Selective information sampling: Cognitive coherence in evaluation of a novel item

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Abstract

This study investigates the amount and valence of information selected during single item evaluation. One hundred and thirty-five participants evaluated a cell phone by reading hypothetical customers reports. Some participants were first asked to provide a preliminary rating based on a picture of the phone and some technical specifications. The participants who were given the customer reports only after they made a preliminary rating exhibited valence bias in their selection of customers reports. In contrast, the participants that did not make an initial rating sought subsequent information in a more balanced, albeit still selective, manner. The preliminary raters used the least amount of information in their final decision, resulting in faster decision times. The study appears to support the notion that selective exposure is utilized in order to develop cognitive coherence.

Keywords: selective exposure, evaluation behavior, confirmation bias, information sampling.

1 Introduction

In order to make accurate judgments it is critical that decision-makers limit any biased processing of evidence prior to the final choice. Yet, evidence suggests that biased processing of information frequently occurs during judgment and decision-making (Brownstein, 2003). A number of studies have demonstrated that people use both selective exposure to information (e.g., Schulz-Hardt, Frey, Luthgens, & Moscovici, 2000), and selective processing (e.g., Russo, Medvec, & Meloy, 1996) to bias their judgments toward an early favorite, before the decision is made. (See Brownstein, 2003, for review.) We focus on the first of these phenomena, selective exposure to information during evidence gathering. By "selective exposure" we mean that people select evidence that they expect to be able to use to support beliefs or options that are already strong.

1.1 Selective exposure to information

Explanations of selective exposure to information are frequently discussed in terms of cognitive dissonance theory (Festinger, 1957, 1964). The theory proposed that, having made a choice, negative affect is experienced as

a result of the negative aspects of the choice and the positive aspects of alternatives. Thus selective exposure to information is driven by a form of motivated reasoning (Kunda, 1990) to avoid negative affect. However, although dissonance theory was initially assumed to be a post-decisional process, many studies demonstrate that selective exposure can occur before making a final choice.

According to Brownstein (2003) biases in processing prior to making a choice may derive from the competition between the competing alternatives and hence the need to differentiate between the early favorite and the competing alternatives. Essentially, the biases are hypothesized to derive from some form of motivated reasoning (Kunda, 1990), whereby individuals engage in a degree of selectivity of exposure or biased evaluation of information to support one choice over others. However, many everyday tasks involve evaluating single items with no alternatives. For example, we may be deciding whether or not to buy an auction item, we may be evaluating a piece of evidence as a member of a jury, we may be judging a speech made by a member of parliament, or attempting to evaluate a person's character.

Whilst theories of motivated reasoning can account for pre-decision biases prior to choice between competing options or where we expect some personal stake in the outcome, it is more difficult to understand how motivated reasoning could account for hypothesis testing in

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the evaluation of a novel single item. Instead, Bond et al. (2007) cite a more general effect of cognitive coherence (Holyoak & Simon, 1999; Simon, Krawczyk, & Holyoak, 2004; Simon, Snow, & Read, 2004) to account for biased processing in novel single item evaluation. Although they did not explore selective exposure explicitly, they did demonstrate pre-commitment biases in the evaluation of attributes prior to judging a single novel item. Accordingly, perhaps cognitive coherence may be used to explain selective exposure in these other scenarios.

We hypothesize that evidence gathering during single item evaluation may be driven by a need to gain a coherent representation of the item, leading to violation of a normative rule requiring fair consideration of all evaluations. Thus, any initial disposition towards one evaluation over another should be more likely to induce selective exposure, whether it be a tenuous preliminary decisions, a choice which initially appears to be promising, or a given or self generated hypothesis to test. Evaluation of a single item may be seen as a sequential process of collection and evaluation of information with the aim of increasing cognitive coherence to a specific point.

1.2 Sequential processing and selective exposure

Jonas et al. (2001) explored selective exposure to information with an accumulative paradigm comparing a sequential search task against a simultaneous search task. A sequential search task allows participants to read each selected item of information before they move on to the next. A simultaneous search task forces participants to select all the information they think they would like to read before they see any of the results of their selections. Jonas et al. found that, when the information was presented sequentially, the selectivity of exposure was greater than when the information was presented simultaneously.

