Looking behaviour and preference for artworks: the role of emotional valence and location

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Abstract

The position of an item influences its evaluation, with research consistently finding that items occupying central locations are preferred and have a higher subjective value. The current study investigated whether this centre-stage effect (CSE) is a result of bottom-up gaze allocation to the central item, and whether it is affected by item valence. Participants (n=50) were presented with three images of artistic paintings in a row and asked to choose the image they preferred. Eye movements were recorded for a subset of participants (n=22). On each trial the three artworks were either similar but different, or were identical and with positive valence, or were identical and with negative valence. The results showed a centre-stage effect, with artworks in the centre of the row preferred, but only when they were identical and of positive valence. Significantly greater gaze allocation to the central and left artwork was not mirrored by equivalent increases in preference choices. Regression analyses showed that when the artworks were positive and identical the participants' last fixation predicted preference for the central art-work, whereas the fixation duration predicted preference if the images were different. Overall the result showed that item valence, rather than level of gaze allocation, influences the CSE, which is incompatible with the bottom-up gaze explanation. We propose that the centre stage heuristic, which specifies that the best items are in the middle, is able to explain these findings and the centre-stage effect.

Keywords: eye tracking, preference, centre-stage effect, art, decision making

1. Introduction

In Western Society a robust social convention is that the person with the highest status will often be positioned in the centre a group of people (McArthur, 1981). This relationship between the central position and status has surprisingly important implications such as influencing how much a person is preferred, their perceived status, and even whether they will be given a job. For instance people who hold the belief that "Important people sit in the middle" are more likely to give a job to the candidate in the centre of a photograph of five potential job candidates (Raghubir & Valenzuela 2006). This 'center-stage effect' (CSE) has also been found to apply to consumer choices so that when people are presented with a row of similar items they show a preference for items in the middle rather than at either end of the row (Atalay, Bodur, & Rasolofoarison, 2012; Christenfeld, 1995; Raghubir & Valenzuela, 2006; Rodway, Schepman, & Lambert, 2012; Shaw & Bergen, 2000; Valenzuela & Raghubir, 2009). Therefore it is apparent that not all locations are treated equally, and the preference for centrally located people and objects influences decisions in a wide range of settings, including consumer choices and the evaluation of people.

Previous work demonstrating a middle preference has tended to use everyday consumer items (Christenfeld, 1995) such as pens and chairs (Shaw et al., 2000), packets of chewing gum (Valenzuela & Raghubir, 2009), socks (Rodway et al., 2012), or vitamins and cereal bars (Atalay et al., 2012). In each of these studies the set of items were selected to be very similar, or identical, and have also possessed a neutral or mildly positive valence. As these items may not be intrinsically interesting it is possible that when people are forced to choose between them they select the middle item as their default option because of indifference toward the items, as can occur on some rating scales (see Kulas, Stachowski, & Haynes, 2008). Similarly, as proposed by Christenfeld (1995), limited interest in the items may also cause participants to expend minimal mental effort on the selection, with the middle item selected because it appears to be the easiest option and requires the least thought.

One of the aims of the current study was to test this possibility by investigating whether the middle preference generalises to stimuli that may require more cognitive and emotional appraisal during their evaluation and selection. Works of art were chosen as stimuli because it has been argued that visual art is appraised differently from everyday objects (Cupchik, Vartanian, Crawley, & Mikulis, 2009). The former involves complex cognitive and emotional responses that are believed to be key processes of the aesthetic evaluation of a work of art, but not the processing of everyday objects (Cupchik et al., 2009; Leder, Belke, Oeberst, & Augustin, 2004; Leder, 2013). In this study three works of art were presented on each trial and participants were asked to select the one that they most preferred. It was reasoned that if the middle preference is simply a product of minimal effort when choosing among items with little intrinsic value, then it may not be present for works of art which elicit greater in-depth cognitive and emotional appraisals. Conversely, if position continues to have an effect it will show that the centre-stage effect generalises to aesthetic preferences and that it might not be due to the use of everyday items that require minimal cognitive appraisal.

A further central aim of the study was to examine the two primary explanations of the centre stage effect. One explanation is that it is caused by a 'center-stage' decision heuristic that specifies that central items are more important and valuable and are therefore to be preferred (Raghubir & Valenzuela, 2006; Valenzuela & Raghubir, 2009). Thus, the middle advantage arises because the middle location has a special status, carrying implicit assumptions about the importance of the object (or person) in the middle of a group (McArthur, 1981; Raghubir & Valenzuela, 2006; Valenzuela & Raghubir, 2009). A second explanation of the CSE is that it is due to attentional processes, with greater attention to the central item enhancing preference (Shaw et al., 2000). Evidence exists for both accounts and previous research has not convincingly favoured one explanation.

Raghubir and Valenzuela (2006) examined these two explanations of the CSE by examining how people's beliefs about items located in the centre influenced their choices, in addition to using indirect measures of attention. They provided a range of evidence in favour of the heuristic explanation, with people's belief that central items are more valuable causing a middle preference in a wide range of circumstances. In addition they found that when participants chose an item for another person, rather than themselves, it increased the strength of the middle preference, which they suggest reflects the meta-cognitive knowledge people have about the factors that govern choices in other people. Valenzuela and Rahugbir (2009) also predicted that if belief-based mechanisms underlie the middle preference, rather than attentional processes, then those beliefs will be affected by additional sources of information that strengthen or weaken the middle preference. Their findings were in line with their prediction but they obtained no evidence to suggest that greater attention to the middle item caused the middle preference. Consequently Raghubir and Valenzuela (2006) concluded that metacognitive beliefs about position were necessary and sufficient for the middle preference to emerge.

Despite persuasive evidence from Valenzuela and Raghubir's studies, without directly examining gaze behaviour it is difficult to discount the possibility that gaze influences location based preferences, independently of the centre stage heuristic. A robust finding in the vision literature is that people look first and for longer at the centre of a computer screen, or visual scene, than at peripheral items (Bindemann, 2010; Tatler, 2007). As increased exposure has been found to increase liking (Zajonc, 1968) the central looking bias could underlie the CSE.

