Gut thinking and eye tracking: Evidence for a central preference heuristic

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Abstract

People prefer the central item in an array of items. This could be due to applying a decision heuristic or greater visual attention to the central item. We manipulated task instructions as participants chose one from three consumer items. The instructions were to “think carefully” in one block and to “use gut feeling” in another. A centrality preference appeared only in the “gut” condition, which was also negatively correlated with self-reported reflective thinking disposition (Need-for-Cognition). Eye-movement patterns, however, were equivalent across both instruction conditions with more frequent and longer fixations on the middle items. The findings demonstrate an effect of instructions on the centrality preference for non-identical consumer items, and provide evidence for a heuristic cause of the centrality preference rather than the allocation of visual attention. The results also show that the centrality preference is more likely to be present when people choose quickly and intuitively.

Introduction

People make numerous routine choices throughout their daily lives and the factors that influence those choices are of interest to businesses selling products, to academic psychologists who study decisions, and to governments wanting to nudge people towards better choices (e.g. Keller, Markert & Bucher, 2015). A factor that reliably influences choices is the position of an item or option, with people showing a bias to choose items in the middle of an array more often than items at the fringe (Christenfeld, 1995; Raghubir & Valenzuela, 2006). This centrality preference (CP) has been found in many choice contexts, including when selecting from consumer items, pictures, job candidates, artworks, toilet cubicles, bets, chairs, pens, menus, and others (Chandon, Hutchinson, Bradlow, and Young, 2009; Kim, Hwang, Park, Lee, & Park, 2018; Kuhn, Pailhès, & Lan, 2020; Michel, Velasco, Fraemohs, & Spence, 2015; Reutskaja, Nagel, Camerer, & Rangel, 2011; Rodway, Schepman, & Lambert, 2012; Rodway, Schepman, & Thoma, 2016; Shaw, Bergen, Brown, & Gallagher, 2000; Sundali & Croson, 2006; Valenzuela & Raghubir, 2009).

Certain features of the choice context have been found to influence the strength and emergence of the CP (Bar-Hillel, 2015). For example, the CP tends to occur when the items are similar or identical, when little analysis of the items is required but not when there is interactivity in the choice (Bar-Hillel, 2015), and when the choice is more implicit rather than explicit (Pailhes & Kuhn, 2020). It is also present when the items are considered simultaneously rather than in a sequence (Rodway et al., 2012) and when the items are arranged horizontally but not vertically, where a preference for the top item tends to emerge (Bar-Hillel, 2015).

Several explanations of the CP have been proposed. One possibility is that it is due to greater attentional focus on the central item increasing preference and choice (Shaw, et al., 2000; Ataley, et al., 2012). Alternatively, it has been suggested that it is due to the application of a ‘center-stage’ decision heuristic that specifies that the best option occupies the middle position and which is an alternative to effortful processing (Raghubir & Valenzuela, 2006; Rodway, et al., 2012; Rodway et al., 2016; Valenzuela, & Raghubir 2009). A further suggestion is that it is due to greater reachability (physical and mental) of the middle item, when the items are evidently identical, with the central item being easier to reach and therefore more likely to be chosen (Bar-Hillel, 2015).

The attentional focus explanation of the CP is plausible because people have a bias to look first and longer at the centre of a scene (Bindemann, 2010; Tatler, 2007), so that the increased exposure of the central item could enhance liking (Zajonc, 1968) and choice of that item (Armel, Beaumel, & Rangel, 2008). However, there are several difficulties with an attentional explanation. For example, Chandon, et al., (2009) found using supermarket display shelves of brands (soap bars and pain relief tablets) that the relationship between attentional focus and product choice was quite variable. Although a product’s central position on a shelf increased attention and choice of a product, being on the middle shelf also increased attention but without influencing product choice. Raghubir and Valenzuela (2006) also examined attentional effects on the CP and found that participants were more likely to choose a job candidate in the central position if they believed important people sit in the middle, but they also recalled less about the candidate’s performance, suggesting less attention was directed at them. In other studies participants also overlooked errors of people in the middle position, whilst also believing they were more important. Valenzuela and Raghubir (2009) found that the CP is influenced by cognitive beliefs about the importance of the central position, such as when choosing an item for another person. Valenzuela and Raghubir (2009) concluded that the CP was caused by the application of a decision heuristic, which specifies that important people and items occupy a central position, rather than greater attentional focus on the central item.

An additional version of the attentional explanation of the CP is that increased looking at the central item initiates a central cascade effect (Atalay et al., 2012; Shimojo et al., 2003). The cascade is believed to consist of a positive feedback loop operating between central looking and preference, so that greater looking at the central item enhances preference and thereby increased looks to the central item (see Armel, et al., 2008). A difficulty with this account is that cascade theory has been questioned as an explanation of looking and preference (Glaholt & Reingold, 2009, 2011; Nittono & Wada, 2009; Schotter et al., 2010; van der Laan, et al., 2015; see also Bird, Lauwereyns, & Crawford, 2012). In addition, if preference developed during looking it might be expected that first looks at the middle item would enhance preference (via the feedback loop) and would therefore predict CP, but this is not what Atalay et al. (2012) found. Moreover, Kreplin, et al., (2014) examined the cascade account of the CP by presenting images of three artworks which had either a positive or negative valence. In replication of Atalay et al., (2012) a tendency to look first and longer at a central artwork was present, but the choice of the artwork was only predicted by the final fixation and not by the first fixations. This suggests that the CP was not due to a build-up of preference across time, as proposed by the cascade theory. Finally, although eye movements were equivalent when selecting from artworks of positive and negative valence, the CP was only present for artworks with a positive valence. The finding that the CP can depend on the valence of the items is in line with other findings, showing that the CP is present when choosing from good paintings, or faces, but not bad paintings or faces (Li & Epley, 2009), and when making a 'most prefer' choice but not a 'least prefer' choice (Rodway et al., 2012). This evidence is consistent with the belief that the CP is caused by a decision heuristic which states that the best items are in the middle, so that the heuristic no longer applies when the items (or choices) are of a negative valence.

