

Boundaries of the Centrality Effect during Product Choice

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Abstract

Horizontal centrality bias has been found to influence what products consumers pay attention to and what products they choose to purchase. Such bias offers substantial competitive advantage to brands that know about it and display their products so as to capitalize on it. Atalay, Bodur and Rasolofoarison (2012) identified the key components of this horizontal centrality effect: initial fixation bias, gaze cascade bias, and subsequent choice bias. In this paper, we re-examine their study under two new conditions: time pressure and a more ambiguous choice action. We find that although the horizontal centrality effect persists, it is modified in the extended time condition. The central gaze cascade component does not arise in the data when the choice moment is ambiguous, however, choice bias persists under all conditions.

Keywords

Central gaze cascade, horizontal centrality, time condition

Introduction

Consumer visual attention is a major predictor of product choice. Atalay, Bodur and Rasolofoarison (2012) demonstrated that when controlling for brand familiarity and preferences, consumer product choice is strongly influenced by visual attention. In particular, the *horizontal centrality bias* within a product array focuses visual attention on the central option in an array of products, increasing the choice probability of that central product. The horizontal centrality effect is not determined by a product's position relative to an external frame such as a computer screen or store shelf, but by its position within a *focal category* – an array of similar products which a consumer can visually isolate within a larger display (Atalay et al, 2012). It is not the initial, instinctive central gaze within a focal category, but the rapidly increasing number of central eye fixations towards the end of the gaze (in the microseconds before choice occurs) that is related to product choice (Atalay et al, 2012). This rapid increase in central eye fixations is called the *central gaze cascade effect*. Other factors such as memory and brand preference are subordinate to visual attention in the choice process (Atalay et al, 2012).

The discovery of horizontal centrality bias has strong implications for marketing and in particular, retail shelf strategy. In this paper, we therefore aim to replicate the findings of Atalay et al, and extend them by introducing two issues not covered in the original paper: time constraints and an ambiguous choice action. As the majority of consumer decisions are made with an element of time pressure (Iyer, 1989), this study introduces short and long time constraints to identify whether the horizontal centrality effect still occurs under these circumstances, and whether visual attention still bears a strong relationship to product choice. In Atalay et al's study, the moment of consumer product selection is simultaneous with the act of viewing that product in a display. In real purchasing

situations, however, the moment of choice is more ambiguous; there can be multiple moments of choice involved in a purchase process, from the selection of a product on a screen or shelf to the point of purchase. To reflect real purchasing situations, our study introduces a delay between the period of visual attention and the moment of product selection, to determine whether the initial central fixation and central gaze cascade continue to influence consumer choice after the initial stimulus is removed.

The role of visual attention in consumer choice

Visual attention is an important predictor of brand choice, making it a critical consideration in marketing strategies (Atalay et al, 2012; Lindner, Eitel, Thoma, Dalehefte, Ihme & Köller, 2014; Pieters & Warlop, 1999). Visual attention plays a crucial role in the first and final few seconds of a consumer's selection process, where important changes can be recorded by tracking eye movements (Lindner, Eitel, Thoma, Dalehefte, Ihme & Köller, 2014; Pieters & Warlop, 1999). The centrality bias in visual attention in particular has strong implications for the management of retail shelf space. Consumers exhibit a centrality bias regularly in everyday situations; when presented with an array of options, they consistently select the item at the centre of the array, from a stall in a public restroom to items from menus in fast food restaurants, buffets and snack bars (Atalay et al, 2012; Shaw et al, 2000). Even when it is not central in the consumer's overall field of vision, or the array is not distributed symmetrically, if an item is in the vertical and horizontal centre of a focal category it is most likely to be selected (Chandon et al, 2007, 2009). This effect is particularly pronounced at the point of purchase (Chandon et al, 2007), implying that the manipulation of the visual attention process through product position can be used by brands and retailers for competitive advantage.

