The Last Mile and the Next Day:

The changing times and spaces of shopping – implications for energy demand

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Abstract

There are many forms of shopping and all have consequences for the movement of goods and people, and for the patterns of energy demand that follow. In bringing different aspects of DEMAND research together we make three key points. First, different modes of shopping affect the practices and energy demands of consumers and of retailers, distributors and producers alike. Second, patterns of energy and travel demand vary depending on how aspects of shopping are organised in time and space. However, our third point is that different forms of shopping co-exist, overlap and change. Rather than trying to compare the energy demands of physical vs online shopping, as if these were coherent forms, the more important task is to explain escalating expectations of delivery and of what shopping entails. For all forms, what matters is how the 'last mile' is organised and why the 'next day' is so significant. In developing these points our aim is to inform and promote further research and reflection on the travel and energy demands associated with shopping in all its forms.

Introduction

Online shopping is now the primary mode of shopping for 48% of 18-24 year-olds (Commission on Travel Demand, 2017: 2), 90% of those aged 16-34 have purchased an item online within the last 12 months (Jones, 2017), and in recent years the format of 'click-and-deliver' has spread. As these figures suggest, forms of retailing and related patterns of consumption are on the move. This is not simply a result of the 'arrival' of online shopping: it is a consequence of multiple interlocking trends in how, where and when goods are manufactured, bought, sold and used.

There is a significant body of research on the energy and carbon impacts of the raw materials, processing, and industrial production of goods (Wiedmann and Minx, 2008), and on the travel-related energy implications of trips to the shops and of deliveries between providers, retailers and end-consumers (Mangiaracina et al., 2015). In all of this there is tendency to treat producer-logistics and consumers' shopping habits as separate fields.

By contrast, we conceptualise shopping as a practice that is at the intersection of systems of provision and consumption and that also links them (Stobart, 2010). Thinking about shopping in these terms allows us to consider the distinctive spatial and temporal features of different 'modes' of shopping, and the extent and character of the energy demands that follow.

What is shopping and how has it changed?

Shopping is a routine, familiar and taken-for-granted aspect of everyday life: it is also constantly changing. Forms of buying and selling have always been interlinked, and as social and cultural histories of shopping and retailing (Davis, 2013; Klaffke, 2003) show, innovations on both sides of the till have involved new materials (displays, baskets and trolleys, labels, see Cochoy, 2009), procedures and practices, including stock-keeping, displaying, and delivering

on one side and budgeting, browsing and bargaining on the other (Stobart, 2010). Different methods of organising buying and selling combine to form what we describe as 'modes' of shopping, each of which has distinctive spatial and temporal qualities (Mattioli and Anable, 2017).

For example, in the mid to late 20th century dominant modes of shopping involved walking around a high street of village, town, or city, with a basket or a shopping trolley, and purchasing goods in specialised shops and/or using cities' department stores. These forms of shopping took place throughout the week, with extended trips at the weekend. From the 1970s onwards in the UK, malls or 'enclosed shopping centres' (Bunce, 1983) were built, along with the development of 'out of town' supermarkets. The subsequent rise of supermarket shopping,[1] led to much speculation about the 'death of the high street' (Oram et al., 2003), and the replacement of multi-sited grocery shopping with a single weekly, bulk shop. Similar trends occurred in non-food shopping, with big-box retail units located at the periphery of cities, or even on the motorway system (Fernie et al., 2010) competing with town-centre shops specialising in furniture, décor, DIY, appliances, technology and other goods, and with out-of-town supermarkets also selling non-food goods.[2]

Many of these developments relied on the car. As Bunce explains, "assumptions about shoppers' means of transportation [were] implicit in many new shopping developments" (Bunce, 1983: : 312). And as Urry (2004) and others have observed, inexorable increases in car use have enabled the spatial distancing of increasingly 'peripherally centralised' sites (Cass et al., 2005), which in turn make cars even more essential for everyday life.

These are not the only ways in which shopping in the UK has developed since the 1970s. The range and types of goods provided and how they are distributed has also changed. For example, increasing amounts of frozen goods and exotic fresh produce have required extended cold chains and/or more frequent deliveries.

There are also trends in the other direction. For example, in England, over the 20 years to 2014 the National Travel Survey indicates that the average number of 'shopping trips' has decreased (by 27%) as have average distances travelled to the shops (by 19%). In short there is evidence of an ongoing re-arranging of 'shopping' in ways that predate the 'arrival' of online options. This is important in that all such developments matter for how goods and people circulate, and for the travel and energy demands that follow.