According to the reachability account (Bar-Hillel, 2015), many position effects on choice can be explained by suggesting that the item that is most likely to be chosen is the one that is most easily reached, particularly when the items are the same or evidently equivalent. This account makes the distinction between identical items and non-identical items. For identical items Bar-Hillel suggests that items in the middle tend to be chosen because they are the easiest to reach physically (and not miss), whereas items at the end could be missed and therefore tend to be avoided. Conversely, for non-identical items it is suggested that the serial nature of mentally processing and recalling the options causes the chooser to favour items at the edge of an array or list. However, the predicted edge advantage for choices involving non-identical items is contrary to the findings of some studies, which have obtained a CP (e.g. Atalay et al., 2012; Li & Epley, 2009; Rodway, et al., 2012). Moreover, although the reachability account might explain the CP in some settings, it does not appear able to explain the influence of metacognitive beliefs or item valence on the CP. For example, it could be suggested that reachability can explain the effect of item valence in terms of motivation-related behaviour, with people approaching/reaching for a positive item and avoiding a negative item. However, experiments that have obtained an effect of valence have required participants to always choose one item, in an array of either negative and positive items. In such circumstances, where a choice has to be made, it is not apparent why participants avoid the centre when the items are more negative than positive, unless they have a metacognitive belief that the best items are in the centre.

Based on the available evidence we suggest that the heuristic explanation of the CP, originally proposed by Raghubir and Valenzuela (2006), is more consistent with the experimental data and can explain why the CP is eliminated or reduced in certain circumstances (Kreplin et al., 2014; Rodway et al., 2016; Valenzuela & Raghubir, 2009). Consequently, the aim of the current study was to test predictions derived from the heuristic account of the CP, while also providing a test of the attentional and reachability explanations of the CP. A further aim was to explore the boundary conditions of the CP to better understand when the CP emerges in consumer choices.

Over recent years heuristic thinking has been summarised as 'Type 1' processing which is thought to be fast, automatic, and intuitive and can lead to judgment biases. In contrast, 'Type 2' processing is considered to be slow, effortful and reflective (Evans, 1984, 2003, 2010; Kahneman & Frederick, 2002; Stanovich, 1999), encompassing logical and rational reasoning and is engaged when overcoming automatic Type 1 responses (Evans, 2008). Therefore, if the CP is due to the implementation of a decision heuristic, the CP should be stronger when people are more likely to use a heuristic short cut during Type 1 processing, such as when making a quick intuitive choice, rather then when engaging in Type 2 reflective processing.

It is important to note, however, that there are at least two ways in which reflective versus heuristic thinking can be conceptualised. Traditionally, susceptibility to heuristic biases is associated with a lack of ability in executive functions such as inhibitory and working memory processes (Frederick, 2005; Toplak, West, & Stanovich, 2011). More recently, however, a more nuanced approach has emerged suggesting thinking dispositions (or 'modes of processing') as a further predictor of reflective thinking. Stanovich (2011; Evans & Stanovich, 2013) has suggested that it relates to the tendency to collect information and seek various points of view before reaching a decision.

To capture whether disposition, or ability, for reflective processing was linked to the CP, participants were asked to complete two individual difference questionnaires. The

Cognitive Reflection Test (CRT) was used to measure the participant's ability to engage in reflective thinking and avoid (e.g. inhibit) heuristic thinking (Toplak et al., 2011; Toplak, West, & Stanovich, 2014). The CRT consists of short math-like puzzles that assess the ability to withhold an intuitive (but incorrect) Type 1 response and engage in reflective Type 2 processing to generate a correct response. It is considered a measure of miserly processing (Toplak et al., 2014) following the notion that an inability to overcome heuristic thinking leads to normatively suboptimal performance (Kahneman, 2011; but see e.g., Gigerenzer & Gaissmaier, 2011 for a more positive view of heuristic or 'one-reason' thinking). Hence, if the CP effect is based on heuristic thinking and the inclination to spend minimal amounts of mental effort (Christenfeld, 1995; Raghubir & Valenzuela, 2006) then we would expect an association between CP and CRT. The Rational Experiential Inventory (REI) was used to measure participants' disposition for intuitive vs reflective thinking (Pacini & Epstein, 1999). We concentrated on the subscale of the REI that measured people's 'need for cognition' (REI-rational), as this has been shown to correlate with the CRT and the tendency toward heuristic processing (Pennycook et al., 2016; Thoma et al., 2015). Whereas the CRT is generally considered a measure of reflective thinking ability, the REI-r (need for cognition) is a self-assessment of one's rational vs intuitive thinking style.

To examine the heuristic explanation of the CP, we tested the prediction that the CP would be present when heuristic thinking was promoted through the use of instructions to use heuristic thinking, or because of an individual's tendency toward heuristic thinking. We therefore manipulated task instructions in favour of heuristic thinking or reflective thinking. Participants were repeatedly presented with three similar consumer items and were either instructed to use their 'gut' feeling or to 'think very carefully' about their choice. The 'gut' instructions were expected to promote intuitive Type 1 processing, and heuristic thinking, and result in a CP. Conversely, the 'think' instructions, were expected to promote reflective, Type 2 processing (see Hilbig, Scholl, & Pohl, 2010) and were expected to reduce or eliminate the CP. In addition, we predicted a negative relationship between cognitive reflection, as measured by CRT and REI, and the CP. This would indicate that individuals who have a tendency towards heuristic thinking are more likely to show the CP. We also measured eye movements as a measure of attentional focus, but like Kreplin et al., (2014) we expected that eye movements would not predict the CP. Finally, contrary to the reachability account, which would predict an edge preference for not identical items, we predicted that a CP would still be obtained in the 'gut' condition when the items were similar but not identical.