Neurological research supports the connection between eye movements and attention, irrespective of pre-existing preferences or memory (Pieters & Warlop, 1999). Gaze pattern analysis therefore aids in understanding how visual attention affects choice. In gaze pattern analysis, visual attention is observed by tracking measurable movements of the head, eye saccades and fixations. Information can be extracted from both the pattern of saccades (rapid eye movements from location to location, lasting 20-40 milliseconds: Rayner, 1998) within and between brands, and the length and pattern of fixations (stable pauses between saccades, which last an average of 200-400 milliseconds and can range from 50 milliseconds to a second in length: Rayner, 1998), as a consumer's chosen brand will receive both considerably more inter-brand and intra-brand saccades, and longer fixations (Pieters & Warlop, 1999), especially under time pressure.

The horizontal centrality effect has three components: the *initial central fixation*, the *central gaze cascade*, and the *choice bias*. The initial central fixation component appears to be instinctive: consumers tend to look at the central option first due to a physiological preference for eye movements that place the pupils centrally (Paré & Munoz, 2001). The central gaze cascade occurs when consumers progressively increase the attention they pay to the central option in an array as they draw closer to their purchasing decision (Atalay et al 2012). The choice bias is created by the disproportionate amount of attention focussed on the centre option throughout the entire gaze, rather than the propensity to initially fixate on the central option (Pieters & Warlop, 1999). Looking at an item for a greater amount of time increases the likelihood of it being selected in a purchase situation (Pieters & Warlop, 1999).

The tendency for consumers to initially fixate on the centre option of an array and again directly before selecting a product has a clear relationship with choice. However, there is

limited research exploring conditions under which this horizontal centrality effect is more or less prominent. This study considers two potential boundary conditions for the effect: a long and a short time constraint, and a more ambiguous choice moment.

Choice under time pressure

Time pressure – that is, any restrictions an individual perceives on the time available for them to make a choice or perform a task (Iyer, 1989) – is common in most choice situations (Pieters & Warlop, 1999; Reutskaja, Nagel, Camerer, & Rangel, 2011). Time constraints influence tasks ranging from selecting a brand of orange juice seconds before the supermarket closes, to deciding whether to run to catch the bus pulling up to the stop or wait 15 minutes to catch the next one. Time constraints also affect the amount of information individuals can process when making a decision, to the point where it becomes a key factor in determining the outcome of choice (Iyer, 1989; Shi, Wedel & Pieters, 2013; Turley & Milliman, 2000) and the level of satisfaction with that choice (Kim & Kim, 2008). As people are generally time-poor, time restrictions have considerable implications for information processing and decision-making (Bettman et al, 1998).

Everyday time constraints mean that a comprehensive comparison of all options in any purchase situation is rarely possible (Shi, Wedel & Pieters, 2013). To compensate, people use heuristics to simplify cognitive processing, and these mental shortcuts can influence what information is prioritized when making the decision (Tversky & Kahneman, 1974). Motivation is another important consideration in decision-making under time pressure (Pieters & Warlop, 1999). Research demonstrates that when an individual's task involvement is high, they allocate more time to visual processing and acquisition of information (Celsi & Olson, 1998) in order to resolve an issue or make a choice quickly.

Literature on decision-making suggests that consumers' choice-making strategies may also change under time pressure, producing fundamentally new behaviours (Payne et al, 1992; Pieters & Warlop, 1999). People generally employ one of three strategies – *acceleration*, *filtration* or *strategy shift* (Payne et al, 1992) when making a choice, with their chosen strategy reflecting the nature of the choice. Acceleration is used in situations of moderate time pressure, limiting the search for and processing of visual information, for example by using shorter fixations on the stimulus (Pieters & Warlop, 1999). When faced with greater time pressure, individuals commonly switch to using a filtration strategy instead, becoming more selective about which brands and product attributes they notice (Bettman et al, 1998). Under extreme time pressure, people tend to compare only specific product attributes (Dhar & Nowlis, 1999; Payne et al, 1992) or adopt hybrid heuristic approaches to the decision if the product is being considered holistically (Reutskaja, Nagel, Camerer, & Rangel, 2011). Research demonstrates that the use of such strategies allows a broader selection of products to be considered quickly during the information-gathering phase (Pieters & Warlop, 1999).