Modes of shopping: spatial and temporal characteristics

To understand the forms of transport and travel associated with shopping we need to consider how different modes are organised in space and time. To take the spatial aspects first, the various formats of shop that now exist (e.g. high street, supermarket, big box retail, convenience store, open market, catalogue shop, online shop) differ in the following respects. Each has:

- a typical size (from a corner shop to a hypermarket);
- a typical location (suburban/local, high street/central, or peripheral/out-of-town);
- different provision of storage and display space in-store (which determines whether goods have to arrive just-in-time, the range of products available to the consumer etc.);
- links to supply chains of different lengths (deliveries from vehicles of different sizes from different suppliers and locations), in turn requiring;
- space for deliveries to the shop, either on-street or off, and storage.

These characteristics are significant in that people have to travel to shops physically or virtually and find ways of bringing the goods they purchase back home – either by transporting them personally or having them delivered. Modes of shopping, and types of shopping environment consequently intersect with geographies of mobility systems: parking places, loading sites, public transport routes and cycle lanes. And for retailers as for consumers, the storage of goods is a crucial issue, requiring space in warehouses, shops and homes, including cold spaces.

Space is only one aspect. Time and timing, including notions of convenience and speed of delivery are also important. From the retail side, relevant temporalities include the working hours of employees and the time required to receive, prepare and (re)display stock and clean the premises. Daily and weekly schedules are also organised around opening hours (as the main window of activity), and delivery times. The timing of deliveries in turn depends on the type of shop, the supply chains involved, and local authority regulations like those that limit traffic in city centres and pedestrian areas. In addition, deliveries can be regular and predictable or triggered by 'just in time' strategies (Cherrett et al., 2009), seasonal peaks such as the run up to Christmas, or the schedules of suppliers and logistics carriers.

From the consumer perspective, the, temporalities of shopping relate to its:

- duration (from a moment for an online impulse buy to a whole day's leisure shopping);
- regular or routinized nature (e.g. on a set day every week) or its spontaneity;
- periodicity (a bi-/weekly food shop, daily milk purchases, weekly window shopping for clothes and other goods), and;
- timing (to coincide with shop opening times, but also to fit around or within other schedules of work, education, family, leisure etc.)

In practice the temporal and spatial aspects of shopping are interlinked – for example, the amount of space required for storage relates to the temporal 'flow' of goods, which is related to rhythms of consumption as well as those of provision, and to other considerations such as cost and land value.

Although it is useful to describe and characterise different 'modes' of shopping in these terms, it is important to recognise that these are not stable arrangements. For example, major supermarket chains now operate what look like corner shops: providing large-scale logistics behind the façade of a small-scale outlet. In addition, forms of on- and off-line shopping continue to co-evolve, becoming increasingly complex and perhaps increasingly interlinked.

On and off-line shopping: fragmenting and de-tethering?

Physical shops have traditionally 'anchored' practices of buying and providing in space and time. Forms of online shopping complicate and challenge some of these relationships.

The rise of internet access, and the availability and use of laptops, tablets, and smartphones, correlates with the rise in online shopping, with both showing smooth rates of growth since the turn of the century (Allen et al., 2017a: 2). Online shopping, which now accounts for 10-12% of retail sales in the UK (Commission on Travel Demand 2017: 2), has distinctive space-time characteristics.
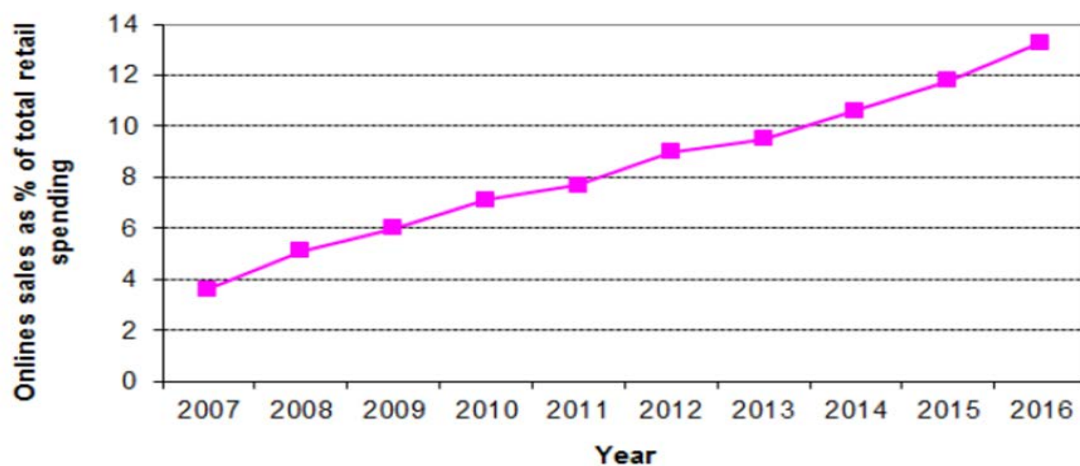