Method

Participants

We performed a statistical power analysis (GPower, 3.14) for sample size estimation, which we based on data from Kreplin, et al., (2014) comparing number of centre locations chosen in different conditions (positive, neutral, and negative context) using a Wilcoxon matched pairs test. The effect sizes (ES, Cohen's d) in this study were between .56 and .59. Setting a one-tailed alpha = .05 and power = 0.80, the calculated sample size projected for the lower effect size was N = 21 for this within group comparison. Thus, based on the counterbalance needs we set the sample size as N= 24.

Twenty-four participants (10 male) were recruited from the student population at the University of XXXX with a mean age of 24.04 (*SD* = 5.70, range 19 - 45). Ethical approval was granted by the University of XXXX Ethics Committee and the researchers complied with the Ethical Code of Conduct of the British Psychological Society. Participants provided written consent and were not remunerated for their time. All participants had normal or corrected to normal vision.

Materials

Images of durable common consumer (head phones, mobile phones, tennis rackets, laptops etc.), tools (e.g., hammers, pliers, drills, etc.) as well as non-durable (fast-moving) goods (shower gels, crisps) items were used. A total of 180 images were collected from an online image search and were grouped into sets of three similar images. Each image had a dimension of 300 x 300 pixels and the images within each set were comparable in terms of size and image quality (see Figure 1). Each participant viewed 60 sets of images which were categorised into four subgroups: tools (18 sets of three images), durable consumer items (18 sets), crisps (12 sets) and shower gels (12 sets), plus 3 extra triplets for practice (chocolates). Each block consisted of three practice trials and 60 test trials and lasted for approximately 10 minutes. The location of each item within each triplet was counterbalanced across participants and the order of images was randomised. The instructions at the beginning of each block (counterbalanced order) were manipulated by asking participants to 'think carefully' when selecting items in one block and to 'use gut feeling' in another block.

Procedure

Eye tracking data was recorded using a Tobii T120 eye tracker with a 19-inch LCD display screen with a resolution of 1280 x 1024 pixels and a sampling rate of 60 Hz. Eye tracking sensors were built into the bottom of the screen allowing for discreet tracking of eye movements. The eye-tracker device recorded eye movement data from both eyes with an average accuracy of 0.5° visual angle. The eye-tracker was calibrated individually for each participant prior to data collection whereby participants were asked to fixate on a moving red circle presented on a black screen. For analysis we used a built-in Tobii fixation classifier with thresholds of 35 for both velocity and distance.

<Figure 1 about here >

Participants were seated approximately 65cm away from the screen and were asked to remain still throughout the testing period to minimise head movements. On-screen instructions asked participants to view a set of three images and choose one object based on gut feeling ("Use your gut instinct to make your choice") or after careful deliberation ("Think carefully about your choice"). For each trial, a set of three images was displayed simultaneously on screen. Participants were required to place their dominant hand on the keyboard and make a judgment on one of three images in each set, by pressing keyboard keys 'V' (left item), 'B' (centre item) or 'N' (right item). A fixation point ('+') was presented at the horizontal and vertical centre of the screen (and the location of the following centre item) for 500ms between each set of images and images remained on screen until a keyboard key was pressed. Testing began with an initial practise session and in total, sixty sets of images were presented to participants in both conditions. Whilst both conditions (the "think' instruction block and the 'gut' instruction block) used the same image sets, the order of images and the condition (gut, think) were counterbalanced across participants. Thus each image (or triplet of images) was seen only once in a block, so twice in the experiment. Participants were informed that this study was on decision-making in relation to consumer items but did not make reference to the centrality preference on image choice until the debriefing stage.

The tendency to use heuristic processing (as performance and thinking style) was assessed following eye-tracking tasks using two questionnaires, the Cognitive Reflection Test

(CRT; Frederick, 2005) and Rational-Experiential Inventory (REI-40; Pacini & Epstein, 1999). The Cognitive Reflection Test is a 'performance-based' measure assessing an individual's ability to inhibit an intuitive but incorrect 'gut' (intuitive) response and engage in reflective processing to solve the task and find the correct answer. Whilst the original test comprises of three items (Frederick, 2005), the current study incorporated an additional four questions from Toplak et al. (2014) so participants were presented with seven questions in total.

Example item:

If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?

[Intuitive answer: 100 minutes, correct answer: 5 minutes] (from CRT; Frederick, 2005)

CRT performance was measured by counting the number of implied "intuitive' answers, to assess how far participants followed a heuristic thinking pattern. The maximum total score was seven with lower scores signifying an individual's ability to think in an analytic way and override heuristic processing. The second questionnaire employed in the study is the Rational Experiential Inventory (REI). The REI is a self-report test measuring two thinking styles, a rational, analytic style and an experiential, holistic style. Whilst people use both cognitive processes flexibly and interactively, the REI questionnaire measures an individual's tendency to make decisions in a rational or intuitive way. Twenty questions relate to rational thought, taken from a Need for Cognition scale (NFC; Cacioppo & Petty, 1982) and twenty questions measure experiential thought processes, taken from a Faith in Intuition (FI) scale. The test consists of 40 questions and participants rate their responses on a five-point Likert scale (1 = definitely not true of myself to 5 = definitely true of myself).

Example item:

I enjoy intellectual challenges

(Need for Cognition or REI-R)

I tend to use my heart as a guide for my actions

(Experientiality, REI-E, or Faith in Intuition)

Our predictions were mainly based on the REI-R (rational – need for cognition) subscale, as this has been shown in the past to predict heuristic processing (see Toplak et al., 2011).

Data Extraction

Eye-tracking data was extracted using Tobii Studio (version 3.3.2) software. Three regions of interest (ROI) were created to define the area in which looking behaviour could be analysed. Each ROI was equal sized, measuring 300 x 300 pixels and jointly covered the vertical entirety of the screen displaying the three images.

A number of different eye-tracking and behavioural indices were calculated including fixation count, fixation duration and keyboard keypresses. A fixation is defined as a momentary pause in the visual scanning of an item within an ROI. Fixation count indicates the number of times a participant fixates on a stimulus, fixation duration is the amount of time each participant fixates on an ROI, and the key presses indicate a participant's behavioural choice. A key press ended a trial and constituted the recording of that trial's fixation count and total durations. Data was exported to Excel and analysed in SPSS.

