Social Science & Medicine 108 (2014) 68–73

Contents lists available at ScienceDirect

Social Science & Medicine

journal homepage: www.elsevier.com/locate/socscimed

Short report

Sales impact of displaying alcoholic and non-alcoholic beverages in end-of-aisle locations: An observational study

Ryota Nakamura [a,b], Rachel Pechey [a], Marc Suhrcke [a,b], Susan A. Jebb [a,c], Theresa M. Marteau [a,*]

[a] Behaviour and Health Research Unit, Institute of Public Health, University of Cambridge, UK
[b] Health Economics Group, Norwich Medical School, University of East Anglia, Norwich, UK
[c] MRC Human Nutrition Research, Elsie Widdowson Laboratory, Cambridge, UK

ARTICLE INFO

Article history:
Available online 22 February 2014

Keywords:
United Kingdom
Alcohol
Non-alcoholic beverages
End-of-aisle display
Grocery store
Primary prevention

ABSTRACT

In-store product placement is perceived to be a factor underpinning impulsive food purchasing but empirical evidence is limited. In this study we present the first in-depth estimate of the effect of end-of-aisle display on sales, focussing on alcohol. Data on store layout and product-level sales during 2010–11 were obtained for one UK grocery store, comprising detailed information on shelf space, price, price promotion and weekly sales volume in three alcohol categories (beer, wine, spirits) and three non-alcohol categories (carbonated drinks, coffee, tea). Multiple regression techniques were used to estimate the effect of end-of-aisle display on sales, controlling for price, price promotion, and the number of display locations for each product. End-of-aisle display increased sales volumes in all three alcohol categories: by 23.2% ($p = 0.005$) for beer, 33.6% ($p < 0.001$) for wine, and 46.1% ($p < 0.001$) for spirits, and for three non-alcohol beverage categories: by 51.7% ($p < 0.001$) for carbonated drinks, 73.5% ($p < 0.001$) for coffee, and 113.8% ($p < 0.001$) for tea. The effect size was equivalent to a decrease in price of between 4% and 9% per volume for alcohol categories, and a decrease in price of between 22% and 62% per volume for non-alcohol categories. End-of-aisle displays appear to have a large impact on sales of alcohol and non-alcoholic beverages. Restricting the use of aisle ends for alcohol and other less healthy products might be a promising option to encourage healthier in-store purchases, without affecting availability or cost of products.

1. Introduction

In recent policy debates, comparatively little attention has been paid to the subtle ways in which the retail sector may influence purchasing, including product placement in prominent displays to attract shoppers' attention (Chevalier, 1975; Curhan, 1974; Frank and Massy, 1970; Klein and Wright, 2007; Park et al., 1989; Sorensen, 2008; Wilkie et al., 2002; Wilkinson et al., 1982). It is estimated that around 30% of total supermarket sales come from the ends of aisles (Cohen and Babey, 2012a,b; Sorensen, 2003), described by Cohen and Babey as "the most important malleable determinant of sales" (Cohen and Babey, 2012a, p.1381). Recent interest in public health and policy circles on environmental influences (such as in-store layout) that affect behaviour without full conscious awareness provides a clear impetus for an in-depth evaluation of the impact of end-of-aisle display on sales (Cohen and Babey, 2012a; Marteau et al., 2012).

While it is likely that marketing research exists within the retail and manufacturing industry regarding the sales effect of an end-of-aisle location, there are equivocal results from empirical published evidence (Bemmaor and Mouchoux, 1991; Chevalier, 1975; Curhan, 1974; Glanz et al., 2012; Sigurdsson et al., 2011; Wilkinson et al., 1982). The most relevant experimental studies, conducted over thirty years ago, found that special display (a special location plus a standard shelf space) increased unit sales of brands of soap, pie shells, apple juice, and rice by between 77% and 243% (Wilkinson et al., 1982), and prime location increased sales of hard fruit and cooking vegetables by 26% and 48% (Curhan, 1974), respectively, in the USA. In contrast, a more recent study from Norway reported that displaying bananas at check-out locations failed to increase sales (Sigurdsson et al., 2011). Effect size estimation is made all the more challenging as not all studies have attempted to disentangle the effects of price, price promotion and promotional location.