Figure 1: Online sales as a percentage of total retail spending in the UK, 2007-2016 (Source: Allen et al. 2017a: 2)

In spatial terms, online shopping is 'de-tethered'[3] meaning that there is no need to be physically present, and that acts of purchasing, browsing etc. can take place in any web-connected site whether that be at home, at work or on the train (Wiig, 2016). In response, increasing proportions, particularly of larger businesses[4] are now 'cross-platform'– with an online presence complementing their physical shop(s). Cross-platform or 'multi-channel' shopping is not a new phenomenon (eg: mail order catalogues existed prior to the 20th century). What does appear new is the significant growth in 'multi-channel' operations across multiple retail sectors, and a proliferation of forms that allow people to engage in shopping and shopping-related activities (eg: browsing, price comparison, purchase) via social media, 'marketplaces' such as eBay or Amazon, and Comparison Shopping Engines (CSEs).

In terms of time, and from the consumers' point of view, e-commerce is more flexible than traditional shopping. With a smartphone or similar device, literally any time can be shopping time. Opening hours are not relevant, and with items like streamed music, e-books or travel tickets, the instantaneous quality of receiving goods at the point of purchase is retained. In other cases, and as with mail order, e-commerce has helped separate activities like browsing and purchasing in time and space, meaning that different 'aspects' of shopping can happen over extended periods or in a broken series of shorter moments of attention (Peterson et al., 1997; Schiffman and Kanuk, 1999).

The spatial 'de-tethering' of shopping and its temporal fragmentation have further consequences for the geographies and temporalities of retailing, provision and delivery. For example, there are many ways of delivering goods bought online. In some cases deliveries are organised by companies that have sophisticated logistics systems, but sometimes individual items are sent from one person's home to another – as is the case with purchases from 'marketplaces' such as eBay. Either way, with more people and organisations involved in (re)selling online, the number of 'last miles' travelled is likely to increase (Riccardo et al., 2015: 581; Van Wee et al., 2013; Allen et al., 2017b). Since consumers and retailers are no longer co-located, the delivery of online purchases appears to add to what Allen et al. call 'logistics sprawl' (Dablanc et al., 2014; Allen et al., 2017b) with increased distances to, from and between geographically dispersed warehouses. The extent to which the growth in 'last miles' is a growth in miles driven and energy used will depend significantly on the extent to which the deliveries process is one in which lots of different 'last miles' get put together.

The timing of delivery is therefore critical. In the past, it was usual to wait for 'mail order' purchases to arrive in the post – often a delay of a few days or more. The gap between ordering and receiving goods has been shrinking. For example, in the case of food shopping, 'next-day' deliveries increased by 50% between 2013 and 2015, with 74% of online retailers offering next-day and 4% offering same-day delivery services in 2016 (Allen et al., 2017a: 19, 55). Consultants report that "free next-day delivery and an accessibly priced same-day service is becoming the norm", a conclusion based on the finding of "six in ten shoppers abandoning baskets online […] because of issues relating to the last mile […] fast becoming the ultimate battleground for retailers as shoppers demand more convenience."[5]

In combination, increases in the number of delivery service providers twinned with the goal of 'next day' delivery makes it difficult to consolidate and streamline distribution (Cherrett 2017). A further complication is that in some sectors up to 50% of all online purchases are returned, a pattern that is incentivised by a number of factors including free delivery for large spends, and an expectation of home browsing and return, enabled by 'easy' return policies.

More immediately, the challenges of synchronising delivery times with times when recipients are at home are significant (Jones 2017). Failed first-time home deliveries have enormous environmental costs as well as costs to businesses (Song et al., 2009; McKinnon and Tallam, 2003). Alternatives, like sending deliveries to workplaces or pick up points, using 'click-and-

collect' services, or relying on neighbours, family, or friends appear to be gaining ground but there is no one 'solution'. Which arrangement works best and when differs from case to case and depends on the existence (or not) of a safe place to which deliveries can be made.