Results

Data was analysed using SPSS 23.0.

Behavioural Analysis

Non-parametric tests were employed to analyse behavioural data since preference scores did not meet the assumptions of parametric tests (Atalay et al., 2012).

Friedman ANOVAs were computed to establish whether condition of instructions using a ‘gut’ or ‘think’ approach would result in a centre stage effect in item preference when choosing one of three items. Friedman ANOVAs showed a significant effect for choice scores of an item’s location in the ‘gut’ condition ($\chi2$ (2,24) = 7.828, p = 0.020), but not for the ‘think’ condition ($\chi2$ (2,24) = 0.152, p = 0.927). Follow-up Wilcoxon tests showed that in the ‘gut’ instruction condition centre locations (M= 23.79, CI = [21.05, 26.53]) were preferred more often than left (M= 17.62, CI = [15.17, 20.08]; Z = 2.59, p= 0.01) and right (M= 18.58, CI = [16.58, 20.58]; Z = -2.016, p= 0.044) locations. In contrast, in the ‘think’ condition scores for centre locations (M= 20.33, CI = [17.99, 22.68]) were not significantly different than left (M= 19.75, CI = [17.84, 21.66]) or right (M= 19.87, CI = [17.79, 21.96]) locations (see Figure 2). The difference between the two centre locations for the think and gut instructions was significant, Z = 2.03, p = 0.042).

<Figure 2 about here >

For each instruction condition a new variable was computed to create an average difference score between the centre and the mean of left and right location to see if there was an interaction between location and choice scores across conditions. Post-hoc Wilcoxon signed ranks test obtained a significant difference in average difference scores between the gut condition (M = 5.69, CI = [1.58, 9.79]) and think condition (M= 0.52, CI = [-2.99, 4.04]; *Z* = -2.016, *p*= 0.044) showing that the difference in choice of central versus lateral positions was greater in the gut condition than the think condition.

Eye-tracking analysis

A two-way repeated measures analysis of variance (ANOVA) with three levels (left, centre and right) was computed for both conditions (gut, think) to investigate the number of fixations (fixation count) and length of fixations (fixation duration). Data were screened for outliers (none were identified using the 3 standard errors rule).

Effect of Condition

Eye-tracking analyses showed a significant main effect between instruction condition for the variable fixation count, $F(1,23) = 22.90$, $p < .001$, $\eta^2 p = .499$. Participants made more fixations in the think condition compared to the gut condition (see Table 1).
For the variable fixation durations there was also a significant main effect between conditions, $F(1,23) = 16.05$, $p = .001$, $\eta^2 p = .411$. Overall, there were longer fixations in the think condition compared to the gut condition (see Table 1).

Effect of Location

Eye-tracking data showed a significant main effect between locations (left, centre and right) for the variable fixation count, $F(2,46) = 115.77$, $p < .001$, $\eta^2 p = .834$. In both conditions, participants made more fixations to the central position, demonstrating a central looking bias (see Figure 3). Planned comparisons revealed a significant difference in fixation counts between left and centre locations, $F(1, 23) = 96.21$, $p < .001$, $\eta^2 p = .807$ and between centre and right locations, $F(1,23) = 162.75$, $p < .001$, $\eta^2 p = .876$. There was also a significant main effect between locations for the variable fixation durations, $F(2, 46) = 62.76$, $p < .001$, $\eta^2 p = .732$ (see Figure 4). Planned comparisons revealed a significant difference in fixation durations between left and centre locations, $F(1,23) = 48.08$, $p < .001$, $\eta^2 p = .676$ and between centre and right locations, $F(1,23) = 145.35$., $p < .001$, $\eta^2 p = .863$. In both the 'gut' and 'think' conditions, participants fixated for longer on the central image than images presented on the left and right. There was no statistically significant interaction between the effects of condition and location for the variable duration fixation, $F(2,46) = 2.20$, $p = .12$, $\eta^2p = .087$. Likewise, there was no statistically significant interaction between the effects of condition and location on fixation count, $F(2,46) = 2.02$, $p = .144$, $\eta^2p = .081$.

The analyses of eye-tracking patterns therefore find no indications of being influenced by instructions, except overall longer and more fixations in the think condition. As these longer trials in the think condition (fixation duration recording ended with a button press) led to more fixations and longer overall time fixating it would be informative to investigate whether each individual fixation led to longer fixations as well.

In a final analysis, we calculated a proxy for average looking time for each item (ie. position) per instruction condition, by dividing the mean fixation duration for each position by the mean number of fixations per item/position. This measure informs us whether the think condition resulted in longer fixations per location once increased fixation counts were taken into account. A 2 (condition: think vs gut) by 3 (position) ANOVA found no main effects for location ($p = .084$) or condition ($F(1,23) < 1$) nor an interaction effect ($F(1,23) < 1$) on average looking time.

<Figure 3 about here >

<Figure 4 about here >

<Table 1 about here >

Correlation Analysis

To examine the association between thinking style and ability to resist engaging in heuristic thinking on position choice, participants completed a Rational Experiential Inventory (REI) and the Cognitive Reflection Test (CRT). Pearson correlational analyses investigated the relationship between an individual's thinking disposition (assessed with the Rational Experiential Inventory scores), ability to inhibit heuristic thinking (Cognitive Reflection Test, as measured by the wrong intuitive choices), eye-movements (fixation count, fixation duration) and the centre preference score.

Two new variables for fixation count and fixation duration were computed to capture the centre preference effect for each variable. This was done by calculating the average difference (between the centre and left location and centre and right location) for fixation count (fixation count difference) and duration (fixation duration difference) - analogue to the difference variable for choice counts reported above (preference difference).

