoppers parked their carts for approximately 10 percent of the time that they spent shopping. Activities carried out during such time slots, however, might not be adequately covered by only tracking the carts.

The proposed measurement tool requires further testing of shopping behavior at the point of sale. However, this tool is a research tool more than a routine data collection tool because the human handling involved is costly. The scarcity of academic literature in this field calls for additional corresponding theoretical investigations.

5.3. Limitations and further research

The limited theoretical reasoning available on the approach used in this study does not allow us to generalize its findings to a great extent. First, the chosen measurement imposes several restrictions and does not allow for establishing causal relationships. Second, the observation method restricts the data considerably. For example, familiarity with the store or the extent to which customers have planned their trips (e.g., writing a grocery list) might also be important drivers of their considered in-store behavior; knowing the reason for the parking of shopping carts (e.g., increased mobility, fear of pick-pockets) might shed further light on in-store behavior; finally, crowding effects could not be analyzed thoroughly in the current context because of measurement problems.

These limitations offer several avenues for further research. First, this study investigated the use of shopping carts. However, many supermarkets (and other types of stores) also provide shopping baskets. It would thus be relevant for retailers to know how shoppers differ in their use of shopping carts and shopping baskets. Second, retailers in many European countries require shoppers to pay a cash deposit when using a shopping cart, a practice designed to induce shoppers to return the carts to a central location. Yet this cash deposit might also prevent some customers (primarily those shopping for only a few items) from using a shopping cart at all. The implications of this on sales might be worth exploring. Third, according to retail lore, empty shopping carts compel shoppers to fill them with products. Consequently, shopping carts are designed to be large to induce consumers to purchase a larger number of items. Research should empirically test this presumed relationship between the size of a shopping cart and the number of items actually purchased. We hope the current pilot study will stimulate further research in this important area of retailing.
References


Keywords
retailing, in-store behavioral data, customer tracking, shopping carts