Other research has demonstrated that directing gaze to an item, rather than mere exposure to an item, is important in enhancing preference (Shimojo, Simion, Shimojo, & Scheier, 2003). The influence of gaze on choice has been explained in terms of a gaze cascade theory (Shimojo et al., 2003), which proposes that gaze at preferred items combines with increased exposure to create a positive feedback loop (a gaze cascade) as people view items, so that preference for a particular item becomes stronger and a choice emerges (Shimojo et al., 2003; see also Glaholt & Reingold, 2009; Nittono & Wada, 2009).

One study to directly examine the role of attention and the CSE was conducted by Atalay et al. (2012) who measured participant's eye movements while choosing a consumer item from a row of similar products. They replicated the CSE with participants showing a preference for the middle item. Participants also showed a central looking bias, with more first looks at the central item in the first 500 ms, and also more fixations on a chosen item in the last 500 ms before the choice was made. The increase in fixations on the central item at the start of the task did not predict choice of the middle item, whereas gaze allocation to the centre in the last 500 ms before the choice did predict the central preference. Atalay et al. (2012) explain the middle preference in terms of a *central* gaze cascade effect, with gaze allocated at the central item increasing the preference for that item. However, this is only apparent in the 500 ms before a choice and is not predicted by the central viewing bias at the start of a trial. Atalay et al. (2012) suggest that indirect measures of attention, such as recollection scores or visualisability are not be sensitive at detecting actual behaviour, which is why Raghubir and Valenzuela (2006) may not have found a relationship between attention and the CSE.

A difficulty with concluding that the CSE is due to a gaze cascade effect is that other research has questioned the validity of gaze cascade theory (Glaholt, & Reingold, 2009; Nittono & Wada, 2009; see also Orquin & Loose, 2013), as it has been found that exposure duration determines preferences rather that eye movements (Bird, Lauwereyns, & Crawford, 2012). Moreover, Bird et al. (2012) suggest that eye movements may have no causal role in a preference decision and that the relationship between eye movements and choice can be explained by greater exposure enhancing preference rather than by the allocation of gaze.

A further difficulty in concluding that the CSE is due to attentional factors is that considerable evidence suggests that top-down influences, such as instructions and search strategies, can govern the allocation of gaze to relevant stimuli (Orquin & Loose, 2013). Therefore, although Atalay et al.'s (2012) results show a link between gaze allocation and preference for the central item, it is not possible to conclude that gaze caused the preference, as gaze allocation could have been the product of a top-down 'center-stage' strategy. It is possible that both mechanisms operate and they need not be mutually exclusive. For example, a centre-stage heuristic could increase the allocation of gaze to the middle, and the tendency to gaze at the middle item could be the mechanism by which preference for that item is increased. Furthermore, evidence suggests that the valence of items interact with the effect of exposure on preference. For example, Armel, Beaumel and Rangel (2008) found that greater attention to appetitive items enhanced preference whereas greater attention to unappetitive items reduced preference. Therefore, increased exposure on its own does not increase choice (see also Chandon, Hutchinson, Bradlow, & Young, 2009), as it is dependent on the valence of an item, showing that gaze duration and choice preference can dissociate.

In the current study eye movements were measured and two manipulations were introduced to further examine the relationship between gaze and preference for the middle item. First, the valence of the artworks was manipulated with one category of artworks possessing a negative valence and a second category a positive valence. Armel et al.'s (2008) results suggest that increased gaze only enhanced preference for positive items and therefore gaze to negative artworks may not result in increased preference. Moreover, no other study has examined how the valence of an item influences the CSE but it is possible that the middle preference only applies to positive items and not negative items. This is suggested by the findings of Rodway et al. (2012) who manipulated the valence of the preference decision, but not the valence of the items, by asking participants to select from a row of 5 similar images the image they 'least prefer' or the one they 'most prefer'. They found that the middle item was only selected more frequently when it was a positive preference selection and not when it was a negative preference selection. This indicates that the CSE may only occur for items that are desirable or positive rather than items that are undesirable. Importantly, if valence influenced the CSE but not gaze behaviour then dissociation between gaze and choice of item might emerge. This would enable a clearer understanding of the cause of the centre stage effect, pointing to a heuristic explanation rather than an attentional account.

A final manipulation was to vary the type of decision made. As Bar-Hillel (2011) notes, the middle preference has been demonstrated most consistently in decision tasks where the items are either all identical (e.g. Christenfeld, 1995) or very similar (Shaw et al., 2001; Valenzuela & Raghubir, 2009) making the decision different to other selection tasks where all the items typically differ on several dimensions. Bar-Hillel (2011) suggests that selecting from identical items is a form of 'picking', which occurs quite frequently in every-day life, but less often than when selecting from items which are all different. This second type of selection task is the more typical form of 'choosing'. In choosing tasks the features of the items largely determine which item is chosen and the effect of the central location is diminished but may still be apparent.

To investigate whether 'picking' and 'choosing' a work of art influenced the center-stage effect participants were presented with either three identical works of art or three works of art that were similar but distinct (see fig 1). It was predicted that there would be a preference for middle items but this would be strongest in the picking task, in line with earlier findings. This manipulation also enabled an examination of the relationship between looking and choice selection. If the pattern of looking at the central items was equivalent in the picking and choosing tasks, but the centre stage effect was only present for the picking task, then the results could indicate that looking behaviour does not always predict the item chosen.

Irrespective of the valence of the artworks or the type of choice task, based on the central viewing bias and the results of Atalay et al. (2012), we expected that participants would tend to fixate the central item first and make more fixations to the central item. We hypothesised that if the central viewing bias determines the centre-stage effect then there should be a positive relationship between the number of fixations on the central artwork and the participant's selection of that artwork. Moreover, if the centre-stage effect is caused by looking at the central item in the second (or 500 ms) before the choice is made, or by the first look in the selection task (e.g. Atalay et al., 2012; Shimojo et al., 2003; Yagi, Ikoma, & Kikuchi, 2009), then this would also be reflected in the eye movement and choice data. Conversely, if looking patterns do not cause the centre-stage effect then there should be no relationship between looking at the central artwork and choice of that item. In this case the results may provide indirect support for the central preference being determined by a decision heuristic rather than by looking behaviour.