In the gut condition, there were expected positive correlations between preference difference scores and fixation count difference, r = .431, p < .05, and to a marginal degree with fixation duration difference, r = .401, p = .052 (see Table 2), indicating that more and longer fixations to the centre predicted increased choice of the central item. The only other significant effect was a negative correlation between reflective thinking style (REI-R) and item choice (measured as centre preference), *r* = .-.546, *p* < 0.01. This suggests that – in the 'gut' condition – more reflective thinkers were less likely to show a CP.

In the think condition, there was again a positive correlation between fixation duration difference and centre preference difference, r = . 580, p < .01 (Table 3). There was also a positive correlation between fixation duration difference and fixation count difference, r = .653, p < .01. Unlike in the 'gut' condition, there was no significant correlation between thinking style (REI-R) and item choice (centre preference difference). This indicates that the instructions were effective in prompting an individual to think in a reflective way and that the individuals in this condition did not rely on heuristics to guide their decision.

A further marginally significant negative correlation was observed between REI-E (experientiality or intuition) and fixation count difference, r= - .403, p = .051, indicating the higher a participant's REI-E scores the fewer were their central-to-peripheral looking count differences. Thus, across both conditions, the correlations of main interest (between preference difference on the one hand and CRT and REI-R on the other), we find that only the Gut condition shows a correlation with measures of miserly (heuristic) processing, surviving a Bonferroni correction ($p < .0125$).

<Table 2 about here >

<Table 3 about here >

Regression Analysis

Multiple regression analyses based on the correlations and our predictions were used to see whether eye moments and thinking style significantly predict individuals' behavioural choice (centre preference) in gut and think conditions. Initial tests confirmed the data did not violate any of the assumptions of linearity, homoscedasticity and normality. The dependent variable was the preference for central items (preference difference scores) and the predictors were reflective thinking style score (REI-R) and fixation duration difference.

In the gut condition the results of the regression analysis showed that thinking style and eye movements explained 39% of the variance, R^2=.39, F(2,21) = 6.60, p <.01. Cognitive thinking style (REI-R) significantly predicted item choice in the gut condition, (β = -.48, p = .011). Duration fixation difference was not a predictor of centre preference difference, β = .30, p = .098). For the think condition the total variance explained by the model was 36%, R^2=.36, F(2,21) = 5.93, p <.01). Fixation duration significantly predicted item choice (β = .59, p < .01). However, thinking style (REI-R) was not a significant predictor in an individual's item choice, t < 1. (Adding order of conditions as a dummy variable did not change this pattern of results, and order was not a significant predictor in either regression, *t*'s

< 1). The results suggest that eye-movements alone are not indicative of choice and that, when prompted to make choices in an intuitive way, heuristics guide the position effects.

<Table 4 about here >

<Table 5 about here >

Discussion

This study examined predictions derived from the heuristic account of the CP, namely that the CP would be present when heuristic thinking was promoted, either through instructions or from individual tendencies toward heuristic thinking. As predicted, instructions promoting heuristic thinking resulted in a CP effect whereas instructions that promoted slower reflective thinking eliminated it. These findings are in accord with the view that the CP is caused by the rapid application of a decision heuristic which avoids effortful processing and which states that the better items are located centrally (Raghubir & Valenzuela, 2006; Rodway et al., 2016). They also concur with those of Pailhes and Kuhn (2020) in a card selection task, showing that the CP is more pronounced when implicit rather than explicit choices are encouraged.

The instructions changed the participant's looking behaviour in expected ways, with more fixations and longer fixations following 'think' instructions compared to the 'gut' instructions. For both 'gut' and 'think' instructions there were longer and more fixations for the central item, replicating the central looking bias (Bindemann, 2010; Chandon, et al., 2009). However, task instructions did not interact with location of item choice for the measures of fixation duration and fixation count: looking behaviour patterns across locations were very similar for both instructions. Thus, there was no evidence that attentional focus caused the CP, and a greater attentional focus in the think condition did not result in a CP. It remains possible, however, that the 'think' instructions disrupted the effect of attention on the

CP and that for the 'gut' condition the CP was still caused by the allocation of attention. However, the fact that the REI-R (need for cognition) correlates with the CP in the gut condition would argue against this interpretation. Nevertheless, this question could be examined in future research and predicts that other manipulations which disrupt central attention will eliminate the CP. The fact that the CP was found when the items were not identical, but similar, replicates other findings (Atalay et al., 2012; Li & Epley, 2009; Rodway, et al., 2012) and is contrary to the prediction of the reachability account (Bar-Hillel, 2015) that for non-identical items a preference for items at the edge should emerge. It could be argued that the items in a triplet were so similar that they are judged to be essentially identical or equivalent, or that because the participants were asked to make a quick 'gut' choice it makes the option essentially identical. Despite this possibility, the results of this and other studies suggest that a CP can occur with non-identical items and that reachability may not explain the CP.

Previous research examining location effects on choice with non-identical consumer items (Atalay et al. 2012; Kreplin et al., 2014; Raghubir & Valenzuela 2006; Rodway et al., 2012) obtained a CP without emphasising a quick intuitive choice. Atalay et al. even asked participants to 'carefully review' each product on the screen before making their choice, showing that the CP can also occur when careful choices are made. An important difference between this study and previous research is that a within-subjects design was used, which could have made a difference in choice instructions particularly salient to the participants. Although there were no order effects of task instruction it appears possible that participant awareness of 'gut' and 'think' choices caused them to approach the choice in a clearly different way for the different instructions. In addition, no previous study has placed such a strong emphasis on thinking carefully about the choice, which may have particularly encouraged reflective rather than heuristic thinking in this experiment. A possible interpretation of the effects of instruction across different studies is that encouraging reflective thinking eliminates the application of the central preference decision heuristic, and therefore the CP, whereas emphasising ‘gut’ choice leaves it intact. Thinking disposition (REI-R) predicted choice in the ‘gut’ condition, with more reflective thinkers less likely to show the CP, but not the ‘think’ condition. This result provides partial support for the view that heuristic thinking causes the CP, with more reflective thinkers potentially resisting the application of the centre stage heuristic when instructed to use their ‘gut’. However, thinking disposition (REI-R) did not predict the CP in the ‘think’ condition, and it could be expected to if thinking style influences the application of heuristic thinking that underpins the CP. Therefore the extent to which thinking style influences the CP is unclear and requires further investigation, but it is informative that thinking disposition during quick, ‘gut’ decisions might be predictive of the tendency to resist heuristic thinking.