The fact that selective exposure effects are facilitated by a sequential task suggests that information selectivity is not simply based upon *a priori* rules (either correct or fallacious) but instead represents an ongoing and accumulative process of evidence gathering and feedback. Indeed many recent models now opt for an accumulative structure as a way of modeling deliberation (e.g., Busemeyer & Townsend, 1993; Link & Heath, 1975; Nosofsky & Palmeri, 1997; Ratcliff, 1978, Vickers, 1979). Interestingly the descriptions of theories of biased pre-decision processing have some strong similarities to sequential models.

The theories suggest: maximizing choice certainty (Mills & O'Neal, 1971), bolstering intention until ready to act (Kuhl, 1984; Beckmann & Kuhl, 1984), restruc-

turing the decision environment until full dominance occurs (Montgomery, 1983, 1989), or differentiating until a sufficiently superior alternative emerges (Svenson, 1992, 1996, 1999). Essentiall, all these theories imply that the decision-maker must reach a critical point of differentiation between elements at which the choice is made. We argue that this point may depend upon the coherence of the representation reaching an asymptotic level or threshold.

The important aspect of these models is that they are time related and hence they can predict deliberation times depending upon the way information is processed. Given a non-selective exposure to evidence, where information varies in the extent that it is consistent with an initial disposition, there will be a certain time taken before the decision-maker finds a level of acceptable cognitive coherence. However, suppose the decision-maker seeks out information only if it is expected to increase cognitive coherence. This selectivity towards coherence would increase the rate at which coherence is reached and the models would predict faster decision times based upon less information. Using cognitive coherence and sequential sampling models we can make a prediction concerning the deliberation time and the exposure of information in terms of volume. Given highly selective exposure, fewer samples would have to be taken to reach the threshold resulting in shorter deliberation times. Given less selective exposure, more samples would have to be taken to reach the threshold resulting in longer deliberation times.

In summary, we frequently perform evaluation of single novel items in the absence of competing choices or personally meaningful hypotheses. Although theories involving motivated reasoning would fail to predict anything in these cases, the theory of cognitive coherence predicts that selective exposure may still occur. Therefore, this study focuses on two theoretical questions. Firstly, if cognitive coherence is important, then we should observe selective exposure towards information which increases coherence. Thus searching would depend upon differentiating opinions which are important to the individual. Given no initial preliminary disposition or past experiences, we hypothesize that a more general search pattern will be observed driven by the information structure; more *bottom-up* information selectivity. Given a preliminary disposition, coherence can be achieved through selective exposure aiming to differentiate the initial disposition from alternative evaluations, more *top-down* information selectivity. Secondly, models of sequential sampling, when applied to both the theories of cognitive coherence and biased pre-decision processing, predict that deliberation time should be negatively related to the degree of selective exposure as it facilitates the rate at which the asymptotic level of coherence is met.

Figure 1: The image of the phone and the specifications.

2   The study

The task chosen was rating a hypothetical cell/mobile telephone as one might in an online shop like Amazon.com, i.e., rating the phone on a five point scale. The search task involved searching through a number of opinionated hypothetical reviews written by customers concerning the phone. The reviews ranged on a 5 point scale from highly negative to highly favorable. In order to generate a measurable disposition, we asked participants to provide an initial rating based upon limited specifications, before asking them to examine the opinionated reviews. Thus we may observe different selective exposure between different preliminary raters. Also, participants who are asked to provide an initial rating may demonstrate different patterns of information exposure, compared to a control group that viewed the same specifications but did not provide an initial rating. Although the control group did not outwardly provide a rating, they may have formed a disposition nonetheless. Therefore, we used a second control group that did not even view the specifications prior to the information search.

Thus, we had three groups that differed in their experience prior to information searching experience. Preliminary raters (PR) viewed specifications and then provided an initial rating. Specification-only controls (SOC) viewed specifications but did not rate the phone. Finally, No-experience controls (NEC) neither viewed specification nor rated the phone.

2.1   Method

2.1.1   Participants

In total, 135 University students were recruited via an online advertisement and were rewarded with course credits. There were 96 female and 39 male participants; their ages ranged from 18 to 59 (M =21.94, SD = 6.05).

