Tracking customer behaviour in fashion retail using RFID

ABSTRACT

Purpose

The purpose of this study is to explore how tracking of products by the use of RFID technology may describe customer behaviour in real-time.

Design/methodology/approach

The study was conducted as a field experiment, where a commercially available RFID platform was deployed in the fitting rooms of a fashion retail store.

Findings

The study demonstrates an application of in-store RFID tracking to describe customer behaviour, and some practical challenges of utilizing such technology. An example typology of four fitting room traits was constructed based on the data collected.

Practical implications

Different customer types most likely require and respond differently to attention from the personnel operating the fitting room area. By identifying customer behaviour in real-time, it is possible to deliver "best practice" shop stewardship and create a more personalized retail experience.

Originality/value

The study is based on real-life retail settings, rather than anecdotal management observations or economic and demographic indicators. To the best of our knowledge, few contributions combine RFID and consumer behaviour outside conceptual work or laboratory experiments.

Keywords: RFID, Customer Behaviour, Category Management, Retail Operations, Fashion Retail, Supply Chain, Technology in the retail environment

Article Classification: Research Paper

INTRODUCTION

In today's business environment, fashion retailers face multiple challenges, most of which are related to the expansion into and balancing of omni-channel retailing. Customers are more informed than before, and the transaction cost of comparing and switching between both online and brick and mortar retailers is decreasing (Nunes and Cespedes, 2003, Stone et al., 2002). Physical stores have traditionally played the advantage of enabling product 'touch and feel', correct fit and sizing, zero delivery lead-time, and advice and up-sales from sales representatives (Bhatnagar et al., 2000, Liao and Cheung, 2001, Levin et al., 2003). However, the lines between online and offline retail are fading (Enders and Jelassi, 2000). Online channels increasingly offer free returns, next or same day shipping and improved choice navigation aiding the customers, while benefiting from advantages such as consolidated inventory, economies of scale in purchasing and lower labour and facilities costs. In order to remain attractive and economically viable, physical stores need to operate as efficient as possible and, at the same time, excite customers in innovative ways.

Under these conditions of modern retail, being able to detect and understand customer behaviour may constitute a competitive advantage. Ultimately, the retailer would like to know everything about the customer the minute he or she enters the store, in order to tailor a marketing message to the individual needs and beliefs of the customer and the nature of the selling situation. In online shopping, retailers generally have access to large amounts of log files and data-rich customer profiles through tracking cookies and analytics. However, such information is rarely available for physical stores. Instead, the retailer needs to categorize customers based on certain characteristics and serve them accordingly (Dodd et al., 1998). Customer segmentation has received significant attention in the quest for competitive advantage (Lewis and Hawksley, 1990), and research on the subject has a long history going back around 60 years (Van Vliet, 2014). Over the last three decades, customer segmentation has turned from macro-level (market characteristics such as demographical descriptions) to more micro-level (with focus on individual customers). This has led to increased attention to in-store behaviour mapping, to increase the understanding of the customers.

The study of customer behaviour in retail stores is by no means a new phenomenon. Applebaum (1951) discusses how analysis of records, observation, interviewing and controlled experimentation can be used to discern different types of customer behavior. Each technique has its advantages and disadvantages. For instance, many customer activities are observable without the customer knowing that the

observations are being made. As such, it does not alter the customer behavior. However, it can be a troublesome and expensive procedure, as it in some instances is necessary to follow the customer in the store to observe what he or she does. Stores can also serve as laboratories for conducting controlled experiments to investigate customer's behavior and response to different products and methods. However, as noted by Applebaum (1951), this requires stringent control, and is a complicated, slow and expensive technique. Some information is easiest to observe by interviewing customers in the store. However, in many instances this requires deduction, for instance for explanations of deviations between actual and planned purchases, as studied by Granbois (1968). To overcome this weakness, he proposes a combination of entrance interviews with in-store observation to study in-store behavior. While combinations of different techniques can provide more insight into customer's behavior, it requires even more effort.

Most studies have utilized either manual observational techniques, or surveys and interviews that rely on customers' retrospective recall, which can introduce a high degree of unreliability and little validity due to e.g. interview bias and manual counting (Newman et al., 2002). To address these shortfalls, several authors (Hui et al., 2013, Newman and Foxall, 2003, Newman et al., 2002, Dodd et al., 1998) have proposed video as a data source for tracking customer behavior. However, analyzing video to capture customer behavior in a real-time, unobtrusive manner is challenging. As discussed in this paper, new technological opportunities, such as those represented by electronic article tracking in the value chain, provide new sources for customer tracking data, that can be obtained in an unobtrusive, inexpensive and real-time manner. The goals of the paper are two-fold:

(1) This paper primarily demonstrates the use of radio frequency identification (RFID) technology to collect customer behaviour, illustrated through a case study of fitting rooms in a fashion retail store.
(2) The potential of using such in-store behavioural data for customer segmentation is verified through construction and description of a simple customer typology.