* Corresponding author.
E-mail address: tm388@cam.ac.uk (T.M. Marteau).

http://dx.doi.org/10.1016/j.socscimed.2014.02.032

The effect may also be modified by characteristics including the real or perceived 'healthiness' or desirability of a product.

The aim of the current study is to provide the first systematic estimate of the effect of end-of-aisle displays on product sales, controlling for price, price promotion, number of display locations, as well as other product-specific characteristics. The study focuses on alcohol products, to add to the evidence-base for potential policy interventions to reduce population alcohol purchasing, and subsequent consumption. For comparison purposes, three types of non-alcoholic beverages – carbonated drinks, coffee and tea – are also considered. Carbonated drinks include both sugar-sweetened and artificially sweetened beverages. Coffee and tea were included in different forms (e.g. ready-to-drink, ground, and bagged).

2. Methods

2.1. Data

The data comprised a novel combination of two commercially available datasets: TNS PathTracker and Kantar WorldPanel. The TNS PathTracker data came from one store of a major supermarket chain in the UK, and consist of: (1) the display location(s) for each product ("stock keeping unit") in that supermarket (out of approximately 1150 display locations); (2) the paths taken in store by a proportion of the supermarket's trolleys, tracked using radio-frequency identification, along with the corresponding purchases. Information on shoppers' characteristics, including shopping history, was not collected. Also, data on shopping trips which did not involve purchasing an item from any of the six beverage categories were not available for the present study. The data covered thirteen weekly slices of a full year, from March 2010 to February 2011. These weekly slices were the first weeks following 4-weekly verification of the products displayed in end-of-aisle locations. Data were collected only for products that were actually purchased (total 1639 products from the six categories): information was not available for products that were never purchased in a given week (no imputation was made for the missing variables of products that were not purchased).

The data on price, price promotions, and other product attributes were incorporated from Kantar WorldPanel data relating to the same period. Since the relevant supermarket chain operates a national pricing policy and, hence, the price of a product is the same across the country (Competition Commission, 2000), these variables are based on data from any branches of this supermarket, not just on the particular store observed in the TNS PathTracker data.

By combining these data, a product-level weekly sales dataset, in which each product was observed a maximum of 13 times (average 7.8 times), were constructed. The weekly sales volume of each product was aggregated from the volume purchased by shoppers using the tracked trolleys. Data were used for six beverage categories, three alcoholic – beer, wine, spirits – and three non-alcoholic – carbonated drinks, tea and coffee.

2.2. Store characteristics

The store is located in a city in northern England, and it is a branch of a major UK supermarket chain with an average sales area of around 2500 m^2 (IGD Retail Analysis, 2013). The typical target of the store is mid-lower income consumers (USDA Foreign Agricultural Service, 2011).

2.3. Display location

The key locations of interest in this study were end-of-aisle displays (special within-aisle displays and the check-out area were not considered). The display location for each product was recorded by marketing company employees during routine store visits. The majority of beverages included in this analysis were located in two sets of aisles, separated by a main thoroughfare which bisected the store. Most aisle ends were located along this main thoroughfare, and facing the thoroughfares that skirted the edge of the store. In addition, ends of smaller aisles, where standard aisles were broken into two, were also included. The display locations are assumed to be fixed over a week.

2.4. Analytic approach

Aisle ends are promotional display locations. Products placed in aisle ends may be characterized by different prices and price promotions compared to products located elsewhere in the store. Price and price promotion are therefore potential confounders of the effect of end-of-aisle display and are controlled for within a multiple regression analysis.

The analytical strategy for isolating the effect of end-of-aisle display rests on the following market convention. Price promotions are proposed by the manufacturer to the retailer during a specific period of the year. The retailer then allocates aisle ends to products for which manufacturers have proposed substantial promotions, sometimes with "slotting fees" (Kantar WorldPanel, personal communication). This implies that the price and price promotion have been fixed at the time when aisle ends are being allocated. The effect of end-of-aisle display on sales can therefore be isolated once the effects of price and price promotion on allocation of aisle end as well as sales are controlled for.