A concern could be along the idea that rather than changing to a different thinking style, ‘gut’ instructions simply caused participants to respond very fast, which for some reason benefitted the centre location items. Indeed, in dual process theory a strong correlation between speed and associative/heuristic processing (as well as expending little effort) is proposed as one of the hallmarks of System 1 (or Type 1) processing (Evans, 2008; Kahneman, 2011). We cannot exclude this possibility without an extra (neutral) condition, but such an interpretation of our manipulation would still not challenge our main interpretation that a gaze cascade effect (which would need time to build up from first to penultimate or last fixation) cannot explain the CP. Nevertheless, we examined this possibility, and performed an extra analysis in which we removed the 16 (66%) slowest ‘gut’ responders: The CP remained, ($\chi2$ (2) = 7.27, p = 0.026) for the gut condition, but there was no position effect in the ‘think’ condition, ($\chi2$ (2) = 0.452, p = 0.798). Importantly, in this small sample there is no difference in overall mean RTs (fixation duration) between gut and think conditions anymore: t(7) < 1. This supports the view that a different thinking ('heuristic') style rather than speed is driving the differential effects.

In contrast to thinking disposition, cognitive reflection performance (CRT-intuition score) was not a predictor of the CP. The CRT has been found in the past to correlate with a number of constructs such as cognitive ability and executive functions (Toplak et al., 2011), numeracy, and thinking dispositions (Toplak et al., 2014). Thus, CRT seems implicated in a variety of mental constructs regarding judgment and choice and the currently observed pattern of results from the CRT indicates that there is no evidence of an effect of individual differences in cognitive ability on the CP.

There are some limitations with this study. The fixation point prior to the start of a trial was located centrally and the longer fixation on the central item could therefore have occurred due to a lingering fixation at the trial onset. While this is a potential issue, it can be noted other studies have found a central looking bias (Bindemann, 2010) and the CP occurred only in the 'gut' condition despite the similarity in looking behaviour for both 'gut' and 'think' conditions. In addition, it could be argued that this is in fact an ecologically more valid situation, as people will first look at the middle of an array. Furthermore, as Atalay et al (2012; p849) showed, the initial tendency to fixate on the centre did not predict choice, and the central viewing bias only predicted choice when it occurred in the 500 ms before a choice was made. Similarly Shimojo et al. (2003) also found that fixations at the start of a trial did not predict choice, but they did so in the final seconds before the choice was made, with an increase in fixations on the preferred item. Another limitation, is that the experiment did not directly test cascade theory of the CP by measuring the build-up of fixations at the start and end of the choice. Therefore, it is possible that there was a cascade of fixations just before a choice was made and this process determined the choice. If this was the case, however, it is unclear why the CP should be eliminated by the instructions, unless a gaze cascade is less likely when participants take longer to consider their choice. This relationship can be explored in future research.

In conclusion, participants demonstrated a CP when they made their choice quickly and intuitively, but not when they were asked to think carefully about their choice. These findings show that the CP can be eliminated or enhanced by the choice instructions. The results are compatible with the view that a CP is caused by the implementation of the centre stage heuristic which specifies that the best item is centrally positioned (Valenzuela & Raghubir, 2009; Rodway et al., 2016) and are largely incompatible with an attentional focus explanation or a reachability account. The findings have broad and important implications for theories and applications of behaviour beyond consumer psychology, whenever position effects may be relevant, such as choice design in health, behavioural addiction, and financial decision-making. The results suggest that the tendency to choose the central item can be eliminated by encouraging a careful reflective choice, and promoted by encouraging a quick, intuitive, choice.

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Research Disclosure Statement

We, the authors, declare that this research was not funded, and there are no relevant financial or non-financial competing interests to report.

Data Availability Statement

The data for this study are available at: https://osf.io/3yuq6/

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Figure 1. Example of a triplet of consumer items (here, toothbrushes).