MARKET SEGMENTATION AND CUSTOMER TYPOLOGIES

As customer needs have become more and more diverse, the appropriateness of "one size fits all"-approaches to marketing has diminished (Hjort et al., 2013). Instead, market segmentation has become a standard marketing management response to heterogeneous markets (Lockshin et al., 1997, Storbacka,

1997, Wind, 1978). In market segmentation, businesses group customers with similar preferences, needs and/or characteristics into segments which are expected to exhibit similar purchase behaviour (Weinstein, 1994), in order to target the most attractive segments with a distinct marketing mix instead of using mass-marketing approaches (Hollywood et al., 2007, Dibb, 1998). Many different criteria for shaping and defining segments have been suggested and studied (Sarabia-Sanchez et al., 2012), and a number of different methods and techniques for segmentations are in use (Hjort et al., 2013, González-Benito et al., 2000). Traditionally, it has been carried out using combinations of easily measurable characteristics, such as demographic, geographic, socioeconomic and life cycle variables (González-Benito et al., 2000, Birtwistle et al., 1998, McDonald and Dunbar, 2004). However, such variables rarely provide enough insight into how customers actually behave (Hollywood et al., 2007). For instance, demographic variables fail to capture consumer information regarding preferences and attitudes, and geographic variables are usually too broad to segment today's diverse markets (Hollywood et al., 2007, Walsh et al., 2001). While psychological, psychographic and behavioural segmentation variables have been employed to cope with this (Birtwistle et al., 1998, McDonald and Dunbar, 2004), many businesses have problems operationalising segmentation as it does not necessarily result in homogeneous segments of customers for which appropriate marketing programmes can be developed (Dibb, 1998). In response to this, typology based studies have emerged as the preferred method of market segmentation, as they go further in examining customer needs and actions in terms of e.g. attribute importance, shopping motivations, frequency and attitude (Mortimer, 2012).

As for traditional market segmentation methods, customer typologies share a common goal of categorizing customers into a limited number of types that differ from each other. There is great diversity in how, and on what basis, various customer types are discerned (Westbrook and Black, 1985). The first taxonomy by Stone (1954) distinguished between four shopper types based on their orientation toward the shopping activity: (1) the economic consumer, (2) the personalizing consumer, (3) the ethical consumer, and (4) the apathetic consumer. Several other typologies (Stephenson and Willett, 1969, Darden and Reynolds, 1971, Darden and Ashton, 1974) up to the mid-70s show an emphasis on store loyalty, convenience, quality, price/bargain consciousness and moral in their categories. More recent typologies (e.g. Reynolds and Beatty, 2000, Westbrook and Black, 1985, Leszczyc et al., 2004) increasingly include other motivation factors in segmenting customers. A contrast occurring in customer categorization the last three decades is that of "doing the shopping" versus "going shopping". This highlights that shopping is not only instrumental but can also have a strong recreational value for customers (Van Vliet, 2014). In later years, several authors (Rohm and Swaminathan, 2004, Keng Kau et

al., 2003, Ganesh et al., 2010) have proposed typologies for online shoppers as this market channel has grown in popularity.

There are numerous challenges associated with segments and typologies in retailing (see e.g. Dibb, 1998 for an overview). For instance, large diversity across studies and narrow scoping of situations or products (e.g. food, clothing, age, gender) divert the focus away from the fundamental, group-based motivators of consumer decision making (Dodd et al., 1998). Further, the majority of the literature, be it market segmentation or customer typologies, considers shoppers as belonging in static segments (Jones et al., 2016). The problem of whether identified segments remain unchanged over time in terms of number, size and profile is largely neglected (Mortimer, 2012). Arguably, segments may change over time because of external market factors (Mortimer, 2012), and cultural influences associated with each purchase situation require shoppers to adapt to the situation, which puts less reliance on traditional static methods for segmentation (Jones et al., 2016). Finally, while many retailers value this knowledge highly, customer categorization if often based on anecdotal management observations or economic and demographic indicators, rather than real-life retail settings (Dodd et al., 1998, Reynolds and Beatty, 2000).

USE OF TECHNOLOGY FOR UNDERSTANDING THE CUSTOMER

Several authors (Hollywood et al., 2007, Machauer and Morgner, 2001) point out that many of the segmentation methods currently employed reveal little of predictive use to marketers as they focus on past behaviour. As noted by Storbacka (1997), the traditional retrospective way of analysing the customer base is more of a strategic tool, as its makes decisions regarding product and price discrimination and allows for systematic risk evaluation within the customer base. On the other hand, prospective analysis deals with the retailer's ability to enhance existing customer relationships in an operative or tactical manner, such as how to approach customers, communicate with them or influence their choices. Only by identifying how a customer behaves throughout the purchasing process the retailer can determine what the customer needs, and translate this into an offering (Nunes and Cespedes, 2003). According to Dodd et al. (1998), customers' purchase decisions are affected by interpersonal influences both within and outside the store, and these can only be understood by a combination of direct observation and in-depth accounts from the customers themselves.

In contrast to most studies that are largely based on customer surveys through personal interviews and/or questionnaires, Dodd et al. (1998) include data from real-life retail settings through camera-based observation. Later, several others have followed in the same lines. Newman et al. (2002) and Newman and Foxall (2003) use in-store CCTV cameras to track customers in a major clothing retailer. By developing a motion estimation algorithm, they are able to detect and track customers from the moment of their arrival at the entrance to the minute they leave the store, and present the shopping trips as distinct paths. These can be used for e.g. store design (Newman et al., 2002). Others have tracked customers' shopping trips by affixing RFID tags under the shopping carts (see e.g. Hui and Bradlow, 2012), or using information from handheld scanner guns that customers use to scan products' barcodes in self-service retail settings (Stilley et al., 2010). While these methods are unobtrusive, they do not give a clear impression of what happens during the shopping trip beyond the customer's movement. In response to this, Hui et al. (2013) equip customers with portable video cameras to directly observe and capture product consideration behaviour. While this gives more insight into the customer's behavior, the presence of a camera is hardly unobtrusive, and may arguably influence how the customer behaves; thereby failing to track true customer behavior.