2.1.2   Design

There were three different between-subjects groups (Preliminary raters, Specifications-only controls, and No-experience controls). There was one within-subjects independent variable, the type of opinionated review, of which there were five levels. 1-Star opinions *hated* the phone and reported its worst features in their reviews. 2-Star opinions *did not like* the phone and mainly reported its bad features. 3-Star opinions thought the phone was *okay* and reported equal amounts of positive and negative attributes. 4-Star opinions *liked* the phone and mainly reported its good attributes, and 5-Star opinions *loved* the phone and only reported its good attributes. Three reviews were written for each type of opinion resulting in 15 items of information for the decision-maker to search through. We recorded the initial rating by the preliminary-rater group and the final ratings by all participants. Thus we can observe any differences in search pattern by both how they finally rated the phone and how preliminary raters first rated the phone. We recorded the number of reviews selected for reading, in each opinion type and the amount of time spent reading each review.

2.1.3   Procedure

Participants were given an information and consent form, before being asked to complete the computer task. All groups were informed that they were to evaluate a cell phone. The preliminary-rater group and specifications-only group were presented with a screen showing a picture of the cell phone and non-opinionated specifications about its size, weight, battery time etc (Figure 1). They clicked on an arrow when they were ready to continue. The preliminary raters were then shown a screen asking them to provide a preliminary rating of the phone. They were then taken to the review menu page. The specifications-only control group skipped the preliminary rating page and went straight to the review menu. The no-experience controls were taken straight to the review menu and were not shown the specifications or the preliminary rating page.

The review menu displayed 15 boxes each one representing the fifteen reviews in a 3 x 5 grid with the five opinion types clearly identified across the top and the three reviews of each positioned vertically underneath each other. So for example, to view the second review by the user who thought the phone was "okay" (3-stars), the participant would click on the second review down in the third column. After reading a review the participant clicked on the arrow, which led back to the review menu. The program recorded which reviews were read and for how long.

Participants in all groups could click on and read as many reviews as they liked until they were satisfied,

Table 1: Participants recruited for each group and their mean preliminary and final ratings out of 5 stars

	Number of participants	Mean preliminary rating	SD preliminary rating	Mean final rating	SD final rating
Preliminary raters	60	2.77	.65	2.83	.668
Specification-only controls	28	-	-	2.75	.645
No-experience controls	47	-	-	2.94	.763
Total	135	2.77	.65	2.85	.697

whereupon they clicked on the arrow at the bottom, which took them to the final rating page. Here the participants were asked to make their evaluation of the phone on the five point scale, indicated by stars.

2.1.4 Materials

The image and the specifications of the cell phone were fabricated for the study (see Figure 1 for an example). Each review was the same length, of 100 words. This allowed us to compare reading times between reviews. The following is an example of a 1-star review.

1 Star- "Hated the Phone"

Review 1

I absolutely hated this phone. I used to have a nice top of the range phone but had to use this as an interim measure. It was a big step down from what I was used to. It was bigger and heavier, which was surprising as there was less in it, and it looked ugly. I also found it difficult to use in loud environments because the sound quality was so bad. In the end, I got rid of it as soon as I could. I would never get one of these again! Don't buy this phone it is absolutely horrendous!

2.2 Results and discussion

2.2.1 Descriptive Statistics

One hundred and thirty five participants were recruited with the greatest number in the preliminary rater group. This larger preliminary rater group was recruited to allow analysis between different preliminary ratings. Table 1 shows the number of participants in each group and their mean preliminary and final ratings. A one way ANOVA showed no significant difference between the groups in their final rating, $F(2, 134) = .661$, $p > .05$.

2.2.2 Exploration of search patterns — valence bias

This analysis examined the distribution of search patterns between the preliminary raters, the specifications-only controls and the no-experience controls. As we are initially concerned with valence selectivity of their total search time we examined the proportion of reviews read in each opinion category by each participant. So, the proportion of 1-star opinions read for each participant would be the total number of 1-star reviews that they read, divided by the total number of reviews read by that participant. This controls for the predicted variances in volume between groups or individuals.

Figure 2 (top left graph) displays the proportion of reviews selected for reading based upon the experience prior to the search task. The results appear to demonstrate a consistent quartic (w-shaped) search pattern across all groups. This was supported by a 2-way, mixed-design, repeated measures ANOVA which compared the different groups (preliminary raters, specification-only controls, no-experience controls) by their search pattern (proportion of reviews read from each category). The first part of the analysis found a significant overall effect of star rating on the proportion of reviews read across all groups (search strategy), $F(3.46, 456.12)$[1] $= 15.50$, $p < .001$. Bonferroni post hoc tests confirmed the quartic pattern revealing significantly more reviews read in the 1,3 and 5, star categories than in the 2 and 4 star catagories ($p < .001$ for all). No other comparisons were significant.