2. Methods

2.1. Participants

Fifty right-handed participants (21 male) were recruited from student population and the general public with a mean age of 28 (*SD* 8.78, range 18 – 56). All procedures were approved by the University of East London's ethics committee. Participants gave written consent to participate without pay. Eye tracking data was collected from a subset of 22 participants (7 male). Eye tracking data from three participants was excluded due to technical problems (such as a large number of data loss during the eye tracking recording due to eye-blinks), the analysis was conducted with the remaining participants (N = 19)[1]. All participants had normal, or corrected to normal vision.

2.2. Materials

Contemporary artwork was used as stimuli to allow the systematic manipulation of valence, as well as combining symmetrical patterns and faces similar to stimuli used in previous studies. Twenty-two contemporary artworks were selected from 15 little known artists. The criterion for an artist to be included was that they had sold their work or had publicly exhibited. The images were divided into three categories: positive-identical (8 items), negative-identical (8 items) and different (6 items) (Figure 1). Positive and negative images had been selected from a pre-rated art database (Kreplin & Fairclough, 2013) of 60 pictures, based on ratings for valence and visual complexity. Images in the database were rated by 1043 participants in an online study design. Participants were asked to provide ratings for visual complexity (easy – complex) and valence (positive – negative) on a 9 point scale. Mean valence ratings for positive images and negative images used in this study were $M = 3.54$ ($SD\ 0.56$) and $M = 6.09$ ($SD\ 0.38$) respectively. Mean complexity ratings in this study were kept at $M = 4.35$ ($SD\ 0.95$). Ratings from the database were only available for identical images, because the database did not contain images that were very similar but slightly different. Therefore additional images for the different condition were chosen over the internet from little known artists that sold or exhibited their work. These were to be similar versions of the same painting but with slight though still distinctive differences (see Figure 1 bottom). We found six such triplet versions which we judged to be of neutral valence but similar complexity than the images in the other conditions. To verify these parameters, fifteen new participants (8 female, age $M = 30.71$, $SD\ 3.45$) rated images in the different condition for complexity and valence on 9-point Likert scales. The mean valence ratings were $M = 5.01$ ($SD\ 1.67$). The complexity ratings showed that images in the different condition ($M = 4.31$, $SD\ 1.82$) are not seen as more complex than those in the identical condition ($M = 4.35$, $SD\ 0.95$; $t(7) = 1.19$, $p = .272$) and neutral in valence. To confirm differences in valence ratings between conditions, a one-way ANOVA showed a significant effect of valence ($F(2,10) =$

[1] **As the main researcher and first author moved to a different University where the eye-tracking equipment was not available she was unable to examine eye movements in all participants. However, it was felt that the sample of 22 participants was sufficient to accurately establish patterns of eye movements during the selection task.**

*63,60, p = .001, η2=0.927). P*aired sample t-tests showed that images in the negative identical condition were rated as significantly more negative than images in the positive identical condition (*t(7) = 33.73, p = .001*), and images in the different condition significantly less positive than images in the positive identical condition (*t(5) = 5.87, p = .002*) and less negative than images in the negative identical condition (*t(5) = 4.52, p = .006*). The different condition was included to assess if the CSE would only be present in identical images or if it would also occur if the images were slightly different. This design allowed a comparison between decision-making that is based on a combination of heuristics and image differences.

Figure 1. Examples of stimuli for a) positive identical: "Magic Realism" ©Michael Parkes. b) negative identical: Monika Weiss "Elytron" 2003, self-shot photography, performance, installation, sculpture and video. Courtesy the artist and Chelsea Art Museum, New York and c) different: Cornelius Voelker "Raspberry", 2008, oil on canvas, 11.8 x 13.8 inch (© VG Bild-Kunst).

2.3. Procedure

To record the eye tracking data participants (N = 22) were seated in front of an ASL6000 Remote Eye tracking system (Applied Science Group, Inc.). The ASL504 eye-tracker screen was 44cm with a spatial resolution of more than 0.5 degrees, a spatial error less than 1 degree and a sampling rate of 60Hz. The remote eye tracker was placed in front of the participant just below the screen. The camera tracked participants' eye movements throughout the experiment in an unobtrusive manner. Participants were asked to place their chin into a head-rest to minimize head movement. The eye-tracking device was calibrated for each participant immediately before the experiment started. The process required participants to look at a series of yellow numbered dots presented on a blue screen.

Participants were seated at a distance of 70 cm from the screen. Each trial consisted of one image set that showed three images simultaneously. Each image had a dimension of at least 300 x 240 pixels, and a maximum of 300 x 350 pixels, image sizes varied slightly depending on the original layout of the picture (landscape or portrait). Instructions on the screen asked participants to inspect the displayed images and to give a preference judgment ("Which image do you prefer?") by pressing the keyboard keys "v" (to select the left image), "b" (centre image), or "n" (right image). The next triplet of images would appear after a response (using keys v, b, n) was made with an inter-trial interval of 1000ms during which a blank screen was shown. Viewing time was not constricted. Twenty-two image sets were shown; six image sets in the different picture condition[2], eight image-sets in the negative identical condition and eight in the positive identical condition. Participants were not informed about the nature of the three conditions, however, all participants commented after the experiment on the fact that some images were identical. The image sets were presented in random order using e-prime 2.0. The location (left, centre, right) of each image within sets for the different picture condition was counterbalanced across participants. This was not necessary for the negative and positive identical condition because the images were the identical. Participants were informed that the experiment concerned decision-making in the context of art, but not about the effect of location on preference until completion of the experiment until the debriefing.