New applications of RFID may arguably provide a more efficient solution for capturing and analysing data from retail in real-time. The cost associated with RFID has traditionally been considered a barrier to implementation of such technology (Garrido Azevedo and Carvalho, 2012). However, over the last years, tag and tagging costs have decreased and the availability of cheap and flexible reading equipment, such as hand readers for shop floor and inventory operations, has increased. Consequently, more and more companies find that the benefits of RFID outweigh the associated costs. In terms of operational improvements, it can be deployed to e.g. improve product availability, make inventory control more efficient, ensure product authenticity and improve theft control (Melià-Seguí et al., 2013, Garrido Azevedo and Carvalho, 2012). Some studies (Choi et al., 2015, Loebbecke et al., 2008) take into consideration the progression of item-level RFID and looks at how RFID in the fitting room opens for detailed monitoring of visual merchandising efficiency, correction of individually misplaced items, and instore product flow. At the same time, it enables interaction with e.g. smart fitting rooms, displays and mirrors to improve the shopping experience by e.g. offering product recommendations and information about garments (Loebbecke et al., 2008, Uhrich et al., 2008, Choi et al., 2015, Melià-Seguí et al., 2013, Serra et al., 2011).

Moreover, RFID can be used to gather data on the sales floor and help close the data void between the goods receipt and the point of sales in the store, thus offering the opportunity to directly observe and analyse physical in-store processes (Al-Kassab et al., 2011). In this respect, it should be noted that commercial application of tracking technology generally raises strong ethical and legal questions. Others have discussed how the use of RFID technology in particular, has profound consumer privacy, civil liberty, and security implications, see Kelly and Erickson (2005). While some (Hui et al., 2013) argue that RFID fails to capture customer behavior in terms of product consideration, this is arguably largely dependent on the retail setting. In fashion retail, trying on products in fitting rooms is tantamount to product consideration. Here, RFID can provide an efficient solution for capturing and utilizing data from retail in real-time. Much of the research in this area tries to overcome the issue of apparel recommendation systems being static and based on knowledge and experience of fashion designers and experts, by offering intelligent promotion and product cross-selling based on the customer shopping behaviour (Wong et al., 2012, Choi et al., 2015, Ngai et al., 2008). To the best of our knowledge no prior contributions address the potential of using RFID to analyse customer behaviour in the fitting room, at least outside conceptual work or laboratory experiments.

MATERIAL AND METHODS

This study was conducted in a high-end fashion retail concept store. The store is owned by a Norwegian lifestyle brand. The company is over 15 years old, and owns and operates 20 brand stores and outlets, plus representation in a small number of other chains as well as online retail in three countries. The brand is positioned as an upmarket brand targeting primarily urban consumers. A store in the chain carries in excess of 2’500 SKUs across 600 products with accompanying variations in size and colour in any given season.

The particular store that were instrumented were chosen out of convenience; one of the (physically) smallest stores in the chain allowing for full instrumentation and least obtrusive for normal operations. The retailer primarily uses RFID for inventory control, using a hand-held reader and tablet setup for stocktaking and inventory management/replenishment. Before implementing RFID, stocktaking was a cumbersome task that involved a large workforce and lasted for hours. With RFID in place, one salesperson uses less than 15 minutes to take inventory of the entire store, thanks to RFID's ability to detect multiple items in very short time (close to instantaneously). This has allowed the retailer to increase the stocktaking frequency from once a month to several times a week. Similar to the hand-held

reader, the fitting rooms' antennae are able to detect multiple items in such short time that the readings appear simultaneous. This is used to detect the presence of multiple garments within one fitting room, for situations where customers bring more than one item to try on.

DATA COLLECTION

A commercially available RFID platform were deployed in a high-end fashion retail concept store in Oslo, Norway. The store has three fitting rooms, separated by half height walls from the surrounding store (see Figure 1). The fitting rooms were equipped with separate addressable RFID-antennae, one per room, connected to a common reader. The RFID reader was used for continuous detection, and a computer connected to the in-store network recorded tags as detected by the three antennae, and stored it to an online database for the purpose of this study. The installation and configuration of the system was conducted by, and in close cooperation with, the technology vendor. In addition to tuning of operational parameters such as field strength and reader sensitivity, the fitting rooms were covered with metallic foil to shield them from spurious readings between rooms.

The retailer already uses RFID for inventory management and other retail operations, so all products were sourced tagged prior to the study. Item-level Point of Sales (POS) data was extracted from the store's checkout system.

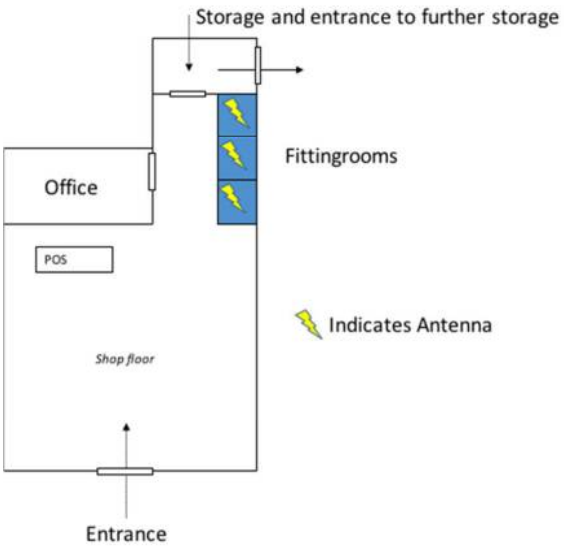

FIGURE 1 SHOP LAYOUT

DATA AND DATA ANALYSIS

The data were stored in a structured database storing high-resolution timestamp, SGTIN merged with the master data record for production identification, and room id. Prior to analysis, the data were trimmed to the store opening hours, discarding any out-of-hours activity. The data was imported into the statistics software R (v3.2.4) for further analysis.