There was also a significant interaction between the search pattern and three groups (preliminary raters, specification-only controls, and no-experience controls), $F(6.91, 456.12)$, $= 2.08$, $p < .05$. This indicates that there may be some effect on information selection depending upon the experience prior to the main search task. The

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[1]Degrees of freedom were corrected for all ANOVA tests using Greenhouse-Geisser correction due to a violation of the sphericity assumption.
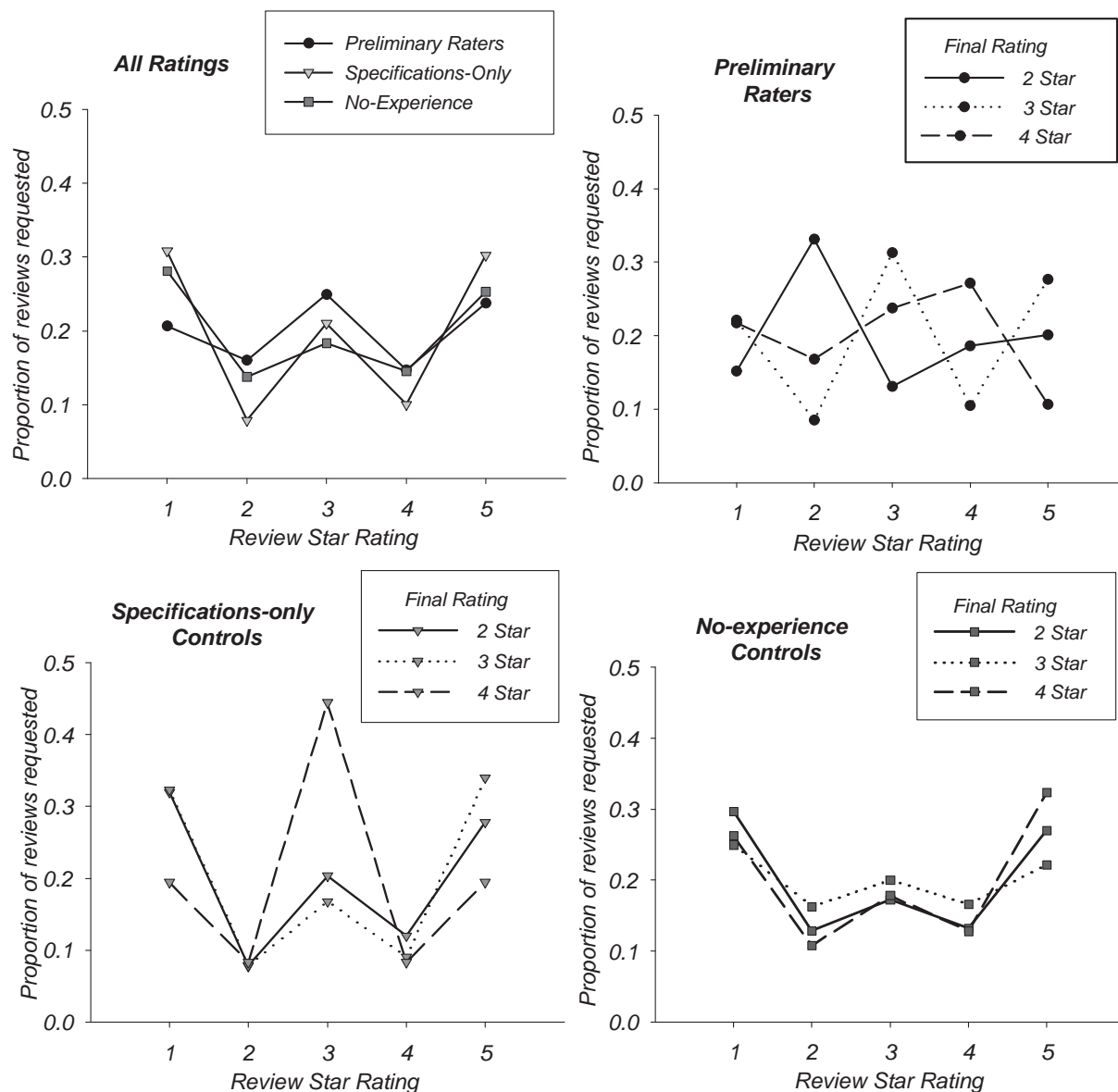
Figure 2: Top left panel displays the overall search pattern distributions by each of the three groups. The other panels display each group separately, showing search patterns based upon their final rating.