2.5. Statistical analysis

The regression analysis was conducted with log-scaled sales volume of each product as the dependent variable (i.e. to correct skewed distributions). The key independent variable was the indicator of end-of-aisle display, with the number of display locations, price per volume, proportion of the week on price promotion, average price of other products in the same category, total number of trolleys purchasing any product from the category in the week, and indicators of each week (which capture seasonal variations in the demand for particular items) as control variables. It should be noted that displaying an item on an aisle end entails additional shelf space (as products are still displayed on the main shelves as well). This component of end-of-aisle display is captured by the variable comprising the number of display locations allocated to each item.

Given that only products that were actually purchased were recorded in the data, a truncated regression model was used (Fixed effect truncated regression estimated via trimmed least squares (Honoré, 1992)). Fixed effect estimation techniques were used to account for (time-invariant) product-level heterogeneity such as brand, size, and normal price. The analysis was conducted separately for the six product categories (beer, wine, spirits, carbonated drinks, coffee and tea), using Stata MP 12.1. All analyses were conducted during 2012–13. Ethical approval was not required for this secondary analysis of commercial data.

3. Results

The average number of aisle ends allocated to products within the categories of interest per week was 8.4 for beer; 10.1 for wine; 2.9 for spirits; 8.5 for carbonated drinks; 3.7 for coffee; and 2.6 for tea. In contrast, the average number of normal shelves allocated to products within the categories of interest per week was 20.9 for beer; 29.3 for wine; 6.9 for spirits; 20.8 for carbonated drinks; 5.2

R. Nakamura et al. / Social Science & Medicine 108 (2014) 68–73

Table 1
Descriptive statistics (mean (standard deviation)) for key variables by whether items were displayed on or off an aisle end.

	Beer		Wine		Spirits		Carbonated drinks		Coffee		Tea	
	Items displayed on aisle ends	Items displayed on within-aisle shelves	Items displayed on aisle ends	Items displayed on within-aisle shelves	Items displayed on aisle ends	Items displayed on within-aisle shelves	Items displayed on aisle ends	Items displayed on within-aisle shelves	Items displayed on aisle ends	Items displayed on within-aisle shelves	Items displayed on aisle ends	Items displayed on within-aisle shelves
Number of items purchased per week	86.37 (115.28)	19.85 (40.94)	49.98 (82.44)	14.93 (29.94)	47.28 (128.67)	10.39 (15.91)	178.26 (188.15)	55.54 (100.06)	69.79 (84.41)	14.13 (28.78)	125.68 (159.71)	13.53 (29.14)
Volume of items purchased per week (litre or kg)	304.94 (469.88)	38.86 (170.31)	35.59 (62.78)	12.40 (22.88)	42.19 (128.36)	7.60 (13.09)	367.54 (387.64)	85.51 (159.47)	13.23 (19.04)	2.41 (5.72)	63.99 (109.23)	3.07 (13.18)
Number of display locations	2.57 (0.98)	1.31 (0.51)	2.12 (0.71)	1.33 (0.48)	2.30 (0.56)	1.22 (0.42)	2.31 (0.59)	1.15 (0.37)	1.99 (0.56)	1.02 (0.13)	2.38 (0.92)	1.03 (0.18)
Price per volume (£ per litre or kg)	2.23 (2.01)	2.73 (1.04)	6.74 (3.08)	7.10 (4.04)	17.25 (5.87)	18.50 (6.49)	0.87 (0.43)	0.90 (0.63)	20.03 (6.61)	18.13 (8.39)	12.76 (9.26)	18.77 (13.10)
Price per pack (£)	7.02 (4.10)	4.13 (3.85)	4.43 (3.21)	6.22 (3.68)	13.22 (4.46)	12.76 (5.00)	1.66 (0.88)	1.25 (0.92)	2.97 (1.15)	2.66 (0.96)	2.36 (1.15)	1.94 (1.11)
Proportion of week on price promotion	0.49 (0.44)	0.30 (0.41)	0.34 (0.40)	0.07 (0.24)	0.28 (0.42)	0.05 (0.21)	0.92 (0.22)	0.79 (0.37)	0.71 (0.40)	0.24 (0.39)	0.52 (0.46)	0.18 (0.34)
Price discount rate (if price promoted)[a]	0.20 (0.11)	0.13 (0.09)	0.26 (0.17)	0.14 (0.15)	0.19 (0.10)	0.08 (0.08)	0.38 (0.14)	0.24 (0.15)	0.21 (0.16)	0.14 (0.12)	0.28 (0.18)	0.13 (0.13)
Observations	176	2502	928	2258	157	1333	177	1566	110	1778	34	2122
Total number of products in category	307		536		201		237		199		213	
Proportion of items that were ever displayed on aisle ends	25.1%		60.1%		28.9%		28.7%		28.1%		11.3%	
Number of trolleys which purchased any item from the category	2455.2 (419.8)		3208.2 (400.5)		1250.7 (388.3)		4480.5 (571.4)		1821.7 (256.0)		1872.4 (268.2)	