Due to the inherent technical challenges with accuracy and completeness of RFID, the data was processed through a custom filtering pipeline – attempting to remove obvious spurious readings and duplicate and missing detections. The two main data quality issues are missing detections and cross-reading between fitting rooms. In the case of missing detections, tags are detected in a fitting room, but then erroneously not read for a short period, appearing as entering and leaving the fitting room in rapid succession. This may be due to the orientation of the tag in the fitting room, or the customer unknowingly and unintentionally obstructing the reader. Cross-reading is when products in one fitting room suddenly are read once or for a short period in a neighbouring fitting room (spurious reading), or products passing outside all three fitting rooms in periods of disuse (due to e.g. open doors and radio reflections).

Detections were fused into episodes per product using a ten-minute rolling-window per fitting room. Spurious readings were filtered and discarded within the fused period. Sizes and gender division of products were assigned according to the master data record, and sizes were recalculated (for the purpose of comparison) into letter sizes (XS-XXL) based on generic size tables per product type.

ETHICAL CONSIDERATIONS

The ethics of the study were considered and discussed prior to commencing the data collection. The study itself did not introduce additional registration outside what were in place in normal store operations. No information about store patrons were registered, and the data collected does not contain any identifying features about the customer or store employees. The RFID setup does not cover the entire store, nor does it permit spatial tracking beyond mere proximity/presence in fitting rooms.

RESULTS

Based on data collected from 46 days at the beginning of 2016, parsing and transforming the raw RFID feed yielded 8 014 fitting episodes that lasted between 1 and 30 minutes within opening hours (9am-7pm Monday through Saturday). Tallying for opening hours, this translates to fitting room activity only accounting for 9% of opening hours.

The relative share between product categories is shown in Figures 2 and 3. The products are categorised into Men and Women's clothing, as well as separate categories for Children's clothing and "Other" articles (including unisex and accessories). Figure 2 shows sales according to POS, while Figure 3 shows the fitting room activity for the same period. The difference between these two figures partly indicates that there is a difference in fitting room behaviour, in that the relative share of Women's products in the fitting room is much greater than the relative share of Women's products sold. Similarly, for the narrower categories of Children's and Other, as to be expected these articles are sold without being tried in fitting rooms.

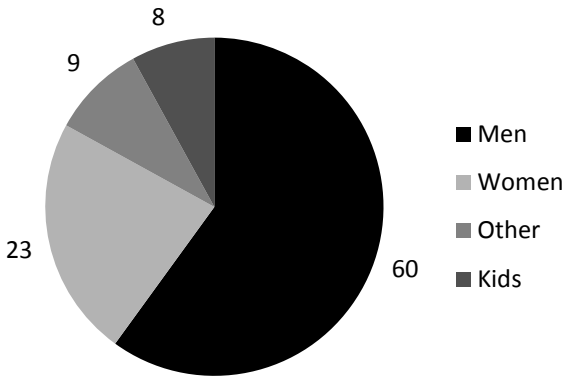

FIGURE 2 SALES BY GENDER

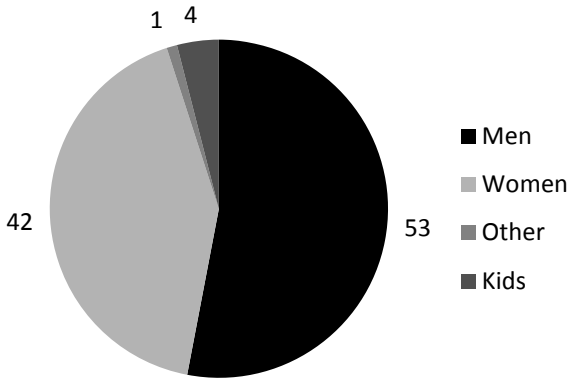

FIGURE 3 FITTING ROOM ACTIVITY BY GENDER

As shown in the figures, on a very coarse level the statistics indicate that Women's products are overrepresented in fitting room activity when compared to sales figures.

Further analysis of time spent in fitting rooms between the categories revealed minor differences in time (less than 1 minute between Male and Female products), but statistically significant (t-test, $p<0.05$). The mean time for an episode being 4.4±5. minutes. The distribution of length of stay in the fitting rooms per episode is skewed with a longer right tail, the median being 2 minutes.

Dividing further, into size distribution (Figures 4 and 5), we can see that there is a distinct pattern to skew between fitted sizes (as shown in grey) and sold sizes (shown in black). For both genders, there is a difference in the distribution of sizes sold and fitted (Chisq $p < 0.05$). Colloquially, it may be said that customers "try smaller sizes than they buy".