quartic search pattern in Figure 2 (top left panel) indicates a degree of selective exposure by all groups, not in the sense of search biased by an initial tendency, but selective in the sense of sampling central and extreme cases more than others.

A 2-way, mixed-design, repeated measures, ANOVA was performed on the controls data to explore their search patterns alone. The test revealed a significant difference across reviews $F(3.05, 222.36), = 24.97, p = .000$. Bonferroni post hoc tests confirmed again, the quartic pattern revealing a significant more reviews read in the 1 and 5 star categories than in the 2, 3, and 4-star categories ($p <$

.001 for all). In addition, significantly more reviews were read in the 3-star category than the 2-star ($p < .01$) and 4-star ($p < .04$) category but also significantly less than the 1-star ($p < .01$) and 5-star ($p < .05$) category. However, no significant difference between the two control groups in their overall search pattern was found, $F(3.05, 222.36), = 1.98, p > .05$. As there was no difference between controls on their overall search patterns, we combined these into one control group. A further 2-way repeated measures ANOVA found a significant difference between preliminary raters and combined controls in their overall search pattern $F(3.33, 436.11), = 3.16, p < .05$. This

indicates that, based upon search pattern, there is a significant effect of making a preliminary rating on subsequent information exposure.

In order to determine where these effects might lie, we divided all three groups (preliminary raters, specification-only controls and no-experience controls) into further subgroups based upon their final rating. As only two participants finally rated the phone with one star and no participants rated it with five stars, we excluded these participants from the subsequent analysis. Figure 2 (top right and bottom graphs) shows the search patterns by each group and their final ratings. A three-way, mixed- design, repeated measures ANOVA was performed on the data revealing a significant interaction between the group and the search pattern depending on the final rating, $F(13.78, 427.08) = 2.62$, $p < .001$. From Figure 2 it is clear that when we are asked to make a preliminary rating, our search patterns are significantly different than if we simply view some specifications or have no experience. Specifically, the quartic pattern is replaced by selective exposure which strongly relates to the final judgment. To determine how the preliminary rating affected our participants selective exposure we also examined the preliminary raters by themselves. A 2-way repeated measures ANOVA examining the differences between the preliminary raters showed that they exhibited significantly different search patterns based upon their initial rating, $F(8, 220) = 5.410$, $p = .000$. A further linear regression analysis determined that the initial rating was highly predictive of final rating, $F(1, 59) = 110.49$, $p < .001$, $R = .81$.

The results confirm that providing initial ratings changed the way subsequent information was sought. However, this analysis does not reveal precisely what information was important to preliminary raters. Thus, we performed a subsequent analysis ordering the information depending on whether the review rating would have least dissonance (align with the preliminary rating), most dissonance (furthest distance from the preliminary rating), or reside somewhere in between.

The means, shown in Figure 3, were compared using a repeated measures ANOVA, which found a significant effect of the distance between the preliminary rating and the review valence on the proportion of reviews read, $F(2, 118) = 12.44$, $p < .001$, which appears as a U-shaped relationship. Indeed, Bonferroni post-hoc t-tests revealed that, while there was no significant difference between the number of most dissonant and least dissonant reviews asked for ($p > .05$), significantly more information was sought in the least and most dissonant categories than in the categories between these two poles ($p < .001$ for both).
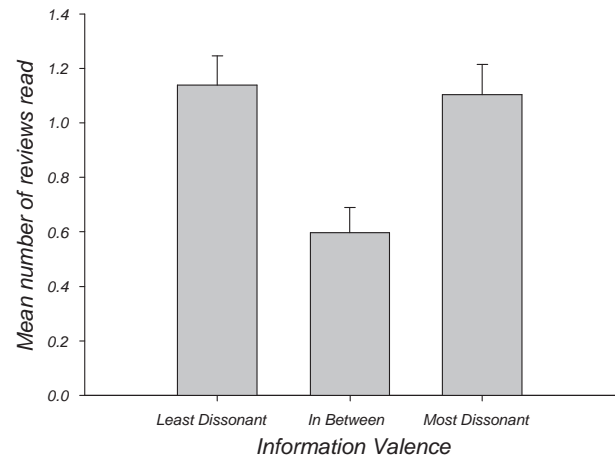

Figure 3: Mean number of reviews read by preliminary raters depending on the distance between the preliminary rating and the valence of the review.

