Investigating Patterns and Differences in Proleader and Antitrailer Information Distortion

THESIS

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By

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Abstract

When choosing among multiple alternatives, it is always possible for an early favorite to be displaced as the leader by one of the trailing alternatives, either because of new information or because the preferred alternative is no longer available. For this reason, it is important to understand not only how people process information about the leading alternative but also how they process information about the trailing alternatives. In this article, we report two new experiments involving the biased predecisional processing of information about tentatively leading and trailing alternatives. Study 1 (n = 462) used a 2x2 between-participants design to vary attribute presentation (jointly, with all alternatives on one screen, versus sequentially, with each alternative on a different screen) and alternative evaluation (ranking versus rating). Joint (versus sequential) information presentation yielded a steeper and negative linear relationship between information distortion and option rank, whereas ranking versus rating the alternatives had essentially no effect. Study 2 investigated the effect of narrowing a choice set on information distortion. Since previous research has shown that second-ranked options are negatively distorted in 2-alternative choices but minimally distorted in 6-alternative choices, we hypothesized that narrowing the choice set from 6 to 2 alternatives midway through a decision would shift distortion of the second-ranked alternative from minimal
to significantly negative. Study 2 (n = 509) used a 2x2 between-participants design to vary information presentation (joint versus sequential, as in Study 1) and narrowing condition (always-six versus narrows-to-two). Contrary to our hypothesis, narrowing did not significantly affect distortion of the second-ranked alternative, which remained slightly positive on average. However, narrowing the choice set significantly increased the positive distortion of the first-ranked alternative. These results may be due to participants viewing the narrowing as a (positive) choice of their top two options.
Vita

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Publications

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Fields of Study

Major Field: Psychology
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Introduction

When choosing among multiple alternatives such as computers, vacation destinations, restaurants, or political candidates, individuals often select a tentatively preferred alternative and subsequently distort new information in favor of that alternative; this predecisional information distortion occurs even in the absence of any pre-existing preferences (Russo, Medvec, & Meloy, 1996; Russo, Meloy, & Medvec, 1998). In these decision situations, it is always possible that one’s early favorite will be displaced as the leader by one of the trailing alternatives. This could occur as the result of new information about the leading or trailing alternatives or because the previously preferred alternative is no longer available. For this reason, it is important to understand both how people process information about the leading alternative and how they process information about the trailing alternatives.

Predecisional information distortion has been demonstrated across a variety of contexts, including consumer decisions (Bond, Carlson, Russo, & Tanner, 2007; Carlson et al., 2006; Russo et al., 1996, 1998; Russo, Carlson, Meloy, & Yong, 2008), risky monetary gambles (DeKay, Stone, & Miller, 2011), personal and policy-oriented risky decisions (DeKay, Patiño-Echeverri, & Fischbeck, 2009a, 2009b; Miller, DeKay, Stone, & Sorenson, 2013; Russo & Yong, 2011), legal decisions (Hope, Memon, & McGeorge, 2004; Simon, Pham, Le, & Holyoak, 2001; Simon, Snow, & Read, 2004), and medical decisions (Kostopoulou, Russo, Keenan, Delaney, Douiri, 2012; Levy & Hershey, 2006).
Information distortion has been shown to occur with real choices (Carlson & Pearo, 2004), with monetary incentives (Meloy, Russo, & Miller, 2006), and when initial preferences are manipulated experimentally (Carlson et al., 2006; DeKay et al., 2011, Miller et al., 2013; Russo et al., 1996, 1998; Simon et al., 2004). Additionally, several studies have found that distortion predicts individuals’ final choices (DeKay et al., 2011; Miller et al., 2013; DeKay, Miller, Schley, & Erford, 2014; Russo, Carlson, & Meloy, 2006).

Some of the earliest investigations of biased predecisional information processing were associated with Festinger’s (1957, 1964) theory of cognitive dissonance, which proposes that humans strive for consistency, feel discomfort when faced with inconsistencies, and tend to alter their attitudes or behaviors to minimize those inconsistencies. In earlier investigations, Festinger found little to no evidence of biased predecisional processing and therefore focused almost exclusively on postdecisional processing (Festinger, 1964); however, a substantial body of subsequent research revealed substantial predecisional processing biases, and a variety of theories and explanations have arisen to describe these findings (Brownstein, 2003).