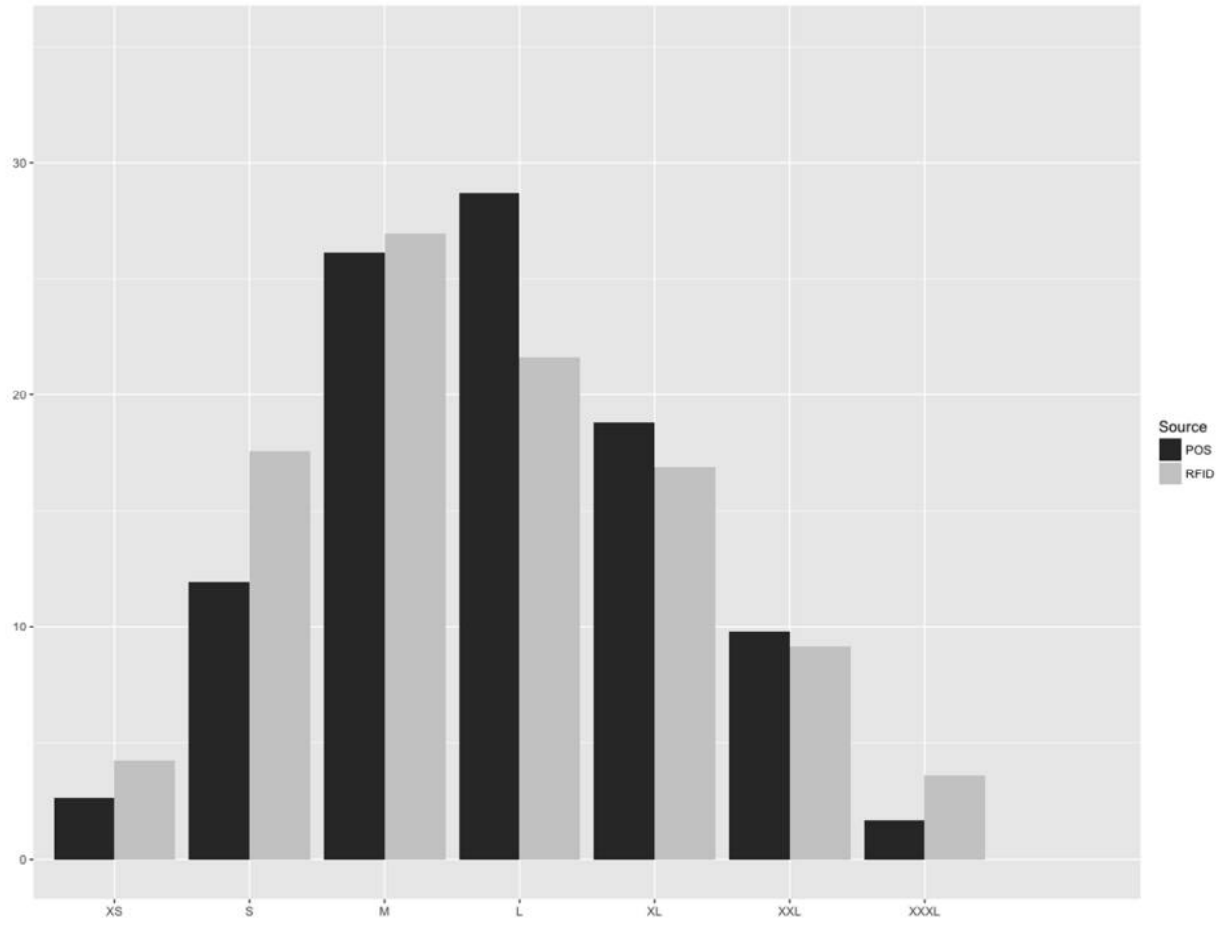

FIGURE 4 MEN'S SIZES SOLD (POS) VS FITTED (RFID). PERCENTAGES 100% WITHIN SOURCE.