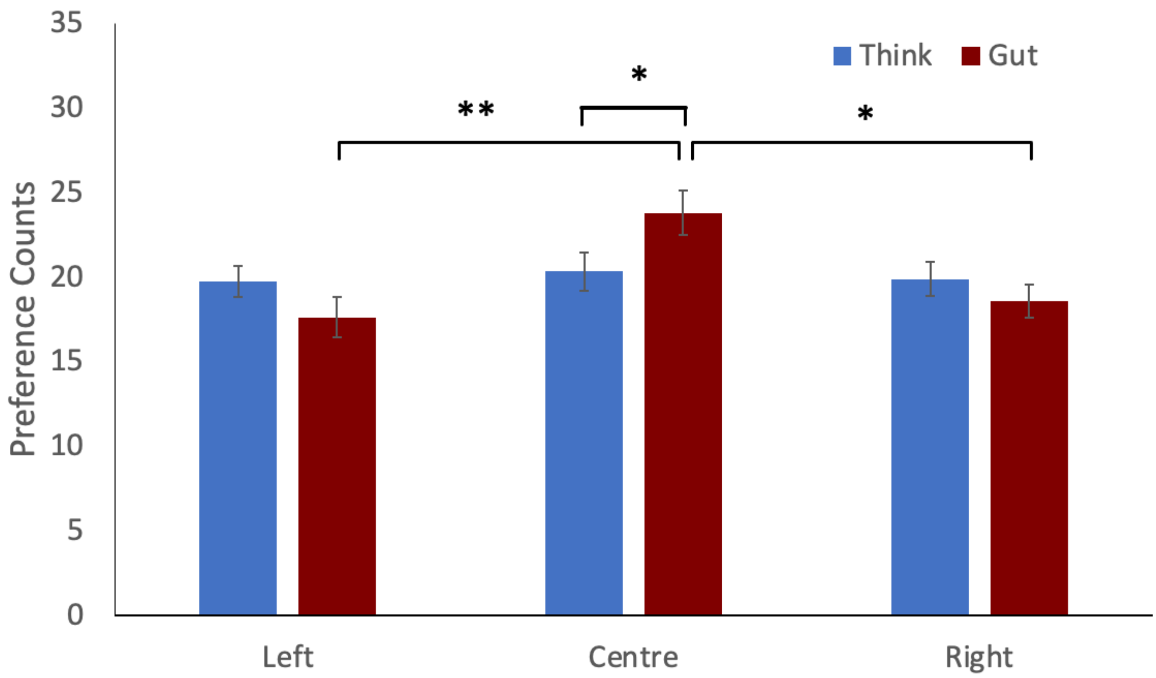

Figure 2: Frequency of preferred items' locations as a function of instruction conditions ('think' vs 'gut'). Error bars are standard error of the means.

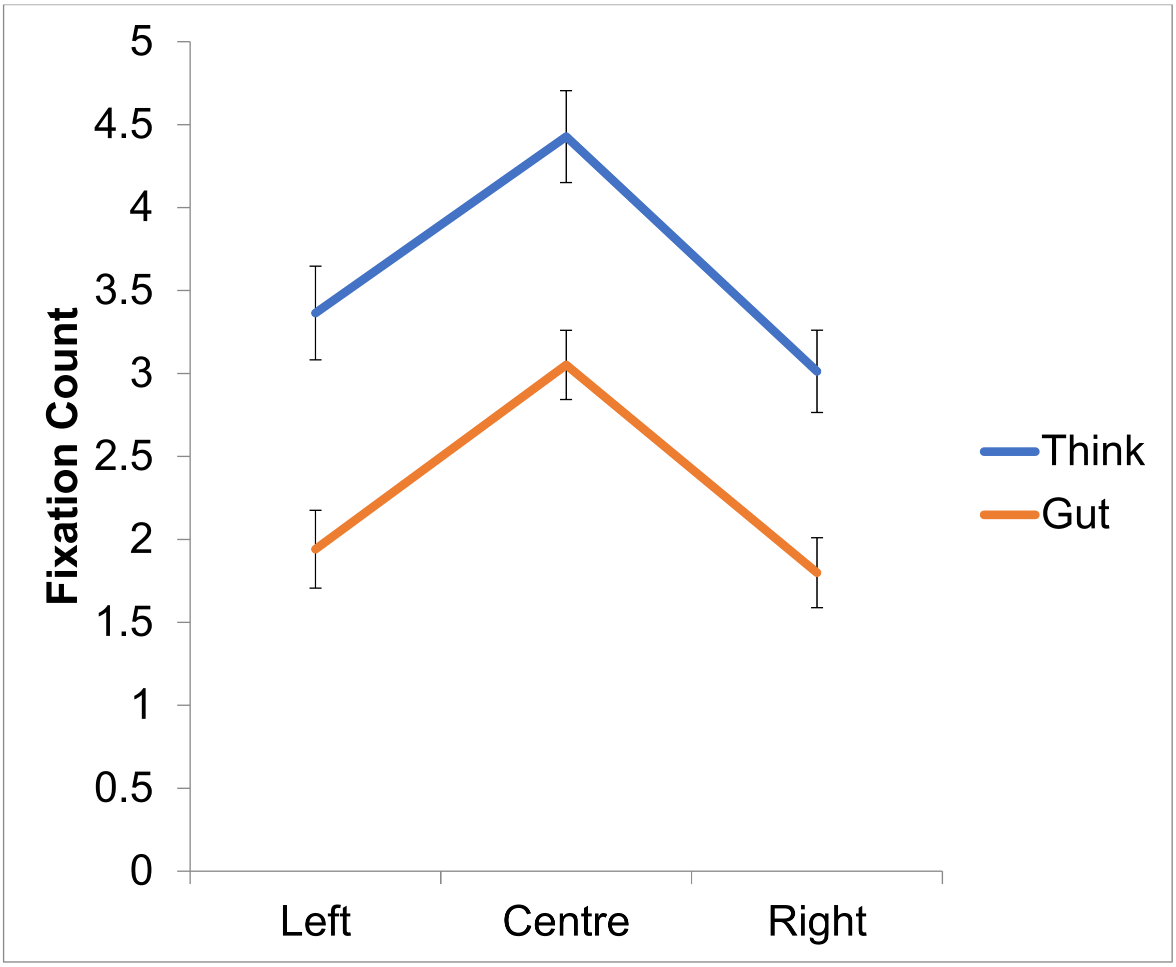

Figure 3: Mean number of looking counts for chosen items at each locations as a function of instruction conditions ('think' vs 'gut'). Error bars are standard error of the means.