It is clear that visual attention is affected by time pressure in decision-making situations. However, eye-tracking research into the impact of time pressure has produced mixed results. Studies tend to note either an acceleration of visual behaviour, or no effect at all (Orquin & Mueller-Loose, 2013; Pieters & Warlop, 1999; Reutskaja, Nagel, Camerer, & Rangel, 2011). When acceleration is found to occur, it is unclear whether decision quality is affected (Goodie & Crooks, 2004; Reutskaja, Nagel, Camerer, & Rangel, 2011). The lack of a clear understanding of how time pressure influences the horizontal centrality effect presents an excellent research opportunity. However, it is important to acknowledge that sometimes there are no time restrictions on choice. This study therefore considers two types of choice context: an extended and a limited time condition.

Measuring the act of choosing

A second aspect to understanding the role of the horizontal centrality (particularly the gaze cascade) in the choice process is the issue of how choice is measured. Present methodological approaches tend to have participants actioning their choice by pressing a computer button immediately after viewing the available options (Atalay et al, 2012). In a retail context, however, the moment of choice is rarely as definable as the act of pressing a single button. Choice may occur prior to any actual contact with shelving; thus, the act of choice is the act of reaching for a product. Choices can also change once the individual is in contact with a product; thus, the act of choice is the act of placing a product into a shopping cart. Further complicating this, is the opportunity for individuals to revise their choices prior to and even at the point of purchase. There is in fact no single, clearly definable moment of choice in a retail environment. Even in online shopping environments, there are analogous behaviours to those described above. Researchers often simplify the act of choice to one moment so that it can be more easily identified; however, this risks creating effects through over-prescription of participant behaviours, rather than simply measuring them. In other words, the standard methodological approach for measuring choice may be generating the central gaze cascade, rather than simply measuring it.

Store-based eye-tracking studies show that when individuals are under time pressure, they both accelerate their rate of information acquisition and change their processing strategy to filter information more efficiently (Pieters & Warlop, 1999). Shoppers increase the number of inter-brand saccades and shorten the average duration of fixations on any given product, while also filtering information by focusing on key attributes of each product and omitting textual information such as the names of brands (Pieters & Warlop, 1999). Brand

choice can be predicted from an individual's pattern of saccades and fixations: if a brand receives longer fixations and more inter-brand saccades there is a much higher likelihood that it will be chosen (Pieters & Warlop, 1999). However, the nature of the choice process makes its conclusion, (i.e. the 'act' of choice), potentially heterogeneous, in terms of both when it occurs and how the individual behaves when it occurs. Over-prescription of an experimental method during the critical moment of choice may risk inflating results that do not occur in more naturalistic settings. We tested for this by asking participants to action their choices using a different method from those used in prior experiments, and by constructing a less mechanical and more ambiguous choice event.

Method

We combined eye-tracking technology with an on-screen display showing fictional products similar to those used by Atalay et al. (2012) to explore the horizontal centrality effect under both limited and extended time conditions. We also introduced a delay between the participants' assessment of the product array and their choice of a product, in order to more closely approximate real choice conditions.

Sampling

A sample of 64 participants, consisting primarily of university staff and students, was recruited from an Australian university campus. Four participants were measured but excluded during the execution of the experiment due to equipment failure. The final sample consisted of 60 participants, with 36 (60%) females, and an average age of 31.95 years ($SD=13.2777$).

Design and Stimulus

Participants undertook the experiment twice, once for each of two different product categories. A between-subjects design was used for the main manipulation of time pressure, with participants completing either the extended or limited time version of the experiment for a product category. If the participant was allocated to the extended time condition for one product category they were allocated to the limited time condition for the other category. The limited time condition was set to a period of 7 seconds, and the extended condition to 20 seconds, both having been shown to be sufficient time for a consumer to view brands in detail (Pieters & Warlop, 1999). Allocation to condition and the order of presentation of the two product categories was rotated between participants.

The two product categories examined were vitamin supplements and meal replacement bars. The experiment involved participants viewing the products from a single category presented in a 3 x 3 matrix planogram on a monitor. Each column in the matrix was populated with one brand, and each row in the matrix with one brand variant. To ensure that the brands occurred equally across the matrix, their horizontal position was rotated in sequence, creating three types of product display. The products were counterbalanced at brand level, the level at which preferences are more likely to be formed (Cowley & Mitchell, 2003; Keller, 1993). An example of the planogram is shown in Appendix 1.