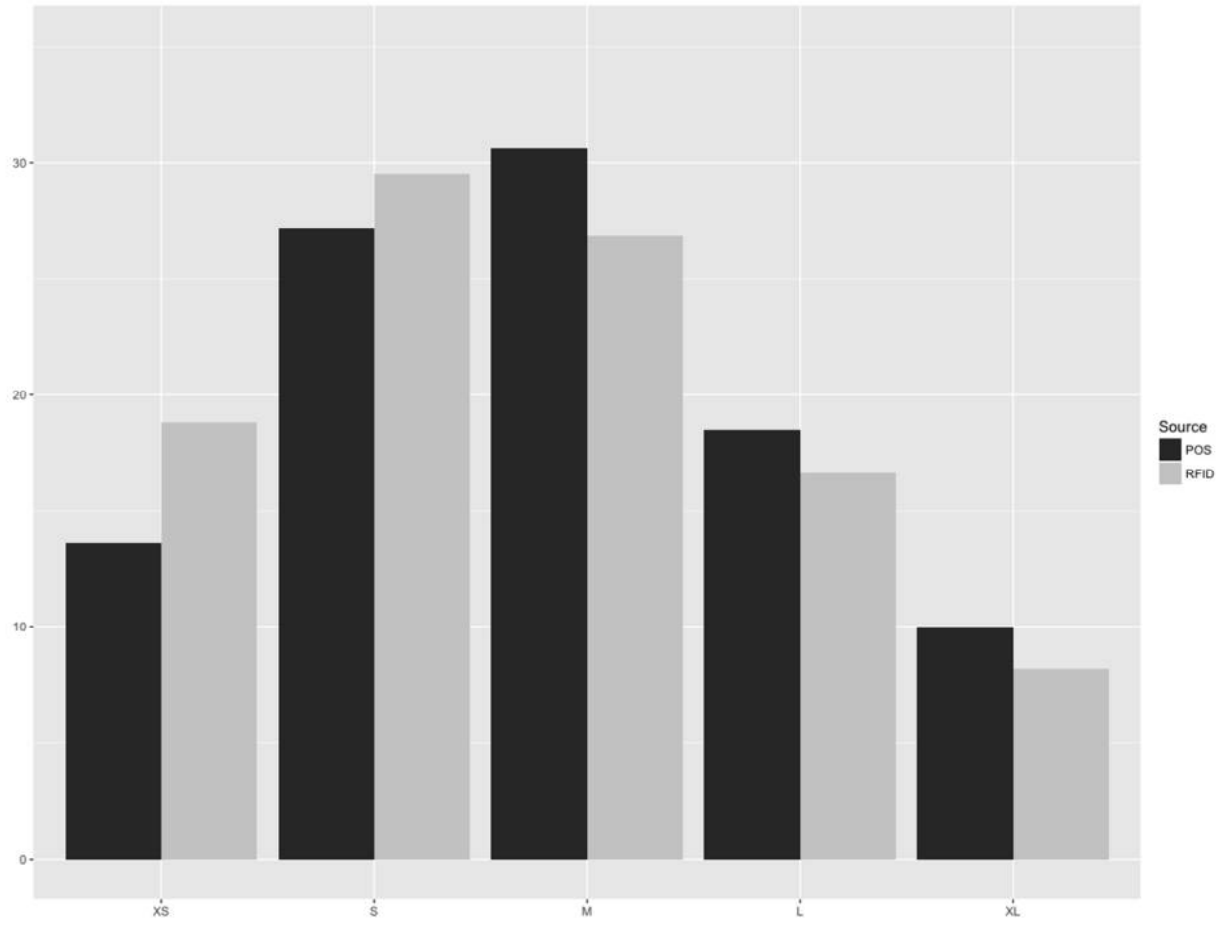

FIGURE 5 WOMEN'S SIZES SOLD (POS) VS FITTED (RFID). PERCENTAGES 100% WITHIN SOURCE.

Moving further in, it is possible to plot the individual RFID detections per fitting room on a timeline. This allows us to examine the contemporaneity of fitting episodes. Figure 6 shows a day (10am to 6pm) for a single fitting room. Products along the Y-axis, with colours and sizes indicated (product names censored), and time along the x-axis. The colouring indicates gender of product.

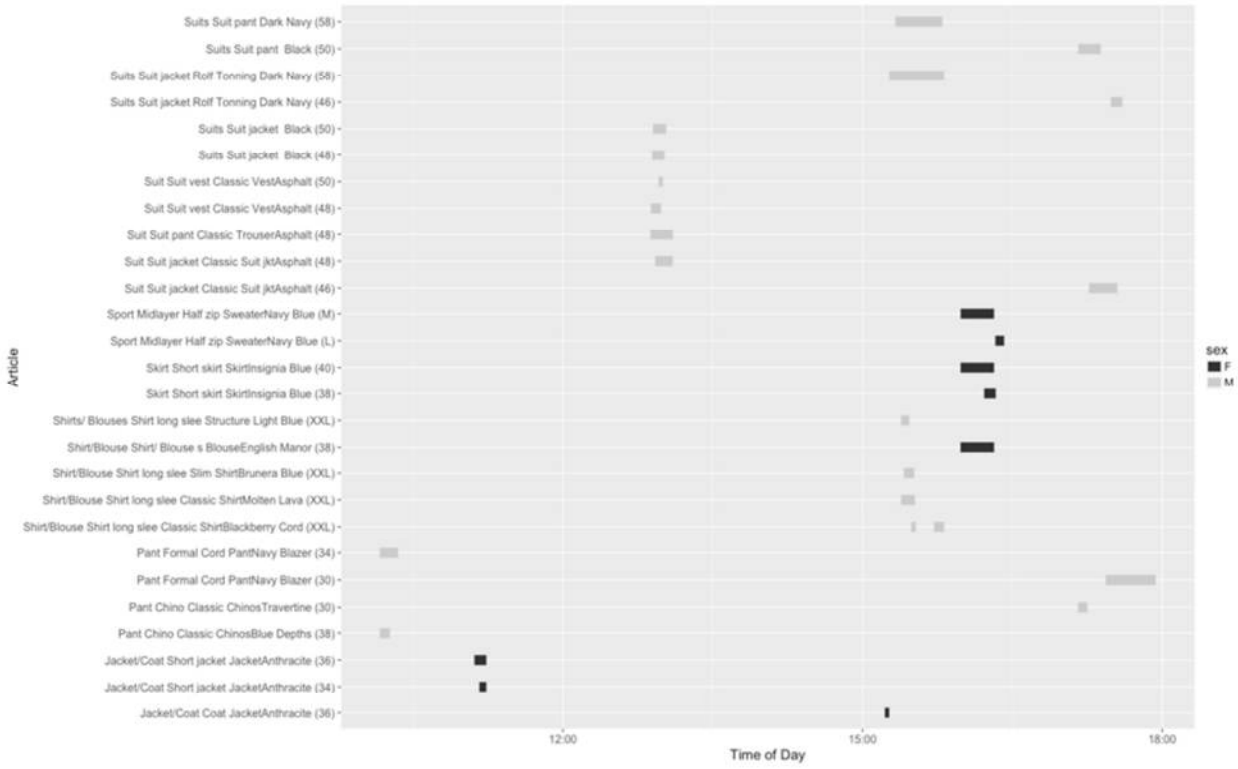

FIGURE 6 FITTING ROOM EPISODES SHOWN ON AS A TIMELINE, COLOUR INDICATES PRODUCT GENDER

RFID-BASED CUSTOMER TYPOLOGY

Based on the data, four patterns of fitting room behaviour were identified. These arguably require different treatment from a retail operations standpoint (be it upselling, visual merchandising, or tailoring of customer experience). In this preliminary typology, the types are (1) Looks, (2) Size, (3) Size and Looks, and (4) Functional Multi-Purpose. These are not orthogonal. For example, sizing customers may also exhibit multi-purpose traits.