We argue that these results demonstrate that selective exposure is used to increase cognitive coherence in the developing representation through increasing the differentiation of opinions. Given no initial disposition (no-experience controls) or a possibly weak or undefined one (specifications-only controls), selectivity appeared more driven by the task structure. Thus, the quartic search strategy of our controls represents attention to information that appears as if it would increase the coherence of the representation, that is, increase differentiation of opinions. This is achieved by viewing the worst and the best reviews and to a lesser extent a middle anchor point. The 2- and 4-star reviews act to undermine this coherent differentiation of opinions and so they tend to be ignored.

We suggest that a stronger, or at least more defined, initial disposition is formed through a preliminary rating. This disposition results in a change in the representation of the task. Now the differentiation must be between the individual's initial disposition and furthest opposite opinions. Again, only information that is specifically going to increase this differentiation is selected. Participants are concerned with information that both confirms their initial opinions, and also the most dissonant opinions. So rather than examining the full spectrum of opinions it seems that people simplify the task by looking at the most different opinions as these are the most informative in terms of differentiation. This results in the quickest understanding of the range of opinions allowing an coherent representation to be formed efficiently.

Alternatively, it is possible that the most extreme and central ratings are objectively most informative. Future research must settle this question.

Table 2: Total time and amount of information sought prior to the final rating depending on initial experience

	Mean total time spent information searching (seconds)	Std. deviation	mean total number of reviews read	Std. deviation
Preliminary raters	45.98	36.20	4.42	2.86
Specification-only control	56.32	48.62	4.96	3.31
No-experience control	74.72	39.74	6.13	3.45

2.2.3 Effect on decision time — volume bias

Figure 2 shows that preliminary raters' search patterns differ from the control's quartic trends, suggesting some change occurring in the approach evaluators have to collecting evidence after providing an initial rating. We considered that selective exposure may be a tool to increase cognitive coherence and that this may also have a measurable impact on decision times.

In order to examine volume differences in evidence collection we need to examine the total amount of information sought as a function of group (preliminary raters, specifications-only controls, and no-experience controls). The theory predicts that the faster a coherent representation is formed then the quicker the overall search time should be.

The results of a one-way independent ANOVA demonstrate that for the "mean total time spent information searching" dependent measure there was a significant effect of the experience prior to information searching $F(2, 132) = 6.75$, $p = .002$, with the preliminary-rating group taking less time than the others. For the "mean total number of reviews read" dependent measure there was also a significant effect of initial experience, $F(2, 132) = 3.89$, $p = .023$, with the preliminary-rater group reading fewer reviews. Bonferroni post-hoc tests revealed a significant difference between the preliminary-rater group and the no-experience control group for both dependent measures ($p < .001$, $p < .05$ respectively). The specifications only control was not significantly different from either group in either measure ($p > .05$ for both) although a significant linear trend was found across groups for the dependent measures ($p < .05$ for both).

These results indicate that a preliminary judgment leads to quicker decisions, compared to a control with no experience. Due to a lack of statistical difference between the specification-only group and the others we cannot be sure whether the volume difference is due to forming an initial judgment or simply viewing evidence. Neverthe-

less, these results are still important as they demonstrated that the amount of information required at the review stage is dependent on initial experiences. This quicker decision time is precisely what would be expected if a decision threshold was being met faster due to cognitive coherence being reached at a faster rate than controls.