In summary, physical shops have acted as spatial and temporal anchor points for deliveries and for shoppers. There are obvious complications, such as product availability, the challenges of finding time to get to the shops, and of getting goods home, but in general, the experience of shopping has been instantaneous: when something has been bought it is usually handed over on the spot. For retailers, the existence of bricks-and-mortar shops has made it possible to exploit economies of scale and develop sophisticated and increasingly efficient logistics systems. The fragmented and distributed time-spaces of online shopping threaten to undo some of these arrangements: more trips are needed to transport smaller numbers of goods between an increasing number of suppliers and consumer-recipients, and back again when items are returned or when attempted deliveries fail. In the words of Allen et al. (2017b) there is a risk that 'everyone delivers everywhere'.

In reflecting on these trends it is tempting to ask whether online shopping is somehow 'better' or more efficient than the physical version, but it doesn't take long to realise that this is an impossible question to answer. As is already obvious, the forms are not entirely distinct. More than that, they are closely interwoven: one mode of shopping does not simply replace another, instead, multiple forms co-exist. In thinking about the implications of present and future trends for energy and travel demand, it is nonetheless useful to take stock of the more obvious spatial and temporal characteristics of different modes, and of the various practices involved.

Multiple modes of shopping: implications for energy and travel demand

At a societal level, significant transitions between one or another of these stylised 'modes' are likely to have noticeable consequences for spatial and temporal characteristics of 'shopping' (seen in the round), and for the forms of travel and energy demand that follow.

For example, as supermarkets and big box retail outlets became more dominant (compared with high street shops), the car dependence of shopping and the distances travelled rose, in aggregate (Mattioli et al., 2016). Similarly, there is evidence that a swing towards online shopping has resulted in an increase in the amount of van traffic, some of which relates to a growing number of home deliveries (Allen et al., 2017b).[6] Other research indicates that in Britain, vans used to deliver online shopping goods currently make up 10% of observed daily van traffic (Braithwaite, 2017).

Constituent shopping practice (Zhai et al., 2016)	High street shopping: Frequent multiple trips to nearby sites	Supermarket bulk shopping: Fewer trips to more distant sites	Online shopping: Multiple fragmented activities in varying times and places.	Energy/travel implications
Browsing (Product trial)	In person/online, visual and tactile, in opening hours. Assistant may have tablet.	In person/online, visual and tactile, in opening hours, fewer trips to distant sites.	Visual and informational. Multiple shops' stock comparable.	Physical and virtual, depending on item .
Price comparison (Information search)	Inter-shop, sequential. Assistant tablet may help.	Inter-shop, sequential. Online.	More prevalent and sophisticated. Increase 3rd party websites (Google shopping tab). Instant.	Increasingly virtual, potential to reduce mobility and energy impacts.
Purchasing (transaction)	Cash/card, in person, in opening hours.	Cash/card, in person, in opening hours, OR online	Virtual, instant, through online banking, intermediaries (PayPal) etc. Any time, anywhere.	Increasingly virtual, Over-purchasing and returns (encouraged by retail) energy/mobility intensive.
Home delivery	Consumer usually responsible, except for large items.	Consumer usually responsible, bulk shops necessitate cars or portage.	Now occurs in brick/mortar shop, 3rd party shop, home, work, neighbours and more. Deliveries from multiple sources, individual deliveries.	Home delivery dominates, more efficient than dedicated shop trip, but increasingly fragmented, and increasing returns. Heterogeneity makes assessment difficult.

Table 1: Modes of shopping. Source: based on Jones (2017) and Zhai et al. (2016)

Whist these are intriguing trends, patterns of movement and the characteristics of locations and destinations are constantly in flux. For example, evidence to the Commission on Travel Demand revealed that 48% of houses and 31% of flats in London received 5 deliveries a week in 2014 (Transport for London 2014, cited in Cherrett, 2017). Meanwhile, new delivery options are appearing. These include consolidating deliveries from multiple companies to a 'carrier's carrier'; micro-consolidation hubs; bookable loading bays; mobile or even floating depots; unattended receptions; attended collection point systems; and goods-to-person delivery using robots or drones (Cherrett, 2017).