2.4. Data extraction (eye tracking)

To analyse the data, three identical Regions of Interest (ROI) were identified using Eyenal analysis software (Applied Science Group, Inc.). A ROI identified the area in which subsequent looking behaviour was analysed. ROIs covered 300 x 350 pixels (covering one image) and were defined as left, centre and right. Eyenal was used to extract looking behaviour for each ROI. A fixation was defined as a short pause within the scanning of the item in each ROI. Fixations shorter than 100ms were excluded from further analysis. The number of the first fixation of each trial (the count of the first fixation of each trial), the number of the last fixation within each trial (the count of the last fixation in each trial), the percentage of the total fixation count (how many fixations each location received in relation to all fixations of one trial) and the percentage of the total fixation duration (the amount of time each location was fixated on within a trial in relation to the whole time of the trial) was extracted and exported to Excel and SPSS for further analysis. Using the percentage of

[2] For the different condition only six different image variations were available that would be comparable in amount and style of changing a particular **motif** (rather than the eight triplets in each of the two identical sets).

fixation takes into account time that is lost because of eye blinks or fixations outside ROIs (Glaholt et al., 2009).

3. Results

3.1. Behavioural Analysis

Non-parametric tests were employed as is customary with these types of data (Atalay et al., 2012; Rodway et al., 2011) as assumptions for parametric analyses cannot be upheld for preference counts. Three Friedman ANOVAs were computed to identify if there was a CSE in any of the three conditions (i.e. preference differences between left, centre and right location were compared in each condition) for N = 50. The Friedman ANOVAs yielded a significant effect for preference between locations for the positive identical condition (χ^2 *(2,50) = 9.76, p = .008*), but not for the different condition (χ^2 *(2,50) =0.748, p = .678*) or the negative identical condition (χ^2 *(2,50) = 0.838, p = .658*). Post-hoc analyses for the positive identical condition using Wilcoxon Signed Rank tests showed that the centre location (*M= 3.50, SD 2.09*) was preferred significantly more often than the left location (*M = 2.34, SD 1.66; z = -2.05, p = .040*) and the right location (*M = 2.16, SD 1.53; z = -2.52, p = .012*). In other words, there was a CSE for the positive identical condition but not the negative identical condition or the different condition.

To establish if there was an interaction in preference ratings between conditions and location three Friedman ANOVAs were computed to identify differences between conditions at each location (i.e. comparing differences between conditions at the left, centre and right location). To be able to do this, the data set of the positive identical and negative identical condition was reduced by omitting trials with the two least positive and the two least negative images which left six images in the positive identical condition and six images in the negative identical condition. This step was performed to assure that each condition contained an equal number of images (to match the 6 trials in the ‘different’ condition). Further, it enabled us to investigate whether a possible difference for central preference was masked by an underpowered manipulation of valence. Firstly the Friedman ANOVAs for the positive identical and negative identical condition were repeated. The results showed a significant effect for preference between locations for the positive identical condition *(χ^2 (2,50) = 6.42, p = .040)*, but not the negative identical condition *(χ^2 (2,50) = 0.04, p = .977).* Post-hoc analyses for the positive identical condition using Wilcoxon Signed Rank tests showed that the centre location (*M= 3.08, SD 1.95*) was preferred significantly more often than the right location (*M = 1.88, SD 1.36; z = -2.45, p = .014*) and, approaching significance, the left location (*M = 2.04, SD 1.49; z = -1.86, p = .062*).

. The Friedman ANOVAs conducted to establish between condition effects at each location (i.e. comparing differences between conditions at the left, centre and right location) yielded a significant difference between conditions at the centre location *(χ^2 (2,50) = 15.38, p = .001)* but not the left *(χ^2 (2,50) = 1.98, p = .370)* or right location *(χ^2 (2,50) = 0.54, p = .763).* The results showed that images in the positive identical condition (*M = 3.08, SD 1.95)* were preferred significantly more in the centre location compared to images in the negative identical condition (*M = 2.26, SD 1.72, z = 2.98, p = .003)* and different condition (*M =*

1.82, SD 1.15, z = 3.23, p = .001). In other words, images in the positive identical condition were preferred significantly more often in the centre location compared to images in the negative identical and different condition indicating that valence influences preference at the centre location. Figure 2 displays these results. An additional 3 (condition) by 3 (location) analysis of variance was conducted on the median response times. Missing data were replaced by using the SPSS function 'linear trend at point'. There were no main effects or interactions, all Fs = 1.52. The median response time across all conditions was $M = 4.89$ seconds (SD = 0.485).