[a] Price discount rate is percentage discount, defined by ([reference price] − [discounted price]) ÷ [reference price].

for coffee; and 6.1 for tea. For all categories, the number of items sold and the total volume purchased were higher (three-fold or more) when products were displayed on aisle ends (Table 1). Items purchased from aisle ends were generally cheaper in terms of price per volume (£/L or £/kg) than items purchased from elsewhere in the store (except for coffee). By contrast, price per pack was higher for items on aisle ends (except for wine). Items on aisle ends were also more likely to be on promotion. A greater proportion of products in the wine category (60.1%) compared to products in other categories were purchased from aisle ends at some point during the year.

The regression analysis (Table 2), which was undertaken by product category, shows that displaying an item on an aisle end increased product-level sales volume for all categories, after controlling for confounders. For the alcohol products, the estimated increase in sales volume was 23.2% for beer (regression point estimate: 0.209, 95% confidence interval [CI] 0.063–0.354; $p = 0.005$, equivalent to an increase of sales volume from 38.9 to 47.9 L per week on average product), 33.6% for wine (point estimate: 0.290, 95% CI 0.174–0.406; $p < 0.001$, equivalent to an increase of sales volume from 12.4 to 16.6 L per week), and 46.1% for spirits (point estimate: 0.379, 95% CI 0.178–0.579; $p < 0.001$, equivalent to an increase of sales from 7.6 to 11.1 L per week). For non-alcohol products the estimated increase in sales volume was 51.7% for carbonated drinks (point estimate: 0.417, 95% CI 0.227–0.608; $p < 0.001$, equivalent to an increase from 85.5 to 129.8 L per week), 73·5% for coffee (point estimate: 0.551, 95% CI 0.285–0.817; $p < 0.001$, equivalent to an increase from 2.4 to 4.2 kg per week), and 113.8% for tea (point estimate: 0.760, 95% CI 0.221–1.300; $p < 0.001$, equivalent to an increase from 3.1 to 6.6 kg per week).

An additional display location was associated with an increase in sales for beer of 20.5% (95% CI 0.136–0.273; $p < 0.001$), carbonated drinks of 13.9% (95% CI 0.049–0.229; $p = 0.002$), and coffee of 33.2% (95% CI 0.213–0.542%; $p = 0.002$). A lower price was also associated with increased sales for products in all categories, with the largest association for alcohol: a 1% decrease in the price per volume of alcohol products (equivalent to a £0.05 to £0.13 (£1 ≈ $1.5 ≈ €1.2)) discount from an average product) is associated with approximately a 5% increase in sales volume: 5.6% (95% CI 0.051–0.061; $p < 0.001$) for beer, 5.2% (95% CI 0.048–0.055; $p < 0.001$) for wine, and 5.0% (95% CI 0.043–0.057; $p < 0.001$) for spirits), compared to a 2% increase in sales for non-alcohol beverages: 2.3% (95% CI 0.020–0.027; $p < 0.001$) for carbonated drinks, 2.0% (95% CI 0.013–0.028; $p < 0.001$) for coffee, and 1.8% (95% CI 0.013–0.024; $p < 0.001$) for tea, where a 1% decrease in price is equivalent to £0.02–£0.03. Finally, being placed on price promotion for a greater proportion of the week was associated with more sales for beer, wine, spirits and coffee products: if a beer product went from not being promoted in a week to being promoted all week, sales increased by an estimated 23.7% (95% CI 0.117–0.357; $p < 0.001$), while sales for wine, spirits and coffee products increased by between 30% and 35% (all $p < 0.002$), given the same scenario.