To maintain consistency with Atalay et al. (2012) as far as possible, we used the same fictitious brands and brand variants for the vitamin supplements aspect of the study. The brands were labelled Priorin, Alpecin and Labrada, with brand variants labelled 'healthy vitamins', 'vitamins for wellbeing' and 'body nourishing vitamins'. However, as one of the fictional brand names used for meal replacement bars by Atalay et al. (2012) (Bega) is also the name of a well-known brand of cheese in Australia, using the same names risked introducing perception bias into the experiment. We therefore labelled the meal

replacement bar brands in our experiment Y-Bar, J-Bar and L-Bar, with brand variants labelled 'balanced', 'nutritious' and 'wholesome'. To further distinguish the brands from each other, each brand's packaging was colored differently. Measures of the brand attractiveness were included at the end of the experiment to confirm no substantive differences were perceived between the brands that may influence choice. The measures were quality, attractiveness, popularity and purchase likelihood, all assessed on seven-point scales (1 = very low, 7 = very high).

Procedure

Participants were informed that they would view a selection of products on the screen for either an extended or a limited amount of time, depending on the condition allocated. Participants were instructed to mentally select the product they were most likely to buy in a real purchasing situation. They were also instructed that the products would be automatically removed from the screen after a period of time, but that if they made a selection before that time, they were to verbally indicate that they were ready to proceed. After a participant had viewed a product, they indicated the brand name and location of their chosen product in a blank 3 x 3 matrix. Participants then provided their brand attractiveness ratings. This process was repeated for the second product category. The experiment concluded with demographic questions.

Technology

The eye tracker used was the Eye Tribe, a non-intrusive infra-red tracking system that monitors binocular gaze with a 0.5 to 1° margin of error. This was mounted on a 1680x1050 pixel computer monitor at 60hz. Participants had a zone of approximately 30cm in which they could move their heads without data loss. To ensure accurate fixation tracking, all participants were calibrated to the eye-tracking device prior to the study using

a nine-point calibration, with sampling done at 30hz. The data was captured for analysis using EyeProof software associated with the Eye Tribe.

Results

Prior to examination of the visual fixation or choice data, it was necessary to confirm that the participants perceived no substantive differences between the products variants used within each product category. ANOVAs were used to compare perceptions of the three product variants, in each of the two categories respectively. The three vitamins did not significantly differ on attractiveness ($F = .085$, $p = .918$), quality ($F = .323$, $p = .724$), popularity ($F = .553$, $p = .576$), or purchase likelihood ($F = .251$, $p = .779$). Likewise, the three meal replacement bars showed no significant difference on attractiveness ($F = 1.0005$, $p = .368$), quality ($F = .221$, $p = .802$), popularity ($F = .195$, $p = .823$) or purchase likelihood ($F = .252$, $p = .777$). As there were no perceived differences between the products, any subsequent results we find regarding centrality effects cannot be attributed to these factors.

A critical component of the horizontal centrality effect is the shift in choice probability towards products positioned at the horizontal centre of a product display. To examine whether this shift occurred, we ran a binary logistic regression for each product category. In this regression, two independent variables were included to represent the three possible product positions. The first coefficient was coded for the left position (1 = left, 0 = other) and the second was coded for the right position (1 = right, 0 = other). The results are summarized in Table 1.

If the choice bias was present, we would expect these two coefficients to be significant and negative, reflecting a lowering of choice probability. This was the case for both products, for both coefficients ($p < .01$). There is a clear bias in choice probability toward

the central position, confirming this critical element of the horizontal centrality bias. This provides strong evidence to support the generalizability of the horizontal centrality effect, as the data was obtained using a different method for measuring the act of choice from that in previous studies.

To examine the impact of time pressure on the choice bias, the same logistic regression analysis was used. In this case, however, the two product categories were merged into a single data set, and an additional coefficient was added to the model. The coefficient is whether the data was collected under the limited ($= 0$) or extended ($= 1$) time condition (TimeC), and is included as both a main effect and an interaction with the product position coefficients. The results can be seen in Table 2.