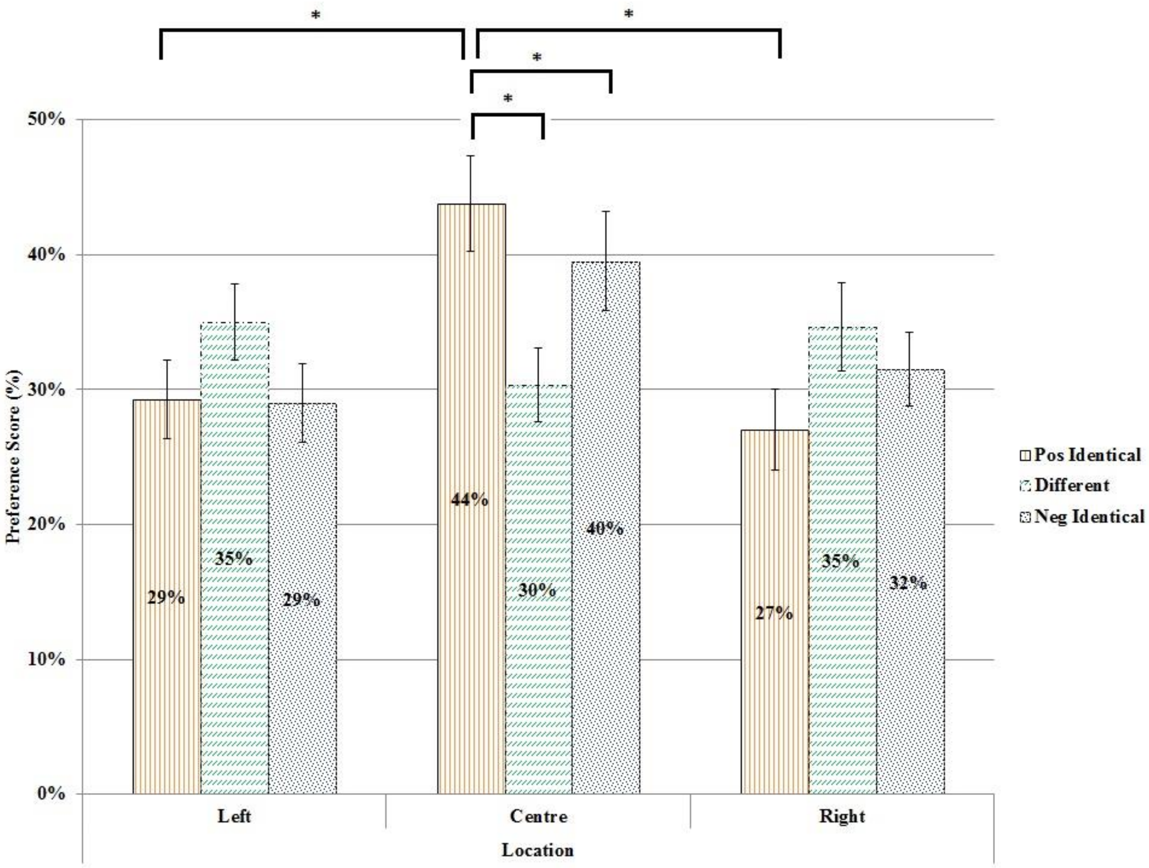

Figure 2. Percentage preferred at each location for the three conditions (N = 50) with standard errors.

To examine whether the subset of 19 participants, who completed the eye-tracking task, showed patterns of preferences similar to the whole sample, a final set of analyses were conducted on their behavioural data. Wilcoxon Signed Rank Tests were performed between locations for images in the positive identical condition to establish if the CSE remained, and between conditions for the centre location to establish if this again indicated an interaction between condition and location. Results for the comparison of location in the positive identical condition showed a trend for a CSE, i.e. images in the centre (*M = 3.98, SD 2.65*) were preferred more often than images on the left (*M = 2.11, SD 2.05; z = -1.66, p = .096*) or right (*M = 2.00, SD 1.81; z = -1.73, p = .083*). Results showed that images in the different condition (*M = 1.78, SD 1.26*) were preferred less often in the centre location compared to images in the positive (*M = 3.98, SD 2.65; z = -2.46, p = .014*) and negative (*M = 3.44, SD 2.65; z = -2.58, p = .010*) identical conditions. No difference was found between images in the positive identical and negative identical condition (*z = -0.97, p = .330)*. Thus overall the pattern of preferences was very similar to the whole sample.

3.2. Eye-tracking Analysis

SPSS 20.0 was used to compute five one-way repeated measures Analysis of Variance (ANOVA) with three levels (left/centre/right) for each condition (different pictures, negative identical pictures, positive identical pictures). Bonferroni corrected significance levels are reported. Greenhouse-Geisser corrections were applied where necessary.

3.2.1. Different Pictures

ANOVAs for the eye tracking data showed a significant difference between locations for first fixations (first fixation) ($F(2,34) = 18.32, p = .001, \eta2=0.51$), the fixation duration (fixation duration %) ($F(2,34) = 6.8, p = .001, \eta2=0.28$), and the percentage of the fixation count (fixation count %) ($F(2,34) = 7.06, p = .001, \eta2=0.29$). No significant difference was found for the last fixations (Table 1). Paired samples t-tests showed that pictures presented in the centre were fixated on significantly more often first (first fixation) than images on the left ($t(17) =2.13 , p = .04$) and right ($t(17) = 7.55, p = .001$). Participants spent significantly less time (fixation count %) on images presented to the right compared to the left ($t(17) = 2.7, p = .01$) or centre ($t(17) = 5.17, p = .001$).

Table 1. *Mean preference score and eye tracking data (with standard deviations) for pictures in the different picture condition (N = 19).*

	Left	Centre	Right
Preference Score	2.00 (1.13)	1.78 (1.26)	2.22 (1.62)
First Fixation	2.00 (1.68)	3.78 (1.89	0.11 (0.47)
Last Fixation	2.28 (1.48)	2.00 (1.23)	1.56 (1.29)
Fixation Count	1.67 (0.64)	5.39 (2.58)	1.30 (0.71)
(Fix Count %)	32.78 (10.74)	34.17 (8.98)	21.79 (8.99)
Fixation Duration	1.61 (0.78)	1.74 (1.13)	1.04 (0.55)
(Fixation Duration %)	33.11 (11.96)	34.16 (10.28)	21.94 (8.88)

Note: Preference score = behavioural data; First fixation = the first fixation of each trial; Last fixation = the last fixation within each trial; Fixation Duration = the duration (sec) of how often each participant focused on each location within a trial. Fixation Count = how often a participant fixated on each location within a trial. The percentage of how often and how long each participant focused on each location within a trial in relation to the whole time of the trial are also given (Fixation Count % and Fixation Duration % respectively). This takes eye-blinks and fixations outside ROIs into consideration.

3.2.2. Positive Identical Pictures

Behavioural and eye tracking data for negative and positive identical condition are summarised in Table 1. Eye tracking data for positive identical images showed a significant difference between locations for the first fixations (first fixation) ($F(2,34) = 11.21, p = .001, \eta2=0.39$), the percentage of the fixation duration (fixation duration %) ($F(2,34) = 9.07, p = .001, \eta2=0.34$), and the percentage of the fixation count (fixation count %) ($F(2,34) = 12.79, p = .001, \eta2=0.42$). Pair-wise comparisons showed that participants fixated first more frequently on the centre picture compared to the right picture ($t(17) = 6.47, p = .001$) and more frequently on the centre picture compared to the left picture ($t(17) = 4.27, p = .001$). Overall participants spent comparatively less time (fixation duration %) looking at pictures located on the right compared to left ($t(17) = 2.57, p = .021$) and centre ($t(17) = 7.06, p = .001$).The percentage of fixation on each location (fixation count %) indicated that participants spent proportionally more time fixating on centre images compared to the right ($t(17) = 8.05, p = .001$), but that the difference between pictures displayed on the centre and the left, although approaching significance did not reach it ($p = .082$; see Table 2). No differences were found for the last fixations.