Comparing the effect of end-of-aisle display with the effect of pricing suggests that for alcohol products, being exposed on an aisle end has a similar effect on sales as a 4–9% decrease in price per volume (equivalent to £0.17–£1.17 off an average product). The effect of end-of-aisle display relative to price for non-alcoholic beverages appears greater, needing a decrease in price per volume of 22%–62% (£0.27–£1.19) to equate to the effect of placement on an aisle end.

Table 2
Regression estimates (based on multiple fixed effect truncated model) of the impact of end-of-aisle display on log-scaled weekly sales volume.

	Alcohol beverages		
	Beer	Wine	Spirits
Effect of aisle end display			
Estimated coefficient (95% CI)	0.209 (0.063–0.354)	0.290 (0.174–0.406)	0.379 (0.178–0.579)
Percentage increase of sales (transformed coefficient)[a]	23.2%	33.6%	46.1%
Key control variables			
Number of display locations (95% CI)[b]	0.205 (0.136–0.273)	0.037 (−0.052–0.125)	0.133 (−0.064–0.329)
Price per volume (95% CI)[c]	−5.574 (−6.099 to −5.049)	−5.180 (−5.549 to −4.812)	−5.007 (−5.685 to −4.329)
Proportion of week on promotion (95% CI)	0.237 (0.117–0.357)	0.346 (0.221–0.471)	0.340 (0.123–0.556)
Observations	2678	3186	1490
	Non-alcohol beverages		
	Carbonated drinks	Coffee	Tea
Effect of aisle end display			
Estimated coefficient (95% CI)	0.417 (0.227–0.608)	0.551 (0.285–0.817)	0.760 (0.221–1.300)
Percentage increase of sales (transformed coefficient)	51.7%	73.5%	113.8%
Key control variables			
Number of display locations (95% CI)	0.139 (0.049–0.229)	0.332 (0.123–0.542)	0.323 (−0.212–0.859)
Price per volume (95% CI)	−2.330 (−2.687 to −1.980)	−2.045 (−2.792 to −1.298)	−1.848 (−2.397 to −1.300)
Proportion of week on promotion (95% CI)	0.138 (−0.028–0.303)	0.306 (0.136–0.475)	0.1848 (−0.003–0.377)
Observations	1743	1888	2156

The 95% confidence intervals are based on bootstrap standard errors. Other control variables include: average price of items in the same product category; total number of trolleys purchasing any product from the category in the week; and weekly time trend dummies. A least squares technique was employed in the estimation. A least absolute deviation (LAD) technique was also used as a sensitivity check, with similar results. In further supplementary analysis, two sided t-tests were conducted to examine whether alcohol and non-alcohol categories have the common mean effect sizes (in which each estimate was treated as being based on $(1/SE)^2$ observations with variance of 1). The result confirmed that the size of the effects of end-of-aisle display is significantly different between alcohol and non-alcohol categories: the test rejected the null hypothesis of common mean effect sizes ($t = 2.369$, $p = 0.018$). Using the same test procedure, the effect sizes were not significantly different between the alcohol beverage categories (beer vs. wine: $t = 0.853$, $p = 0.394$; wine vs. spirits: $t = 0.753$, $p = 0.452$; spirits vs. beer: $t = 1.346$, $p = 0.179$).

[a] End-of-aisle display is a dichotomous variable, which takes the value of 1 if an item is on aisle end and 0 otherwise. The estimated coefficient represents the average difference in the log-scaled sales volume on and off aisle end, conditional on other covariates. Percentage change was calculated by $\exp(\beta) - 1$, where β is the point estimate of the coefficient.

[b] The estimate of the number of display locations gives the percentage increase of sales volume by one extra shelf allocation.

[c] Price per volume is log-scaled, hence the estimate represents the percentage decrease in the sales volume with a 1% increase in price (i.e. elasticity).

Table 3
Characteristics of display locations by category (mean (standard deviation)).