One such explanation is Kunda’s (1990) “motivated reasoning,” in which individuals engage in selective memory search and construct beliefs to support a desired conclusion. Individuals using motivated reasoning enhance evidence supporting their pre-existing beliefs and disparage contradictory evidence, and they tend to be more skeptical of information that contradicts their preferred outcome (Dawson, Gilovich, & Regan, 2002; Giner-Sorolla & Chaiken, 1997). Additionally, if it is more difficult for a preferred alternative to meet a decision criterion, individuals engaging in motivated reasoning will
bolster their preferred alternatives to a greater degree (Boiney, Kennedy, & Nye, 1997). Kunda (1990) speculated that varying an individual’s primary motivations could alter the extent of the bias in this predecisional processing; for example, shifting from a coherence motivation to an accuracy motivation – might decrease bias. A study by Russo et al. (2008) found that priming coherence results in increased amounts of information distortion, which suggests that information distortion could be (at least partially) caused by a motivation for consistency and coherence.

Montgomery’s (1983, 1989) search for dominance structure (SDS) theory, by contrast, treats biased predecisional processing as an inherent part of decision making rather than the result of motivation. SDS theory views decision processes as attempts to find an alternative that dominates (i.e., is not inferior on any attribute and is superior on at least one attribute) all other choice alternatives. Particularly pertinent to information distortion is the dominance-structuring phase of SDS theory, in which individuals distort information by paying more attention to and exaggerating the positive attributes of their currently-favored alternative and the negative aspects of their non-favored alternative(s) while simultaneously paying less attention to and minimizing the negative attributes of their currently-favored alternative and the positive aspects of their non-favored alternative(s).

Similarly, Svenson’s (1992, 1996, 1999) differentiation and consolidation (diff-con) theory assumes that biased processing is an intrinsic aspect of making decisions and that, prior to making a decision, individuals “differentiate,” or separate, their preliminarily chosen alternative from the competing alternatives. One component of diff-con theory is structural differentiation, which includes altering the perceived
attractiveness or importance of attributes in ways that favor the currently preferred alternative. This can involve both upgrading the attractiveness of a favored alternative as well as downgrading the attractiveness of the nonfavored alternatives.

Another model for predecisional information distortion is parallel constraint satisfaction (PCS; Glöckner & Betsch, 2008; Glöckner, Betsch, & Schindler, 2010; Holyoak & Simon, 1999; Thagard & Millgram, 1997), a coherence-based model which has been applied to a variety of cognitive consistency phenomena and which treats biased predecisional processing as the result of normal cognitive processes. PCS is a connectionist approach that views decision making as an automatic process in which information is integrated in ways that maximize consistency. This process is reciprocal, with individual positive attributes leading to a positive evaluation of a choice alternative, which in turn leads to a positive evaluation of the individual attributes – a process which enhances coherence but which is circular and nonnormative.

A number of the theories relating to predecisional information distortion suggest that such distortion could occur both for preferred and nonpreferred alternatives. Motivated reasoning, SDS, diff-con theory, and PCS all state that individuals can focus on or exaggerate positive aspects of a preferred alternative as well as negative aspects of a nonpreferred alternative, which conceptually allows for separable predecisional biases both in favor of a leading alternative and against a trailing alternative. In particular, PCS’s construction of a coherent structure involves both excitatory and inhibitory features, which implies that information distortion should involve both positive distortion of information about preferred alternatives and negative distortion information about of nonpreferred alternatives. Despite this, the majority of research to date hasn’t
distinguished between positive distortion of information to favor the leading alternative (*proleader distortion*) and negative distortion of information to disfavor the trailing alternative(s) (*antitrailer distortion*).

Blanchard, Carlson, and Meloy (2014) recently made this distinction in two- and six-alternative choices (e.g., choices between restaurants). Those authors presented information on one attribute (e.g., desserts) at a time, but presented all alternatives’ information on that attribute, had participants rate the attractiveness of the information items, and had them rank-order all alternatives all on the same screen. With this design, results for the two-alternative choice indicated that there was both proleader and antitrailer distortion and that the two types of distortion were of a similar magnitude. In the six-alternative choice, there was substantial proleader distortion for the first-ranked alternative, essentially no distortion for the second-ranked alternative, and increasing antitrailer distortion for the third- through sixth-ranked alternatives. (See Figure 1, which is copied from Blanchard et al.’s paper, for the observed pattern of distortion.)

![Figure 1](image_url)

**Fig. 1.** Experiment 2 results: mean distortion of information in a six-alternative choice (*D*₁ refers to the most preferred alternative, and *D*₆ refers to the least preferred alternative on the previous attribute). Positive values indicate distortion that favored the alternative, and negative values indicate distortion that disfavored the alternative. Error bars represent ±1 SE.