3.2.3. Negative Identical Pictures

Eye tracking data for negative identical pictures showed a significant difference between locations for the first fixations (first fixation) ($F(2,34) = 19.57, p = .001, \eta2=0.53$), the percentage of the fixation duration (fixation duration %) ($F(2,34) = 8.48, p = .001, \eta2=0.33$) and the percentage of the fixation count (fixation count %) ($F(2,34) = 10.43, p = .001, \eta2=0.38$). No difference was found for the last fixations. Paired comparison showed that pictures displayed on the right received significantly less first fixations than pictures displayed in the centre ($t(17) = 8.19, p = .001$) or left ($t(17) = 5.45, p = .001$). A trend was identified where pictures in the centre received more first fixations than pictures located to the left ($p = .073$). The mean scores for the percentage of the fixation duration (fixation duration %) and the percentage of the fixation count (fixation count %) indicate that participants fixated more often on, and spent more time looking at the pictures located in the centre. Paired comparisons showed that pictures displayed in the centre were looked at more (fixation duration %) than pictures presented to the right ($t(17) = 5.13, p = .001$). Pictures displayed in the centre were also more often fixated on (fixation count %) than pictures displayed to the right ($t(17) = 6.58, p = .001$). No significant differences between how often (fixation count%) and how long for participants spent looking at pictures (fixation duration%) located in the centre and left location (Table 2) was observed.

Table 2. *Mean preference for each location and mean values of the eye tracking data (with standard deviations) for pictures in the positive identical and negative identical condition (N = 19).*

	Positive			Negative		
	Left	Centre	Right	Left	Centre	Right
Preference Score	2.11 (2.05)	3.89 (2.65)	2.00 (1.18)	2.06 (1.89)	3.44 (2.35)	2.50 (1.91)
First Fixation	3.17 (2.74)	4.50 (2.74)	0.22 (0.54)	2.94 (2.20)	4.83 (2.33)	0.11 (0.32)
Last Fixation	2.89 (1.71)	3.00 (1.94)	2.06 (1.16)	2.89 (1.71)	3.11 (1.60)	1.89 (1.19)
Fixation Count	1.65 (0.63)	4.90 (2.25)	1.52 (0.76)	1.60 (0.72)	4.66 (2.15)	1.46 (0.93)
(Fixation Count %)	30.05 (6.48)	35.06 (6.48)	23.07 (7.31)	31.13 (7.97)	35.41 (8.2)	22.29 (7.5)
Fixation Duration	1.46 (0.78)	1.51 (0.71)	1.03 (0.65)	1.42 (0.75)	1.61 (0.83)	1.07 (0.77)
(Fixation Duration %)	31.08 (7.65)	34.09 (6.79)	23.03 (0.95)	31.92 (8.02)	35.40 (8.65)	22.71 (8.5)

Note: Preference score = behavioural data; First fixation = the first fixation of each trial; Last fixation = the last fixation within each trial; Fixation Duration = the duration (sec) of how often each participant focused on each location within a trial. Fixation Count = how often a participant fixated on each location within a trial. The percentage of how often and how long each participant focused on each location within a trial in relation to the whole time of the trial are also given (Fixation Count % and Fixation Duration % respectively). This takes eye-blinks and fixations outside ROIs into consideration.

The results showed overall that the first fixations were predominantly directed to the centre location in all three conditions. The fixation count (fixation count %) indicated that the right location was fixated on least often in all three conditions. No difference was found between the amount of fixation (fixation count %) between the left and centre position in the different picture condition and the negative picture condition; a trend was identified for the positive picture condition with more fixations on the centre position than the left. No reliable difference was found for the amount of time (fixation duration %) participants spent looking at each location in the different picture condition. Participants fixated for longer on the left and centre location compared to the right location in the positive and negative identical condition (see Table 2).

3.2.4. Regression Analysis

Separate multiple regression analyses were used for each condition to assess whether eye-movements predict the preference score at the centre location. The dependent variable was the behavioural preference score and the predictors were entered using the enter method. Preliminary analyses were conducted to ensure no violation of the assumptions of normality, linearity, multicolinearity and homoscedasticity. Outliers (defined as 3 *SD* above/below the mean) were excluded. The fixation count (%) and fixation duration (%) showed a tolerance level below .10 indicating a high co-dependency between these two measures. It was decided to exclude fixation count (%) from the regression analysis because fixation duration is the more prominent measure in preference studies using eye tracking (e.g. Glaholt & Reingold, 2011; Shimojo et al., 2003). The regression model consisted therefore of dependent variable 'preference score' and the predictors: first fixation, last fixation and fixation duration (%).

The total variance explained by the model for the different picture condition was 51% (*F(3,16) = 4.51, p = .022*). The predictor fixation duration (%) (*beta = 0.68*) significantly predicted preference. The first fixation and last fixation did not reach significance in the final model (Table 3). The total variance for the model for the positive identical picture condition was 49% (*F(3,16) = 4.27, p = .026*). The predictor last fixation (*beta = 0.51*) significantly predicted preference. The first fixation and the fixation duration did not significantly predict preference choices. The model for the negative identical picture condition was not significant (*F(3,16) = 0.80, p = .849*). In summary, preference choices in the different conditions were predicted by how long a location was fixated, and positive conditions were predicted by participants' last fixation.