	Alcohol beverages					
	Beer		Wine		Spirits	
	Aisle end	Within-aisle shelving	Aisle end	Within-aisle shelving	Aisle end	Within-aisle shelving
Proportion of trolleys passing the display	33.8% (0.14)	22.5% (0.11)	27.6% (0.11)	21.1% (0.09)	24.9% (0.08)	19.5% (0.09)
Number of different kinds of products placed in each display location[a]	2.85 (2.69)	12.91 (12.12)	7.62 (5.38)	10.89 (7.71)	4.42 (2.05)	20.56 (11.40)
Number of allocated display locations[b]	8.38 (2.43)	20.92 (2.90)	10.08 (1.98)	29.31 (3.47)	2.92 (1.12)	6.92 (1.19)
Number of packs purchased per shopping basket[c]	1.51 (0.93)	1.48 (1.08)	1.41 (1.21)	1.36 (0.98)	1.19 (0.53)	1.13 (1.39)
	Non-alcohol beverages					
	Carbonated drinks		Coffee		Tea	
	Aisle end	Within-aisle shelving	Aisle end	Within-aisle shelving	Aisle end	Within-aisle shelving
Proportion of trolleys passing the display	51.1% (0.16)	30.2% (0.07)	60.7% (0.14)	38.4% (0.04)	61.1% (0.16)	40.7% (0.04)
Number of different kinds of products placed in each display location	2.09 (1.25)	7.38 (4.51)	2.52 (1.96)	28.37 (7.04)	1.58 (1.03)	33.05 (20.73)
Number of allocated display locations	8.54 (2.70)	20.77 (0.73)	3.69 (1.44)	5.23 (0.44)	2.58 (1.24)	6.08 (0.49)
Number of packs purchased per shopping basket	1.49 (1.03)	1.56 (1.27)	1.29 (0.66)	1.19 (0.56)	1.59 (1.02)	1.21 (0.54)

[a] Although it is rare, a shelf may be shared by items from different categories. In such cases the items from different categories are also included in the calculation.
[b] Number of display locations refers to the mean number of display locations that were used by any item from the category in a given week.
[c] For each SKU, the total number of packs sold in a given week was divided by total number of trolleys which purchased at least one pack during the same week.

3.1. *Supplemental analysis*

Further analyses were conducted to explore whether increased customer exposure to products displayed at aisle ends might drive the effects of end-of-aisle display on sales. To this end, the proportion of tracked trolleys that went past each display location in store in a given week, for aisle ends compared to standard within-aisle shelves was examined (Table 3).

A higher proportion of trolleys went past non-alcohol drinks (30%–40% passed within-aisle shelves; and 50%–60% passed aisle ends) than alcohol drinks (20%–22% passed within-aisle shelves; and 25–34% passed aisle ends).

In addition, there tended to be greater reductions in the number of products displayed at aisle ends compared to standard within-aisle shelves for coffee and tea than for other product categories. Finally, more end-of-aisle shelving spaces were allocated to beer, wine and carbonated drinks (around eight to ten different kinds of products) than to spirits, coffee or tea (around three to four different kinds of products). Combined with the mean number of items on each aisle-end shelf, on average 18–77 kinds of products were displayed on any aisle end per week for the former group, whereas only four to thirteen kinds of products were on aisle ends for the latter group.

For all categories, there was little difference in the number of packs purchased per shopping basket when items were displayed on an aisle end compared to only having standard display, suggesting that the uplift was not simply due to the usual consumers of a product purchasing more packs.

4. Discussion

End-of-aisle display substantially increased sales volumes in all six beverage categories studied, with effects on alcohol sales of between 23.2% and 46.1% and on non-alcohol drink sales of between 51.7% and 113.8%. The effect was equivalent to a 4%–9% decrease in price per litre for alcohol categories, and a 22%–62% decrease for non-alcohol categories.

The effect of end-of-aisle display is smaller for alcohol than for other beverages ($p = 0.018$, see Note of Table 2 for detail), and this pattern does not reflect the relative allocation of end-of-aisle displays observed in the study supermarket. There are several possible explanations (and caveats) for this finding. First, the non-alcohol products might have been displayed on aisle ends that were more exposed. Supplementary analyses (Table 3) provided some support for this explanation: non-alcohol beverages were placed on aisle ends passed by more trolleys, increasing exposure to the products and thereby increasing the chances they were purchased. Second, for non-alcohol products end-of-aisle shelves contained fewer products (Table 3), particularly for coffee and tea. More rivals within aisle end locations in alcohol categories may have made the items less prominent, and hence muted the increase in sales generally observed for end-of-aisle displays. Third, in the current study, other types of prime locations such as entrance and check-out displays were classified as non-aisle end. Such prominent, non-aisle-end locations are more frequently used for alcohol beverages, compared with tea and coffee, and the categorisation of these locations as 'non-aisle end' may have reduced the effect size for alcohol categories.