These results reveal that time pressure has a marginal effect on choice bias. There is still a strong central bias, with both the left ($\beta = -1.099$, $p = .000$) and right ($\beta = -1.609$, $p = .000$) coefficients being significant and negative. However, in the extended time condition, the probability of choosing a product shifts from the centre to the right position ($\beta = 1.259$, $p = .014$). While the central product remains the dominant option, the product to its right rises considerably in choice probability.

There are two additional components to the horizontal centrality effect in the visual fields to which a person attends. In the *first* and *last* few seconds of the choice process, people are prone to over-attend to the central area of a product display. To examine the effect in the first few seconds, we plotted participants' gaze data for their first few seconds of reviewing the products, for both the extended and the limited time conditions. The position is characterised by the three columns of the product display. These plots are shown in Figures 1A and 1B.

Figures 1A and 1B show a bias toward the central location in the product display, which starts when the display is first revealed to participants. This effect terminates approximately two-thirds of a second into the experiment. It is notable that the introduction of a different mechanism for capturing choice at the end of the experiment did not reduce the occurrence of the initial central fixation. This supports the generalizability of Atalay et al's (2012) results regarding the initial seconds of the horizontal centrality effect.

Of further note in Figures 1A and 1B is the lack of substantive difference in when the bias toward the centre of the product display ceases. The lack of difference indicates that time pressure has no effect on the initial component of the horizontal centrality effect.

The other component of the horizontal centrality effect is the bias toward the centre of the visual field in the final few moments of the choice process (the central gaze cascade). To observe this effect, we plotted the final five seconds of participants' gaze data for both the extended and the limited time conditions. These plots are shown in Figures 2A and 2B.

Figures 2A and 2B show that in this version of the experiment, the central gaze cascade does not arise in the data for either the extended or the limited time conditions.

Introducing a different mechanism for capturing choice at the end of this experiment means that the central gaze cascade does not manifest, or is unable to be effectively captured. Interestingly however, the choice bias (the core component of the effect) still arises, indicating that the central gaze cascade itself may not be generalizable nor a critical component of the horizontal centrality effect in more realistic choice settings.

Discussion

Visual attention is a consistent predictor of brand choice, and choice is affected by time restrictions (Iyer, 1989; Shi, Wedel & Pieters, 2013; Turley & Milliman, 2000). Research has shown that choice under time pressure tends to produce either acceleration, filtration, or strategy shifts, with acceleration being most common in simple choice tasks like the one employed in this research (Payne et al, 1992; Pieters & Warlop, 1999). When approached from a visual attention perspective, studies note that visual behaviour also tends to accelerate under these circumstances (Orquin & Mueller-Loose, 2013; Pieters & Warlop, 1999; Reutskaja, Nagel, Camerer, & Rangel, 2011). The impact of such acceleration on the outcomes of the choice is still quite contentious (Goodie & Crooks, 2004; Reutskaja, Nagel, Camerer, & Rangel, 2011) and no research has considered the impact of such acceleration on well-established phenomenon such as the horizontal centrality effect.

This study shows that time pressure can influence the horizontal centrality effect. With regards to choice probability, although the central product remains the dominant option in line with previous research (Atalay et al, 2012; Chandon et al, 2007, 2009; Shaw et al, 2000), the product to its right rises considerably in choice probability. In contrast to Atalay et al's (2012) study, we find the central gaze cascade does not arise, or is unable to be captured in either limited or extended time conditions when the moment of choice is separated from the period of visual attention. The introduction of an ambiguous ending to the choice task inhibits the occurrence of the central gaze cascade in the final moments of the decision-making process. However, it does not affect either the initial central fixation or choice. This result suggests the central gaze cascade may not be a necessary feature of the horizontal centrality effect, or that its manifestation may be an outcome of specific experimental conditions. This study therefore confirms Atalay et al.'s (2012) results, but with conditions.

One potential limitation of our study is directly related to our finding regarding the central gaze cascade. We did not detect the central gaze cascade, even though the other two components of the horizontal centrality effect were identified. Further research is needed with alternative methods, particularly with regard to actioning the choice, to determine whether our finding is due to insensitivity of measurement as a consequence of our use of a more ambiguous choice task, or whether the central gaze cascade is indeed not a replicable feature of horizontal centrality bias.