Table 3. *Regression analysis for the centre location for the different condition and the positive and negative identical conditions (N = 19).*

	Different Picture Cond.				Positive Identical Picture Cond.				Negative Identical Picture Cond.			
Predictor	B	SE B	β	Sign.	B	SE B	β	Sign.	B	SE B	β	Sign.
First Fixation	-0.11	0.13	-0.17	ns	0.42	0.22	0.39	ns	-0.10	0.21	-0.10	ns
Last Fixation	0.10	0.23	0.09	ns	**0.67**	**0.28**	**0.51**	**0.03**	-0.28	0.33	-0.22	ns
Fixation Duration	**0.08**	**0.02**	**0.68**	**0.01**	0.05	0.08	0.15	ns	0.02	0.58	0.09	ns

Note: Dependent variable = preference score; Different picture condition *R2 = .64; Positive identical picture condition R2 = .51; Negative identical; picture condition R2 = .05; SE B = Standard Error Beta*

4. Discussion

When participants were presented with three works of art arranged in a line, and asked to select the artwork they preferred, the location of the artwork influenced choice. The effect of middle location depended on both the valence of the artwork and whether the artworks were identical or merely similar. As was expected from previous research (Rodway et al., 2012), when the three artworks were identical and had positive valence, participants showed a preference for the artwork in the middle, i.e. there was a CSE. No reliable preference for the middle artwork was obtained when the artworks were similar but not identical, or when the artworks were identical but of negative valence. These findings are important in delineating the circumstances in which the preference for a middle item emerges.

The CSE has been demonstrated by several studies and the preference for the middle artwork (when the three artworks were identical and positive) was in line with expectations. The finding of a CSE for positive but not negative valence conditions therefore helps to discriminate between the competing explanations of the CSE. For example, the effect of valence on the CSE cannot be explained by the minimal mental effort account (Christenfeld, 1995), or attentional account (Shaw et al., 2000) of the CSE, as both explanations would predict that a middle preference will emerge equally for both the positive and negative works of art. From the perspective of an attentional explanation it could be suggested that the reason why the central preference was not present for the negative artworks is that they received less exposure, because their negative valence caused participants to reduce gaze allocation to these artworks. However, there was no evidence for this in the eye movement data, with equivalent gaze patterns and decision times for the negative and positive artworks.

The absence of a CSE for negatively valenced artworks can be explained by the CS heuristic, as described by Valenzuela and Rahugbir (2009), which proposes that people hold the belief that the best items are in the centre. Clearly, a necessary aspect of the CS heuristic is also the belief that the worst items do not belong in the centre (see Rahugbir & Valenzuela, 2006; Study 1) and as a consequence a central item may not be preferred if it has negative valence. This result is also in agreement with Rodway et al. (2012) who found that when participants were asked to select the item they 'least preferred' (from a row of similar items) the centre-stage effect was eliminated. The modulation of the CSE by emotional valence obtained in this study therefore questions an attentional explanation of the CSE and is in agreement with the CS heuristic, suggesting that cognitive factors determine the emergence of the CSE.

One aim of this study was to examine the generalizability of the CSE by using artworks rather than the common-place consumer items that have been used in previous studies. The fact that the CSE was obtained when the three artworks were identical and positive suggests that the CSE generalizes to non-consumer items that may require more cognitive and emotional appraisal. However, the lack of a CSE for similar but non-identical artworks complicates this interpretation. This result contrasts with the findings of previous studies which have found a middle preference for similar but non-identical items (e.g. Atalay et al., 2012; Christenfeld, 1995; Shaw et al., 2000; Raghubir & Valenzuela, 2006; Valenzuela & Raghubir, 2009; Rodway et al., 2012). Each of these earlier studies used items of little intrinsic interest (e.g. vitamin containers, packets of chewing gum, pens, and pairs of socks), and it has been suggested that when decisions are of minor importance people use minimal mental effort (Christenfeld, 1995), and if no other information is available to discriminate between the options people base their decision on the heuristic that the best things are located in the middle (Bar Hillel, 2011; Rahugbir & Valenzuela, 2006). In the present study it is possible that the use of non-identical artworks caused participants to consider their preference decision more carefully by looking at the particular aesthetic attributes of each item, resulting in the qualities of the art determining preference rather than the location of the art. Indeed, the regression of eye tracking indices on preference choices in this condition showed that fixation durations correlated with preference choice (across the three locations), indicating appraisals depending on individual stimuli. However, when the artworks were identical (and positive) the only difference was their location and aesthetic differences between the options were no longer a factor in the choice, which may have resulted in location determining choice. This interpretation requires further experimentation but our results clearly indicate that it would be imprudent to conclude that the CSE obtained with every-day consumer items generalises to items that may elicit a range of cognitive and emotional responses during their appraisal, such as three similar but different works of art.

The CSE was present only for the identical positive artworks but the analysis of eye movements for the three conditions showed similar gaze patterns with relatively minor differences. A consistent pattern was that participants tended to allocate gaze more to the central artwork and left artwork, than the right artwork. This was present for both the negative and positively valenced art, with significantly more first fixations and longer fixations made to the left and central artwork, compared to the right artwork. Moreover, when the three artworks were similar but different, gaze was allocated to the central and left artwork for longer than the right artwork. This pattern may have reflected a left-to-right scanning strategy acquired from reading (see Megreya & Harvard, 2011). These significant differences in the allocation of gaze to the artworks were not matched by equivalent differences in the preference choices of participants. Moreover, the significant CSE for the positive artworks, but not the negative and non-identical artworks, was not mirrored by equivalent differences in the eye movement data between the different conditions.

In replication of Atalay et al.'s (2012) findings, when the artworks were similar but not identical, participant's first fixations were more frequently allocated to the central artwork, but this initial allocation of attention did not predict choice of the central item. The fact that first fixations, and number of fixations, were not related to preferences is important as it strengthens the view that initial exposure, the central fixation bias, and greater attention to the central item (e.g. Shaw et al., 2000), do not underlie the preference for the middle item. Several studies have shown that the primary relationship between choice and eye movements is reflected as an increase in fixations on the preferred choice in the final few seconds before the choice is emitted (Atalay et al., 2012; Shimojo et al., 2003). Regression analyses of the data found that the last fixation predicted preference for the central item when the artworks were identical and positive, but not for negatively valenced identical artworks, or when they were non-identical. In fact, when different paintings were considered, the duration of fixations were a predictor of choice (across the three locations). These results therefore partially replicate those of Atalay et al. (2012) but extend them to show that the relationship between the last fixation and central preference can depend on the valence of the items and if they are identical or not. This finding is in agreement with the behavioural results and points to the importance of item valence in influencing both preference choices and gaze allocation.