The effect sizes for alcohol are similar to or slightly smaller overall than those previously reported for other products in these and other categories (Bemmaor and Mouchoux, 1991; Wilkinson et al., 1982). It should be noted however that previous studies did not isolate the effect of aisle-end display from the effect of additional shelf spaces or price of items and so do not provide the independent impact of end-of-aisle placement estimated by the current study.

4.1. *Strengths and limitations of the study*

This is the first study to attempt to isolate the impact on alcohol purchasing of the in-store physical environment, specifically end-of-aisle displays. By contrast, the existing literature on alcohol purchasing has focused mainly on the role of price and price promotions and typically relied on observations from only a few leading brands. In addition, the results of the current study provide evidence that could be used to inform policies to reduce alcohol purchasing at population-level.

At least three limitations of the study also need to be acknowledged: first, the study does not explicitly take into account the potential effects of substitution between items or substitution between product categories. As such, the current analysis does not examine whether restrictions on these displays decreases total category-level sales. Second, differences in other factors not assessed in the current study, such as media advertising and other marketing campaigns, may further contribute to the impact of end-of-aisle displays. If this is the case, the effects may have been overestimated. Third, there may be limits to the generalizability of the findings, related to the fact that the study used observational data from only one UK store. Additionally, as is common in market research data (Erdem et al., 1998), only products that were actually purchased were included in the sample (i.e. the analysis was based on a subpopulation of the total products in the store).

4.2. Implications for future research

Replication of the analysis using different data sources and different product categories is required to examine the extent to which these findings reflect a generalizable result. Substitution effects of end-of-aisle display on choice between products and between product-categories should be fully investigated, in order to better understand consumers' responses to interventions via in-store display. This could be done, for instance, by a trolley-level analysis of discrete choice demand system models, which has previously been used to estimate price effects on brand choice (Chintagunta et al., 2005; Nevo, 2001). These models could then be applied to estimate the effect of altering product placement. Future research should also take into account possible unintended effects of such interventions. For example, alcohol manufacturers or retailers could conceivably try to counteract a restriction in end-of-aisle display using overall price reductions (Stuckler et al., 2012). Rigorous monitoring of the retail environment would then be important, for which international systems are currently being set up (Lee et al., 2013; Ni Mhurchu et al., 2013). Finally, experimental studies, either using real or virtual supermarket environments, are needed to reduce the bias in effects estimated from observational data (Curhan, 1974; Waterlander et al., 2011).

4.3. Implications for policy

Mindful of the limitations of the current study the results do have the potential to inform interventions in the retail space to influence food and beverage purchasing, and in turn, consumption. Purchases of certain products might be reduced without impairing availability or cost of products. The results reported here suggest that interventions restricting displays of alcohol and sugar-sweetened beverages on aisle ends may be as effective as some pricing interventions and may also be applicable to other non-alcohol categories. Such interventions may also be more acceptable to the general public and in turn politicians, than direct price regulation. The effectiveness in practice, however, would depend critically upon the industry response not involving any compensatory actions to maintain sales.

Acknowledgements

The study was funded by the Department of Health Policy Research Programme (Policy Research Unit in Behaviour and Health [PR-UN-0409-10109]). The Department of Health had no role in the study design, data collection, analysis, or interpretation. The research was conducted independently of the funders, and the views expressed in this paper are those of the authors and not necessarily those of the Department of Health in England. The final version of the report and ultimate decision to submit for publication was determined by the authors (TMM had final responsibility).