An interesting opportunity arising from this research could be to examine the competing effects of the horizontal centrality effect and the visual bias towards preferred options (Meißner, Musalem & Huber, 2015; van der Laan, Hooge, de Ridder, Viergever & Smeets 2015). Our study used fictitious products to hold preferences stable, presenting a less realistic choice task to that experienced in-store. In reality, prior purchasing, brand familiarity, and personal tastes will create preference structures that impact attention and choice. There is a need to examine which effect dominates in a more realistic choice situation in future research.

This research has two main implications for brands. First, the center position in a display or focal category is advantageous for gaining and retaining market position. Therefore it may be worthwhile for brand managers to pay supermarkets in order to obtain the central position on a shelf or display. Even time poor consumers are subject to centrality bias. It would be interesting to track sales and quantify the sales uplift for a brand displayed in the central position of a display to calculate the return on investment. The second implication for marketers is that although the horizontal centrality bias is extremely strong under all conditions, the central position is not the only advantageous location in a display. Extending the time available for choice makes the bias shift from the center toward the

right. While this effect is comparatively weak, it still offers some benefit for marketers unable to secure the central position in a display, and therefore may be a worthwhile investment if consumers are engaging with a more complex decision that takes more time (Nisbett & Wilson, 1977). As with products in the center of the focal category, it would be interesting to track sales for brands in this position and calculate returns on investment; as the effect may arise from the left-to-right scanning pattern common across English-speaking cultures, it would also be worth expanding the experiment to understand whether the shift to the right occurs in other cultures, or whether the bias changes in line with different orthographies (Eviatar, 1995; Spalek & Hammad, 2005).

Process tracking research suggests that a reference option may influence choice (Atalay et al, 2012) – in other words, the gaze returns to the center toward the end of the decision-making process because the initial point of visual attention functions as a point of reference. However, the fact that in an ambiguous choice situation the consumer's attention does not return to the central point, but choice bias still manifests, suggests a value construction perspective may be more valid, particularly in more realistic choice environments. Bias in how consumers attend to information may lead to bias in their subsequent decisions (Lichtenstein & Slovic, 2006). Testing for bias in consumer perceptions as well as for choice in future studies may help determine whether this is the case. However, it is important to note that in this study we tested for attention and choice using only unfamiliar (fictional) brands. Switching to familiar (non-fictional) brands may change the mechanism driving the bias, or even the nature of the bias itself.

Conclusion

This study replicates and extends Atalay et al.'s experiment (2012) to determine whether the horizontal centrality effect continues to impact on consumer product choices under

time pressure and ambiguous choice conditions. The study finds that while the horizontal centrality effect persists under all conditions, the right-hand product rises in choice probability in an extended time condition, and the central gaze cascade does not manifest in ambiguous choice conditions in either extended or limited time conditions. However, choice bias toward the central product continues to manifest, suggesting that the central gaze cascade may not be a generalizable component of the overall effect. Future studies may build on this research by tracking the benefits of paying for access to the center and right-hand spaces in product displays, testing for cultural differences in the horizontal centrality effect under different time conditions, and testing to determine whether perception bias intersects with visual attention to promote or undermine the horizontal centrality effect.

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Figure captions

Table 1: Logistic Regression of Product Position

Table 2: Logistic Regression of Product Position and Time Condition

Figure 1A: First five seconds of gaze position, extended time condition

Figure 1B: First five seconds of gaze position, limited time condition

Figure 2A: Last five seconds of gaze position, extended time condition

Figure 2B: Last five seconds of gaze position, limited time condition

Tables and figures

Table 1

	Vitamins		Meal Bars	
	β	Sig.	β	Sig.
Left	-1.190	.000	-1.190	.000
Right	-.928	.001	-1.190	.000
Nagelkerke R ²	.202		.242	

Table 2

	β	Sig.
Left	-1.099	.000
Right	-1.609	.000
TimeC	2.268	.303
TimeC* left	.082	.871
TimeC* Right	1.259	.014
Nagelkerke R ²	.241	