There are also significant differences within the population: although some people make a single weekly bulk shop to a distant supermarket others make much more frequent journeys to a nearby store. According to Mattioli and Anable (2017: 22), those car-dependent forms of shopping that account for "70.4% of car driver distance and 65% of CO_2 emissions for food

shopping travel" are undertaken by just 22% of the population. Online shopping patterns are similarly varied. Not everyone is the same, and strategies differ depending on the goods involved (Allen et al., 2017a). At present some items (small, specialist, non-food) appear more suited to online purchasing than others that are large, tactile or perishable – but this is not clear cut, and is in any case changing. Given this complexity and variation, what, if anything, can we conclude about the travel related energy demands of shopping?

The last mile and the next day

It has long been known that 'the last mile' which goods travel has a hugely disproportionate energy and carbon impact, with some studies suggesting that car-based trips to buy items and bring them home sometimes consume more energy than is used in producing and supplying those goods (Browne et al., 2008).

In practice, the details of this last mile are determined by the combination of ways in which shopping, delivery, retail, and related activities are ordered in time and space. In other words, they reflect both the range and prevalence of different, and also related, modes of shopping. These arrangements do not only, or simply, correspond to the relative significance of on- or offline shopping. Instead they have to do with the ways in which these and other hybrid forms are actually organised. Capturing and better understanding how changing forms and modes of shopping impact on energy and travel demand in part depends on better understanding precisely how these last miles are managed.

The 'next day' aspect is also significant but in a different way. Whether goods are bought online or not, swift delivery appears to have become a more significant feature of shopping. This partly relates to the 'instant' gratification of over-the-counter purchasing: a model with which online and mail catalogue shopping cannot directly compete. As described above, different modes of shopping have distinctive spatial and temporal characteristics, all of which matter for the delay between ordering, paying and taking possession. Whilst this gap is an inevitable and unavoidable feature of certain modes of shopping (and an occasional but not necessary feature of others), there seems to be a ratcheting up of expectations in the case of online shopping: especially as regards the speed of delivery.

This time pressure – which applies to physical as well as to online modes of shopping - locks providers and consumers into more energy and travel intensive arrangements than might be the case if immediate delivery were not so highly valued. Slower modes of travel are often less resource intensive, but perhaps just as important, forms of next-week, or perhaps next-month delivery would almost certainly enable more consolidation and planning and fewer trips overall.

In conclusion, we have identified different 'modes' of shopping and distinguished between the space-time characteristics of each. This simplified scheme helps identify and represent the travel and energy-related implications of established and emerging modes. In practice,

patterns of demand reflect complicated, co-existing and constantly changing configurations of buying and selling, confounding any simple analysis of the relative merits of one form of shopping over another. This leads us to argue that it is not the distinction between on and off-line shopping that matters for energy and travel demand, but the ways in which both affect the organisation of last miles and the valuing of the next, or same, days.

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Notes

[1] In 2008, just one of the 'big six' supermarkets that dominate the UK's grocery market, Tesco, had a dominant market share in 87 of the UK's 121 postcode areas. http://www.independent.co.uk/news/business/analysis-and-features/the-big-question-is-tesco-now-too-powerful-in-britain-and-can-its-growth-ever-be-checked-1637575.html

[2] Although there are also claims of 'peak supermarket' in the UK. (See Wood S. and McCarthy D. (2014) The UK food retail 'race for space' and market saturation: a contemporary review. *The International Review of Retail, Distribution and Consumer Research* 24: 121-144), perhaps reflecting 'peak car' (See Goodwin P. and Van Dender K. (2013) 'Peak car'—themes and issues. *Transport Reviews* 33: 243-254).

[3] http://www.demand.ac.uk/wp-content/uploads/2015/11/DEMAND-insight-10.pdf

[4] 97%+ of all businesses with 250+ employees in 2015 have a website: https://www.ons.gov.uk/businessindustryandtrade/itandinternetindustry/bulletins/ecommerceandictactivity/2015

[5] http://www.occstrategy.co.uk/news-and-media/2016/03/reinventing-the-last-mile

[6] Since postal deregulation and privatisation in 2006, the UK's £10bn parcel delivery sector has become a crowded market, with fleets of white vans (and more recently private cars and bicycles) multiplying as a proportion of the traffic in congested city centres. In the UK the number of vans increased from 2.5m to 3.25m in the 10 years to 2011, and van traffic increased by over 28% in Britain in the same period. (See Transport for London. (2011) Roads Task Force Technical Note 5: What are the main trends and developments affecting van traffic in London? London: TfL.) making up 15.3% of all traffic in 2017: an increase of 71.7% over 20 years, compared to 12.9% for cars (See Department for Transport. (2017) Provisional Road Traffic Estimates Great Britain: April 2016 - March 2017. London, UK: DfT, 6).