References

Bemmaor, A.C., Mouchoux, D., 1991. Measuring the short-term effect of in-store promotion and retail advertising on brand sales: a factorial experiment. Journal of Marketing Research, 202–214.
Chevalier, M., 1975. Increase in sales due to in-store display. Journal of Marketing Research 12, 426–431.
Chintagunta, P., Dubé, J.-P., Goh, K.Y., 2005. Beyond the endogeneity bias: the effect of unmeasured brand characteristics on household-level brand choice models. Management Science 51, 832–849.
Cohen, D.A., Babey, S.H., 2012a. Candy at the cash register — a risk factor for obesity and chronic disease. New England Journal of Medicine 367, 1381–1383.
Cohen, D.A., Babey, S.H., 2012b. Contextual influences on eating behaviours: heuristic processing and dietary choices. Obesity Reviews 13, 766–779.
Competition Commission, 2000. Supermarkets, a Report on the Supply of Groceries from Multiple Stores in the United Kingdom. In: Background Chapters, vol. 2. Stationery Office, London.
Curhan, R.C., 1974. The effects of merchandising and temporary promotional activities on the sales of fresh fruits and vegetables in supermarkets. Journal of Marketing Research 11, 286–294.
Erdem, T., Keane, M.P., Sun, B., 1998. Missing price and coupon availability data in scanner panels: correcting for the self-selection bias in choice model parameters. Journal of Econometrics 89, 177–196.
Frank, R.E., Massy, W.F., 1970. Shelf position and space effects on sales. Journal of Marketing Research 7, 59–66.
Glanz, K., Bader, M.D.M., Iyer, S., 2012. Retail grocery store marketing strategies and obesity: an integrative review. American Journal of Preventive Medicine 42, 503–512.
Honoré, B.E., 1992. Trimmed lad and least squares estimation of truncated and censored regression models with fixed effects. Econometrica 60, 533–565.
IGD Retail Analysis, 2013. IGD Retail Analysis Retailer Datacentre. Available at: www.retailanalysis.igd.com (accessed January 2013) (Archived at: http://www.webcitation.org/6NJKxkojg. in February 2014).
Klein, B., Wright, Joshua D., 2007. The economics of slotting contracts. Journal of Law and Economics 50, 421–454.
Lee, A., Mhurchu, C.N., Sacks, G., Swinburn, B., Snowdon, W., Vandevijvere, S., et al., 2013. Monitoring the price and affordability of foods and diets globally. Obesity Reviews 14 (Suppl. 1), 82–95.
Marteau, T.M., Hollands, G.J., Fletcher, P.C., 2012. Changing human behavior to prevent disease: the importance of targeting automatic processes. Science 337, 1492–1495.
Nevo, A., 2001. Measuring market power in the ready-to-eat cereal industry. Econometrica 69, 307–342.
Ni Mhurchu, C., Vandevijvere, S., Waterlander, W., Thornton, L.E., Kelly, B., Cameron, A.J., et al., 2013. Monitoring the availability of healthy and unhealthy foods and non-alcoholic beverages in community and consumer retail food environments globally. Obesity Reviews 14 (Suppl. 1), 108–119.
Park, C.W., Iyer, E.S., Smith, D.C., 1989. The effects of situational factors on in-store grocery shopping behavior: the role of store environment and time available for shopping. Journal of Consumer Research 15, 422–433.
Sigurdsson, V., Larsen, N.M., Gunnarsson, D., 2011. An in-store experimental analysis of consumers' selection of fruits and vegetables. The Service Industries Journal 31, 2587–2602.
Sorensen, H., 2003. The science of shopping. Marketing Research 15, 30–35.
Sorensen, H., 2008. Long tail media in the store. Journal of Advertising Research 48, 329.
Stuckler, D., McKee, M., Ebrahim, S., Basu, S., 2012. Manufacturing epidemics: the role of global producers in increased consumption of unhealthy commodities including processed foods, alcohol, and tobacco. PLoS Medicine 9, e1001235.
USDA Foreign Agricultural Service, 2011. UK supermarket Chain Profiles. GAIN report. Available at: http://gain.fas.usda.gov/Recent GAIN Publications/UK Supermarket Chain Profiles_London_United Kingdom_2-2-2011.pdf (accessed January 2013) (Archived at: http://www.webcitation.org/6NJJiUJYK. in February 2014).
Waterlander, W., Scarpa, M., Lentz, D., Steenhuis, I., 2011. The virtual supermarket: an innovative research tool to study consumer food purchasing behaviour. BMC Public Health 11, 589.
Wilkie, W.L., Desrochers, D.M., Gundlach, G.T., 2002. Marketing research and public policy: the case of slotting fees. Journal of Public Policy & Marketing 21, 275–288.
Wilkinson, J.B., Mason, J.B., Paksoy, C.H., 1982. Assessing the impact of short-term supermarket strategy variables. Journal of Marketing Research 19, 72–86.