Based on our findings we suggest that the CS heuristic, which specifies that the best items are in the middle (Rahugbir & Valenzuela, 2006), is the most convincing explanation of the middle preference. As described previously, Valenzuela and Rahugbir (2009) reached this conclusion from a range of evidence showing that people's metacognitive beliefs about position (rather than attention to an item) determined their location-based preferences. In contrast to Valenzuela and Rahugbir's (2009) interpretation, Atalay et al. (2012) concluded from their experiments that attention, and not inferences, played an important role in causing the middle preference. Atalay et al. (2012) concluded this for a number of reasons including the fact that gaze was allocated to the central item in the last few seconds before a choice. They explained the link between the middle preference and central gaze allocation in terms of a *central* Gaze Cascade effect with gaze and preference operating additively, so that greater gaze to the middle item increases liking, which further increases gaze and the selection of the middle item. In addition, while it was found that participants held the belief that "On the supermarket shelf, I believe that most popular products are placed always in the middle", holding this 'popularity' belief did not correlate significantly with the proportion of fixations on the central brand. Finally, Atalay et al. (2012) measured inferences about particular brands (e.g. popularity, attractiveness, quality) but did not find them to be related to the middle preference. Consequently it was concluded that the middle preference was due to a central gaze cascade effect and not location-based inferences.

There are, however, several reasons why Atalay et al. (2012) might not have found a relationship between inferences and location-based preferences. First, correlating the belief that popular products are in the centre with fixations on the central item is not the most direct way of examining whether the 'popularity' belief influences choice. It would have been more informative to correlate the 'popularity' belief with the actual extent that the middle item was chosen. Second, the other inferences Atalay et al. (2012) measured were about a particular brand rather than about the specific instances of that brand at a particular location. For example, each brand used by Atalay et al. (2012) had three instances and rather than asking participants their inferences about each instance of a brand in a location, participants were asked about the brand in general. This procedure was implemented to reduce the burden on participants but this method could have weakened any link between inferences, choice and location, preventing the detection of a possible relationship. Furthermore, in Atalay et al.'s (2012) study a preference for the middle item always emerged which meant that eye movements could not be compared across conditions where there was, or was not, a preference for the middle. It is possible that similar gaze patterns would have been obtained when the middle item was not chosen, as was the case in our study. This would have demonstrated that eye movements and behavioural preferences dissociate and may have led to a different conclusion about the underlying causes (see also Bird et al., 2012). Finally, it has also been found that the gradual increase in fixations on items that are subsequently chosen can also occur for disliked items, and items that are brighter, and not only for preferred items (Nittono & Wada, 2009). Given that the CSE effect occurs for items that are 'preferred' rather than 'not-preferred' (Rodway et al., 2012), the findings of Nittono and Wada (2009) also suggest that gaze allocation is not closely related to the CSE[3].

Our findings do not contradict the interrelated nature of gaze allocation and choice that has been demonstrated previously (e.g. Atalay et al., 2012; Chandon et al, 2007; Glaholt & Reingold, 2009), but they suggest that location-based preferences are influenced by cognitive factors that specify rules about the attributes of the stimulus in a location (see also Orquin & Loose, 2013). Future studies have to corroborate our finding of a preference difference

[3] We thank an anonymous reviewer for this suggestion.

between positive and negative items and a possible relationship to the item's complexity, but it appears that the middle preference only emerges when a stimulus condition fulfils certain preconditions about what belongs in the centre, irrespective of the participant's eye movements[4]. Thus, we propose that decision heuristics have a superordinate role in determining the middle preference, and although the last fixation predicted central choice for positively valenced artworks, this is as likely to be a reflection of the choice decision as it is the cause of the preference, or the end point of a gaze cascade.

One potential caveat with our study is that eye tracking was measured in a sub-set of participants and it is possible that a clearer relationship between gaze allocation and preferences would have been obtained if the eye movements of all participants had been measured. However, as noted in the methods section, participants behavioural data did not differ in the sub-set, suggesting that all participants behaved similarly. Furthermore, eye movements were measured for all trials, providing repeated measures of gaze allocation for each condition, whereas in Atalay et al.'s (2012) study eye movements were recorded for one choice trial only. This may have made the measure of gaze allocation more accurate and robust in this study, and probably a more valid reflection of consumer choice situations. Finally, the behavioural results of this study are important in their own right by demonstrating that item valence influences the emergence of the CSE and may supersede any effect of gaze allocation.

To summarise, the findings have important implications for predicting preference behaviour and understanding the cause of the CSE. A central preference cannot be assumed to occur automatically, as it is mediated by other information such as the attributes of the items, including their valence and particular aesthetic qualities. The measurement of eye movements replicated previous findings showing that the CSE is not caused by initial attention, the central fixation bias, or the amount of gaze directed at the central item (Atalay et al., 2012). Importantly it was found and that for positively valenced artworks the final fixation predicted choice of the central item. This impact of valence on the CSE is incompatible with a minimal mental effort, or mere bottom-up attentional account of the CSE. Rather, in accord with Valenzuela and Rahugbir's (2009) original interpretation, the findings can be explained by the centre-stage heuristic directing choice behaviour. We suggest this decision heuristic determines location-based choices, with behavioural choices and the final fixation reflecting the belief that the best items belong in the centre.

[4] Preconditions that must be present in the environment for heuristics to work – and therefore to be employed – are also stipulated for other types of heuristics, e.g. the Recognition Heuristic (Goldstein & Gigerenzer, 2002).

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