Figure 1. Proleader and antitrailer distortion results in a six-alternative choice, reproduced from Blanchard et al. (2014).
Blanchard et al. (2014) concluded that their results were not consistent with a motivational explanation for distortion, as individuals would be motivated to distinguish their leading alternative from the rest of the alternatives but would not have any need to particularly disparage their last-choice option. Although Blanchard et al. did not discuss their results in terms of PCS, their results were consistent with a PCS explanation in which individuals would distort information automatically in a way that would make their evaluations (including their evaluations of the various trailing options) consistent and coherent.

Similarly, DeKay et al. (2014) recently distinguished between leading and trailing alternatives in two- and four-alternative choices. DeKay et al. presented information items one at a time in a completely random order and had participants rate the item and indicate their tentative leader after every item. Rankings were not collected for trailing alternatives in the four-alternative condition, so distortion for trailing alternatives was averaged across the three trailing alternatives. This method resulted in a similar magnitude for proleader and antitrailer distortion in both the two- and four-alternative conditions. (See Figure 2 for these results.)
Figure 2. Proleader and antitrailer distortion results in two- and four-alternative choices, reproduced from DeKay et al. (2014).

If the distortion in Blanchard et al.’s (2014) study is averaged across all of the trailing options, the magnitude of the antitrailer distortion is similar to that observed in DeKay et al. (2014). It is possible that, had DeKay et al. distinguished among the trailing options, the pattern of antitrailer distortion may have been similar to Blanchard et al.’s. However, it is also possible that some of the methodological differences might result in differing patterns of antitrailer distortion. In particular, the differences in the presentation of information (jointly versus sequentially) and the way participants were asked to indicate their tentative preferences (ranking all alternatives versus indicating only a first choice) may alter the pattern of information distortion in choices with more than two alternatives.

Previous research has shown that presenting information jointly versus separately can influence how people evaluate that information (Bazerman et al., 1999; Hsee, 1996; Hsee & Leclerc, 1998). This situation is not perfectly analogous, as information
distortion tasks involve sequential rather than separate presentation of information. Unlike participants in separate presentation tasks, participants in sequential information tasks still see all of the information about all of the alternatives. However, it is possible that, in an information distortion context, presenting information about an attribute sequentially rather than jointly makes comparisons more difficult and therefore alters the evaluability of that information in a similar way. Joint presentation of information may provide context for attributes that are otherwise difficult to interpret or assign value to (e.g., an apartment having four windows becomes more meaningful when provided with the context that a competing apartment has six windows). Providing this context may cause individuals to distinguish between options more than they would with sequential presentation, leading them to “spread out” their ratings of various attributes in the joint-presentation condition.

If individuals are asked to rank-order alternatives, as in Blanchard et al.’s (2014) design, they seem to distort information in a pattern that reflects their ranking. If they are simply asked to rate the alternatives, however, they may not distinguish among their lower-ranked alternatives and may distort all of their trailing alternatives negatively and with equivalent magnitude, resulting in a nonlinear pattern of antitrailer distortion.

If the differences in antitrailer distortion caused by these methodological changes were substantial, it could have meaningful effects on how easy it would be for alternatives to shift in the rankings later in the decision process; if the second-choice alternative were minimally distorted, for example, it would be easier for it to supplant the first-choice alternative than if the second-choice alternative were negatively distorted. Similarly, if the last-choice alternative was not distorted substantially more than the other
trailing alternatives, it would be much easier for it to rise in the rankings based on information encountered in the latter portion of the decision process.

Additionally, examining the second-place alternative more closely could be informative. In a two-alternative situation, the second-ranked alternative is distorted negatively (Blanchard et al., 2014; DeKay et al., 2014). In a six-alternative situation, the second-choice alternative is not distorted either positively or negatively (in Blanchard et al., 2014), possibly because it is being kept as a “runner-up” alternative in the event that subsequent information renders the first-choice alternative less desirable. Blanchard et al. (p. 815) suggest that narrowing a larger choice set down to only two options could cause distortion of the second-choice alternative to shift from no distortion to significant antitrailer distortion.
Study 1

Study 1 investigated the effects of different methods of information presentation and evaluating alternatives on the pattern of proleader and antitrailer distortion in a six-alternative choice situation. It had a 2x2 (information presentation [joint versus sequential] x evaluation of alternatives [ranking versus rating]) between-subjects design with two different control conditions.

Hypotheses

Replication of Blanchard et al. (2014). When information for each attribute is presented jointly for all alternatives and participants rank order all alternatives after each attribute, we expected to replicate Blanchard et al.’s finding that distortion is a negative linear function of rank, with the first-ranked option the most positively distorted, the second-ranked option neither positively nor negatively distorted, and the sixth-ranked option the most negatively distorted.