3 General discussion

In summary, the control groups demonstrated a strong preference to explore the 1- and 5-star ratings and, to a lesser extent, the 3-star ratings. The no-experience controls sought the most information in the review stage. The preliminary rater group was biased towards reading reviews with the same star rating as the participant's initial judgement, but this group also examined the most dissonant information. Overall, the preliminary raters sought the least information in the review stage. Thus, we observed a degree of selectivity in all groups, whereby certain types of review were selected over others; a within subjects selectivity effect. Furthermore, this selectivity was different depending whether not a preliminary decision was made, and we observed selective exposure that was specific to that preliminary rating, a between-subjects selectivity effect.

While more recent studies have focused upon biases in selective exposure towards confirming information (Jonas, et al., 2001; Pinkley, Griffith, & Northcraft, 1995; Lundgren & Prislin, 1998; Frey, 1981; Johnston, 1996), early studies found that people were frequently interested in dissonant information. For example, Gerard (1967) found that participants spent more time looking at the alternative they eventually rejected than the alternative they accepted. Indeed, in a study during the 1964 American Elections, participants were offered brochures supporting either their favored candidate or his rival (Lowin, 1967). When the arguments in the sample were strong, it was found that participants ordered more brochures from their

candidate. However, when the arguments in the sample were weak, and hence easier to refute, it was found that participants were more likely to select brochures from the rival (Baron, 2008). In a similar study Albarracin and Mitchell (2004), investigated the relationship between attitude strength and selective exposure. Specifically, it was found that participants who felt confident in their ability to defend their argument were more likely to select dissonant information.

This demonstrates two ways in which selective exposure can be used to develop a coherent representation. Either by selecting confirming information to help strengthen the associations, or by selecting dissonant information which may be discredited and help inhibit the strength of rival evaluations. In our study we observed both. We suggest that this particular finding is perhaps only observable because we offered participants a range of information from more dissonant to less dissonant whereas most previous studies have only offered two categories; either confirming or disconfirming. We observed selectivity towards the extremes, but these extremes depended upon the individual and their subjective representation of the task.

We propose that these results represent selective exposure with the aim of developing a significantly coherent representation of the item through the task. Given a strong initial disposition, coherence may be achieved rapidly through specific search strategies aimed at increasing differentiation between that early disposition and the opposite opinions. Thus we describe this as *top-down driven selective exposure*. Confirming information is collected and accepted and dissonant information is collected and discredited. Given no initial disposition, developing a coherent representation is more difficult as information selectivity cannot be driven by hypotheses. Thus searching still involves selectivity, yet this is more driven by the way the information is displayed than any specific hypotheses. Thus, we define this as *bottom-up information selectivity*.

Cognitive coherence has the ability to explain a wide range of pre-decisional biases, from cognitive dissonance and biased evaluation during choice between competing options, to unbiased but selective exposure during single item evaluation. Furthermore, the parsimony of its account is appealing, as it explains the phenomena simply through our natural drive to seek out patterns and relationships in order to understand our environment.

3.1 Future directions

On the basis of this study we offer some considerations of future studies. We demonstrated that preliminary ratings influence selective exposure. However, it would be interesting to determine how initial dispositions are formed

during single item evaluation. Perhaps, a study could provide different sets of specifications either positive or negative and explore whether selective exposure similar to our preliminary raters can be observed without the need of an initial rating. Another example would be to explore whether there is a difference between search patterns based upon the source of bias (e.g., either by oneself or by another).

Furthermore, it may be interesting to examine the extent to which cognitive coherence may also explain other cognitive biases. Firstly it would be interesting to explore the extent to which other biases in our reasoning and evidence gathering are *active* (driven by motivated reasoning) or *passive* (driven by a basic need of coherence). In addition, the extent to which bias in our reasoning and evidence gathering changes from *bottom-up* (driven by the way information is displayed) to more *top-down* (driven by some initial disposition).

Finally, we explored a novel contribution to selective exposure, through the examination of deliberation time and differences in the volume of information sought. Further studies might examine different predictors of differences in the volume of information sampling and decision thresholds. That is, when do we decide to stop searching for evidence and make a judgement depending on different initial dispositions or tasks? Also, it might be important to explore how much information is normatively optimal in different scenarios. The interplay between decision-thresholds and initial biases is particularly interesting and relates to many real-life scenarios from criminal investigations (Dror & Fraser-Mackenzie, 2008) and forensic decision-making (Dror & Rosenthal, 2008; Charlton, Fraser-Mackenzie & Dror, in press) to gambling decisions under time pressure (Dror, Busemeyer & Basola, 1999).

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