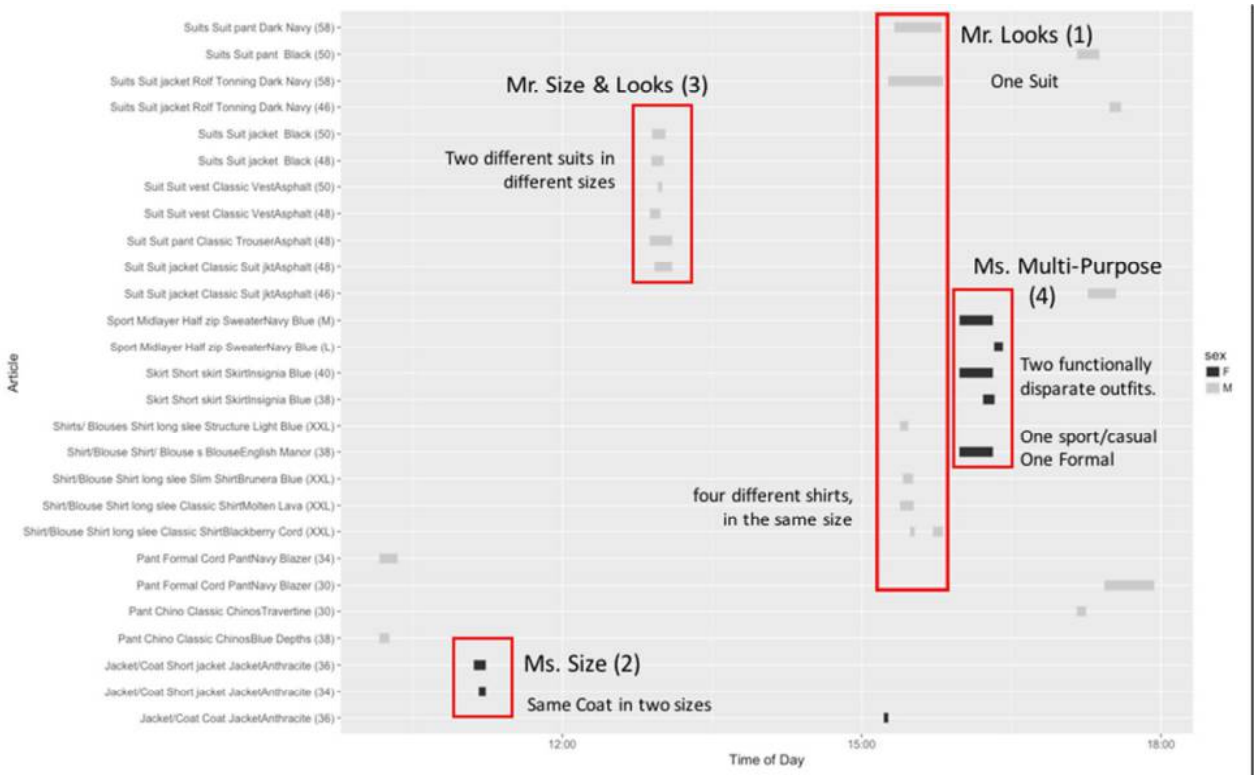

FIGURE 7 ANNOTATED EXAMPLES OF DIFFERENT FITTING ROOM BEHAVIOUR DETECTED THROUGH RFID. PRODUCTS ON THE Y-AXIS, TIME OF DAY ON THE X-AXIS COLOUR INDICATES PRODUCT CATEGORY (TURQUOISE=MALE, RED=FEMALE)

(1) LOOKS

The stereotypical Looks-customer is one who brings identical products (by design or function) and presumably compares aesthetics rather than functionality or design. For instance, bringing multiple shirts all of the same size in order to judge the look in the fitting room. Hence, it is assumed that the customer is familiar with his size, and wishes to try out the look of the product rather than the size. An example of this behaviour is shown in Figure 7, labelled *Mr. Looks*, where in a single episode a jacket and pants is combined with four shirts of identical size (but different looks). In this case, this turned into conversion of the suit and two out of four shirts.

(2) SIZE

The stereotypical Size-customer, on the other hand, is the customer who brings identical products in various sizes in the fitting room. This assumes that the customer to a degree has chosen which look to shop, but is sampling the fit and size of the product. The episode labelled *Ms. Size*, is a simple example

where a coat is tried on in two sizes. In this particular case neither converts (according to POS) – which as a side note may be an example of the disparity between Figure 2 and Figure 3.

(3) SIZE AND LOOKS

Customers may also display both these traits at the same time, for instance by sizing parts of an outfit while considering the look for the whole outfit. For instance, as seen in Figure 7, the episode labelled *Mr. Size & Looks* display both traits at the same time. Here, the customer brings two different suits in two adjoining sizes in the same episode. This may be an efficiency strategy, maximising size and looks in the same fitting session. POS data may confirm the customer's motivation for using this strategy.

(4) FUNCTIONAL MULTI-PURPOSE SHOPPING

Additionally, the RFID data indicates that customers display a significant amount of functional multi-purpose shopping (FMP), where the customer combines different categories in a single trip (Leszczyc et al., 2004). As shown in Figure 7, *Ms. Dual Purpose* fits multiple sizes of a long-sleeved sports sweater (casual-sportswear) in the same episode as sizing two skirts and a blouse (formal attire). These functionally different product categories do not combine to a single outfit in a good way. When combined with POS data, the episode in question ended with conversion of the larger size of the two skirts – while she purchased the casual-sportswear in a size larger than the two that were brought into the fitting room. In the end, the customer combined the purchase of two functionally disparate outfits in a single shopping trip.

DISCUSSION

This study demonstrates the feasibility of RFID technology for fine-grained tracking of customer behaviour. Moreover, addressing the problems discussed by Dodd et al (1998) and Reynolds and Beatty (2000) regarding anecdotal or episodic data collection, it illustrates how the use of in-store RFID allows for continuous and real-life in-store analytics with minimum effort. In our case, the assignment of a customer into a category is purely based on the actual behaviour exhibited on the day, without regard for prior shopping behaviour. This may mitigate the problems of static segments that fail to account for changes over time (Mortimer, 2012, Jones et al., 2016). The application of such a setup yields several opportunities for the storeowner, as well as research opportunities (Melià-Seguí et al., 2013).