Joint versus sequential attribute presentation. We expected that the negative linear trend across the six rankings would be steeper in the joint conditions than in the sequential conditions, with the first-ranked option in the joint conditions being more positively distorted than the first-ranked option in the sequential conditions, and the sixth-ranked option in the joint conditions likewise being more negatively distorted than the sixth-ranked option in the sequential conditions.
**Ranking versus rating the alternatives.** We expected that the negative linear trend across the six rankings would be steeper in the ranking conditions than in the rating conditions, with the first-ranked option in the ranking conditions being more positively distorted than the first-ranked option in the rating conditions, and the sixth-ranked option in the ranking conditions likewise being more negatively distorted than the sixth-ranked option in the rating conditions.

We additionally expected that there would be a significant quadratic trend in the rating conditions, with the distortion pattern “leveling out” lower in the rankings, but that there would not be a significant quadratic trend in the ranking conditions.

**Methods**

**Participants.** Five hundred fifteen participants recruited from Amazon’s Mechanical Turk received $0.50 for completing the survey. Of those 515, 48 were excluded for incorrectly answering the practice questions (described below) at the start of the survey, and 5 were excluded for providing a ZIP code that did not match the state they provided. The final sample therefore included 462 individuals. Of those 462, 58.2% were female and 84.0% were white. The mean age was 38.7 years ($SD = 14.3$).

**Materials.**

**Practice questions.** At the start of the survey, all non-control-group participants completed one of two practice questions. Participants in the ranking conditions were given a ranking-oriented practice question and were instructed: “During the following task, you will periodically be asked to rank the six different choice options. Lower rank numbers are better than higher rank numbers (i.e., a ranking of ‘1’ indicates that that option is your favorite). This is a practice trial for ranking different options. Please click
and drag the choice options below so that ‘Option C’ is in first place (best) and ‘Option A’ is in last place (worst).” The practice question had four options, labeled A-D.

Participants in the rating conditions were similarly given a rating-oriented practice question and were instructed: “During the following task, you will periodically be asked to rate the six different choice options. Ratings can fall anywhere between 1 and 6, with higher numbers indicating greater preference (e.g., if you really love an option, you can rate it as ‘6’). Ratings can be partway between whole numbers (e.g., you can rate an option as ‘3.75’ if you wish). This is a practice trial for rating different options. Please click and/or drag the bars below so that ‘Option C’ has the highest rating (longest bar) and ‘Option A’ has the lowest rating (shortest bar).” This practice question also had four options, again labeled A-D.

Participants who did not correctly rank or rate options A and C in the practice questions were excluded from the final sample.

**Information items.** The information items were six attributes (online reviews, landlord, interior, kitchen, exterior, and amenities; attribute labels were not visible to participants) for six different apartments, for a total of 36 information items (see the Appendix for details). To maintain similarity to Blanchard et al.’s (2014) methodology, we intentionally designed the attributes to be somewhat ambiguous and difficult to compare in a consistent manner. Unlike in Blanchard et al.’s methodology, these items were not pre-tested and were not designed to be completely nondiagnostic. Although some attributes favored specific apartments, we balanced the attributes to avoid having apartments that were clearly superior or inferior to the others.
For example, the six information items for the “exterior” attribute were as follows:

**Walnut Apartment** has Colonial Revival architecture, which is characterized by elaborate front doors and a focus on external symmetry. It has low-maintenance, natural landscaping consisting primarily of plants native to the area. There are some attractive annuals near the main entrances.

**Cypress Apartment** has Chicago style architecture, which is characterized by masonry cladding and limited exterior ornamentation. It has landscaping that is well maintained but rather plain, with small areas of grass and bushes and relatively few flowering plants.

**Linden Apartment** has Shingle style architecture, which is characterized by a plain exterior and an emphasis on horizontal continuity. The grounds are somewhat spacious, with a grassy lawn and a number of neatly trimmed boxwood hedges and trees.

**Birch Apartment** has Tudor Revival architecture, which is characterized by a steeply-pitched roof and half-timbering filled with herringbone brickwork. On either side of the main walkway, there are gardens filled with hostas and similar shade-tolerant foliage.
Alder Apartment has American Craftsman architecture, which is characterized by a simple, sturdy structure with tapered square columns and large eaves. The landscaping features numerous flowering bushes, including azaleas and rhododendrons, as well as open grassy areas.

Juniper Apartment has Eastlake style architecture, which is characterized by complex geometric ornamentation and low-relief carvings. It has a central courtyard with neat flowerbeds filled with local wildflowers and other perennials, but there is no other communal outdoor space.