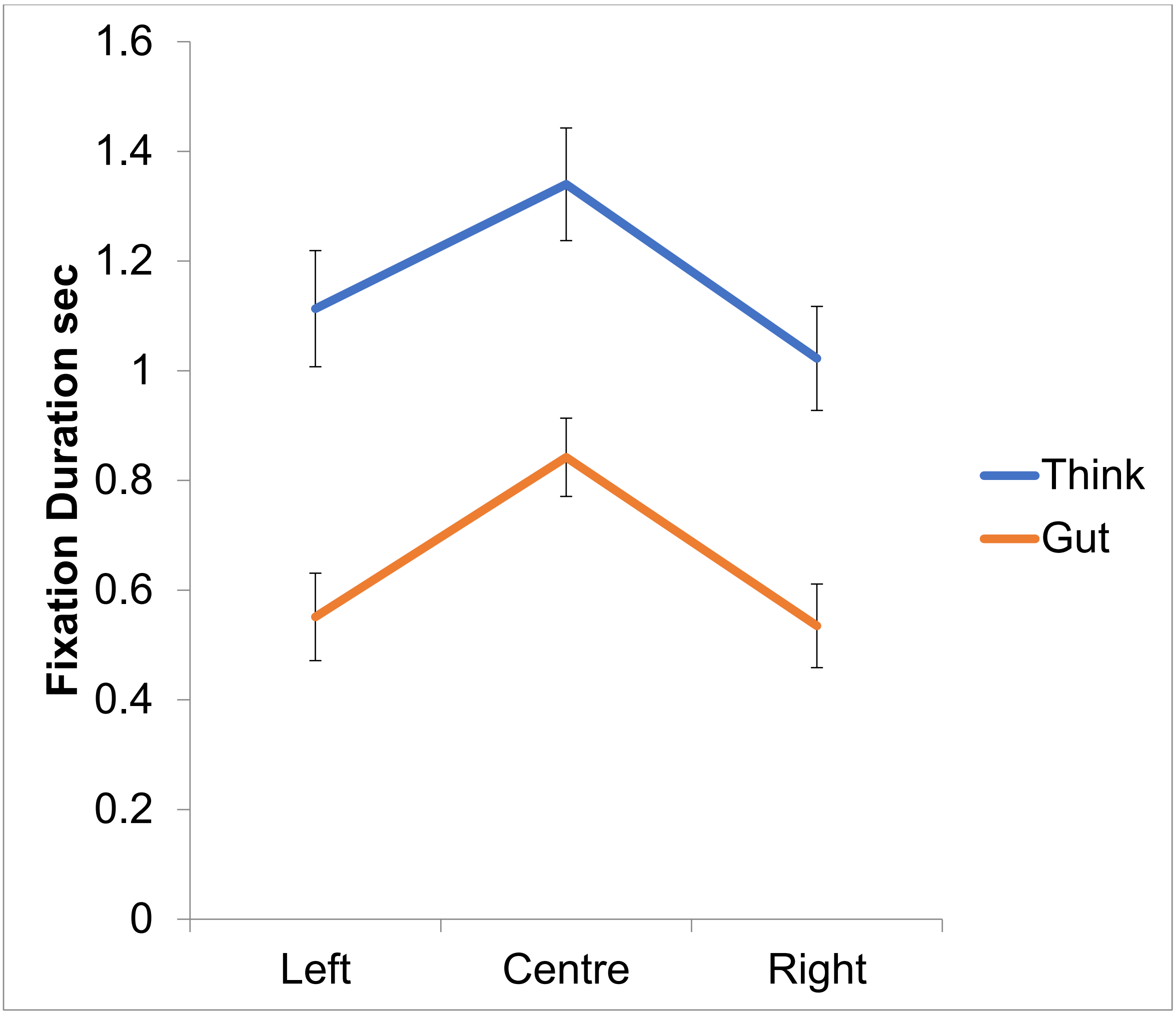

Figure 4: Mean duration of looking times for chosen items at each location as a function of instruction conditions (‘think’ vs ‘gut’). Error bars are standard error of the means.

Table 1

Mean Choice Scores for each Location and Mean Scores of Eye Tracking Data for Both Conditions (N=24).

	Gut			Think		
	Left	Centre	Right	Left	Centre	Right
Choice score	17.63 (15.17-20.08)	23.79 (21.05-26.53)	18.58 (16.58-20.58)	19.75 (17.84-21.65)	20.33 (17.99-22.68)	19.88 (17.79-21.96)
Fix. Duration	0.55 (.38 – .71)	0.84 (.69 - .99)	0.53 (.38 - .69)	1.11 (.89 – 1.33)	1.34 (1.12 – 1.55)	1.02 (.83 – 1.22)
Fix. Count	1.94 (1.46 – 2.43)	3.05 (2.62 – 3.48)	1.80 (1.36 – 2.23)	3.36 (2.78 – 3.95)	4.43 (3.85 – 5.00)	3.01 (2.50 – 3.53)

Note. 95% confidence intervals in brackets.

Table 2

Pearson Correlations among Major Variables for Gut Condition

	Fixation Count difference	Fixation Duration difference	CRT-Intuition	REI-R	REI-E
Preference difference	.431*	.401†	-.162	-.546**	-.270
Fix. Count difference	____	.218	-.024	-.353	-.056
Fix. Duration difference	____	____	-.127	-.204	-.236
CRT-Intuition	____	____	____	-.024	.330
REI-R					-.056

Note. CRT = Cognitive Reflection Test, REI-R= reflective thinking style, REI-E = experiential thinking style

$n = 24$,† = .05, * $p < .05$, ** $p < .01$

Table 3

Pearson Correlations among Major Variables for Think Condition

	Fix. Count difference	Fix. Duration difference	CRT	REI-R	REI_E
Preference difference	.204	.580**	-.303	-.112	-.025
Fix. Count difference	____	.653**	-.105	-.074	-.403†
Fix. Duration difference	____	____	-.227	.078	-.185
CRT-Intuition	____	____	____	-.024	.330
REI-R					-.056

Note. CRT = Cognitive Reflection Test, REI-R= reflective thinking style, REI_E = experiential thinking style

n = 24,† = .05, * p <.05, ** p <.01

Table 4

Summary of Regression Analysis for Variables Predicting Item Choice in the Gut Condition

	b	SE *b*	β	t	p-value
Constant	40.34	15.75		2.56	.018*
Fix. Duration Diff.	19.69	11.38	.30	1.73	.098
Cogn. Style (REI-R)	-11.00	3.96	-.48	-2.77	.011*

Note. R^2 = .39, * p < .05

Table 5

Summary of Regression Analysis for Variables Predicting Item Choice in the Think Condition

	b	SE *b*	β	t	p-value

Constant	4.63	12.65		.37	.718
Fix. Duration Diff.	26.62	7.89	.59	3.38	.003**
Cogn. Style (REI-R)	-3.08	3.41	-.16	-.90	.38

Note. R^2 = .36, * p < .05