Prior to segmentation and further analysis based on RFID tracking if the fitting room, data accuracy and quality must be assured. In this study, the main challenge for data accuracy and quality was to obtain a

balance between reading reliability, detection speed, and accuracy of RFID tag location. Initially the fitting room antennae detected products outside the fitting rooms. Limiting the reading to the fitting room area was improved by balancing the transmitter power and reader sensitivity. This is a generic challenge for RFID deployment in retail operations.

Tracking products rather than customers creates some limitations regarding analytics. For instance, a customer who fits a product, returns it to the rack (or assistant) and then returns to the fitting room with a different product is mistaken as a new customer and thereby not classified into the correct type. In the proposed typology, this should be divided into a Looks- and/or Size-customer, but based on product tracking this is two separate fitting episodes. The same applies for customers that exhibit online purchase patterns, i.e. that purchase products and bring them home for fitting, and later returns them to the same or a different store within the chain. This also limits the possibility to merge online and physical customer behaviour patterns. Despite all of these drawbacks, this study has shown that in-store tracking of products still provides valuable insights into customer behaviour, and that the practical implications of fact-based insight into fitting room behaviour are vast.

Implications for Research

The goal of all research into retail segmentation is to provide actionable knowledge on behavioural differences that can be turned into a strategic advantage for a retailer. However, previous work on retail segmentation has shown that creating models that can be operationalised is difficult (Lockshin et al., 1997).

Much of the research into retail segmentation in physical stores has been based on retrospective static analyses and descriptive models for strategic discussions, rather than predictive, dynamic and operational models for suitable for direct customer engagement, which are commonly found in research on online retailing. However, RFID makes it possible both for researchers and practitioners to move beyond the static snapshots of customer segments, and base the research on richer customer data, akin to the research in online shopping behaviour.

Practical Implications

With an RFID-enabled product base, the instrumentation of fitting rooms represents a minor cost with a potential return in terms of in-store analytics. The focus of this study has primarily been on the fitting room behaviour and creating an evidence-base for a set of fitting room personas and typology

construction for further work. By identifying such traits, it is possible to devise best practice shop stewardship, which in turn can be operationalized by creating a more personalized retail experience. Different customer types most likely require and respond differently to attention from the personnel operating the fitting room area. Understanding these mechanisms may constitute a competitive advantage (Lewis and Hawksley, 1990).

The output from a system performing dynamic customer segmentation based on fitting room data need to be communicated to staff through mobile terminals or screens in appropriate areas of the store. In this way they can choose between various customer engagement strategies based on the identified customer type. This does not remove the need for skilled sales personnel in the store, but rather aids with more information in applying their skills.

In a larger picture, RFID monitoring of fitting rooms may significantly improve possibilities within retail operations analysis. For instance, in combination with POS-data it is possible to examine which product combinations convert well, and which lead to cannibalisation. Further, it is possible to see if size of the various product designs correspond with customer expectations. For instance, this may explain some of the skew between fitted and sold sizes (cf. Figure 4 and Figure 5), and may provide guidance for both store setup and a way to judge goodness-of-fit.

PRIVACY AND ETHICAL IMPLICATIONS

This study has focused on the technical and practical lessons learned from such a setup – but there are obvious issues to the introduction of new technology both in retail and in general.

Direct observation of customers raises many ethical considerations. Our pilot does not extend outside the scope described by others (e.g. Kelly and Erickson, 2005), but there are obvious concerns in the operationalization of such technology. Applications in loyalty programmes or similar customer-tracking schemes where the use of both real-time and historical information will challenge the privacy of participating customers. These concerns are similar to those of existing customer profiling in loyalty schemes, but tracking of articles in store, prior to purchase, extends the data significantly. Formally, the articles are mostly at the privy of the store owner (similar to the wide-spread adoption of electronical article surveillance for theft purposes), but the storage and potentially identification of potential customers increases the sensitivity of the information.

The use of RFID bypasses some of these issues by monitoring products rather than customers. This may be further strengthened by stores disabling the RFID tags when products are sold (this step is often an

integral part of theft control). Ethical considerations and judgement should be applied when it comes to storing and re-using such data for other purposes.

Study Limitations

The study presented was performed on a single store. As such, the generalizability into generic customer behaviour traits is somewhat limited. Further research using more generic product categorizations and data from multiple stores would increase the generalizability of the results and provide results that may be more generalizable in terms of customer behaviour. Further, the study was carried out over a limited period of time, and therefore does not capture the full extent of seasonal changes in collection and its effect on customer behaviour.

Conclusion

Some contributions look into the enhancement of customer experience through shop floor optimization enabled by RFID data capture, but experimental results from real stores with real customers are limited. Only a few specifically look into the potential of RFID in fitting rooms in combination with point-of-sales data. By looking into more than mere conversion rates, it is possible to demonstrate practical applications of in-store RFID for other purposes than stock keeping and theft control in real-life operating conditions, without very specialised or dedicated equipment. Tag and tagging costs have decreased and the availability of cheap and flexible reading equipment, such as hand readers for shop floor and inventory operations, has increased.

This study demonstrates the viability of using RFID to categorise customers into a number of behavioural traits in the fitting room. RFID data is used to elicit a few broad types of customer behaviour. The typology is based upon fitting room episodes with multiple products, varying with size and/or style, where POS data comparison is used to 'validate' the outcome of each episode; i.e., what the customer ends up buying. In this way, RFID captures customer behaviour that has previously not been known by the retailer, covering the selection process prior to purchase.

The main application of RFID in fashion retail is still within logistics and upstream supply chain management. Only through identification of customer behaviour *throughout* the purchasing process may the retailer determine what the customer needs, and translate this into an offering. This study have shown that utilizing RFID at the very end of the supply chain can help better understand customer behaviour, at a negligible additional cost.

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