Figure 1A

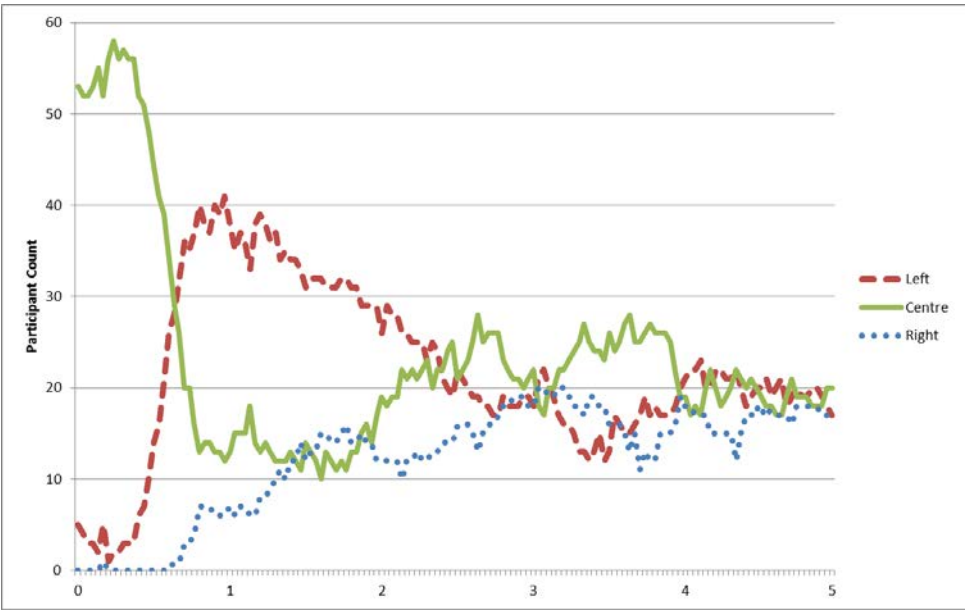


Figure 1B

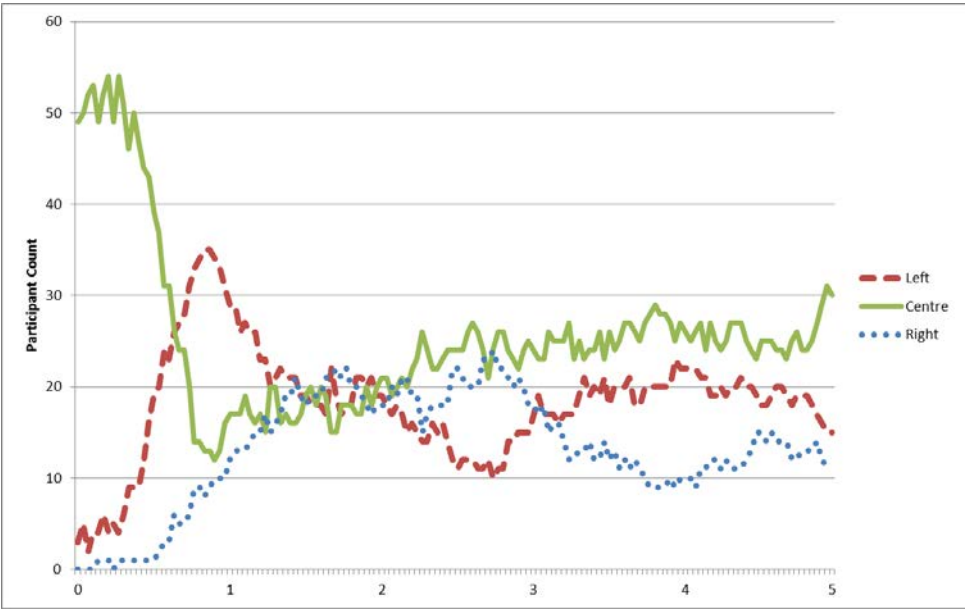


Figure 2A

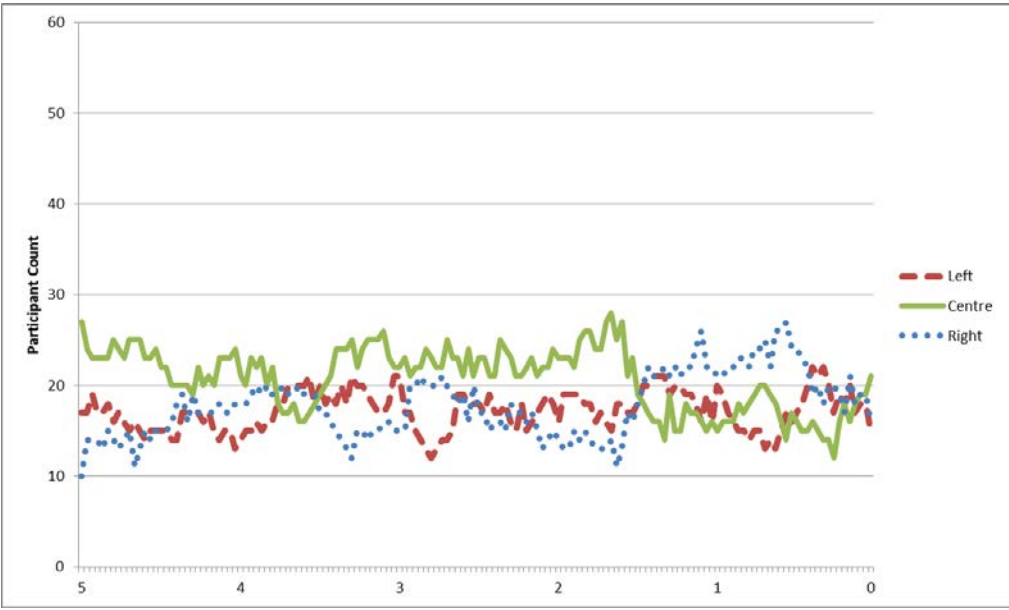
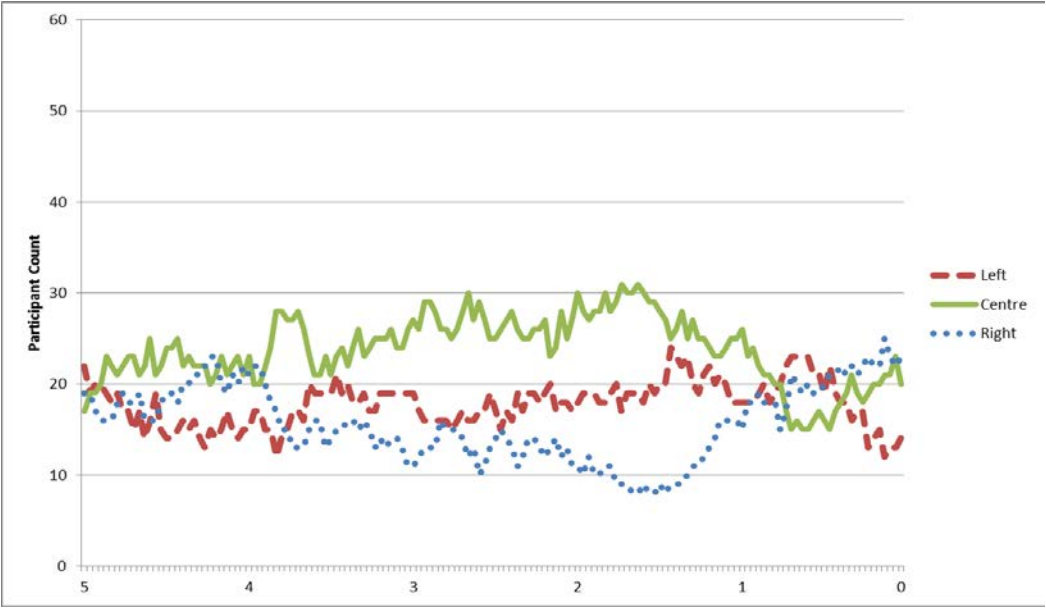


Figure 2B



Appendix 1

Example of 3x3 planogram used as the stimulus.