Through the course of the study, an individual participant always saw information about the six apartments in the same order, but half of the participants saw the items in one randomly determined order (e.g., Walnut always first, Cypress always second) whereas the other half saw the items in a reverse order (e.g., Cypress always fifth, Walnut always sixth).

For the joint-information conditions, all information items for a single attribute (e.g., exterior) were presented on a single screen, and screens were presented in a random order. For the sequential-information conditions, all items about a particular attribute were assigned to a block, and blocks were presented in a random order. All items within the block were presented on individual, sequential screens.

Procedure. Participants were randomly assigned to one of six conditions.
Four of the conditions were choice conditions. Participants in the choice conditions were assigned to groups in a 2x2 (information presentation [joint versus sequential] x evaluation of alternatives [ranking versus rating]) design. These participants completed the relevant practice question (ranking or rating) and were told that they would ultimately be asked to choose one from among six two-bedroom apartments, all of which had heating, air conditioning, similar costs for rent and utilities, and were located in appealing areas.

One group of participants was assigned to a joint-information ranking condition (n = 97), which was designed to be a conceptual replication of Blanchard et al.’s (2014) methodology. Participants in this condition viewed all of the information items about the same attribute (e.g., all information items about the exterior of the six apartments) on a single screen. On the same page, participants then answered the question, “Considering just the information on this screen, how appealing or unappealing are these features of these apartments?” on a nine-point scale with endpoints of “Very Unappealing” (1) and “Very Appealing” (9). Then, still on the same page, participants were asked, “Based on all of the information you have seen so far, how would you rank the six apartments? Remember that more information will be shown.” They were instructed to “Click and drag the different choice options to rank them. A ranking of 1 indicates your favorite option, while a ranking of 6 indicates your least favorite option.” After they rank-ordered the six apartments, participants moved on to the next attribute and repeated the process.

A second group was assigned to a sequential-information ranking condition (n = 91). Participants in this condition viewed information in six-item blocks, with each block consisting of information about all six apartments on the same attribute. Participants
viewed all of the information items individually and, after each information item, answered the question, “Considering just the information on this screen, how appealing or unappealing is this feature of Walnut [Cypress, Linden, etc.] Apartment?” on a nine-point scale with endpoints of “Very Unappealing” (1) and “Very Appealing” (9). After they viewed each block of six items, these participants rank-ordered all six of the apartments based on all of the information they had viewed so far.

A third group was assigned to a joint-information rating condition (n = 98), which followed a procedure identical to the joint-information ranking condition with the exception that, rather than being asked to rank-order the alternatives, participants were asked, “Based on all of the information you have seen so far, how would you rate the six apartments? Remember that more information will be shown. Click and drag the bars for the different options to indicate your ratings. Higher ratings are better (e.g., a rating of ‘5’ is better than a rating of ‘3’).” Ratings were on a continuous scale, with 1 indicating the lowest possible rating and 6 indicating the highest possible rating. After rating all six apartments, participants moved on to the next attribute and repeated the process.

A final group was assigned to a sequential-information rating condition (n = 89), which followed a procedure identical to the sequential-information ranking condition with the exception that, as in the joint-information rating condition, they rated how much they currently liked each of the six alternatives on a continuous six-point scale rather than rank-ordering the alternatives.

After they viewed all 36 information items, participants in the four experimental conditions made a final choice of apartment.
The two final conditions were no-choice control conditions, one of which was a *joint-information control* (n = 42) in which participants viewed all the information items about a particular attribute on a single screen, and one of which was a *sequential-information control* (n = 45) in which participants viewed all information items individually on separate screens. For both control conditions, all information items were labeled with unique, non-repeating apartment names (e.g., Cedar, Willow, Maple) to prevent any preference formation that could cause distortion (Russo et al., 1998). The item evaluations from these conditions were used as baselines for calculating distortion in the corresponding experimental conditions. Participants in the no-choice control conditions did not complete any practice ranking or rating questions, as these participants never compared any alternatives.

All participants completed demographic information, which included indicating their current state and current ZIP code. If the state and ZIP code a participant provided did not match, that participant was excluded from the final sample.

**Results**

**Control conditions.** Aggregated across all 36 information items, the mean ratings for the joint (M = 6.02) and sequential (M = 6.13) control groups were not significantly different, t(85) = 0.66, p = 0.512.

**Calculating distortion.** Control group ratings for each information item were averaged to obtain an “objective,” non-distorted rating for the individual information items. A separate mean was calculated for each of the information items in the joint control condition and the sequential control condition.
These control ratings were subtracted from the ratings provided by experimental participants to obtain a measure of distortion (e.g., if a control rating for Walnut’s exterior was 5 and the participant gave Walnut’s exterior a rating of 7, the distortion score would be +2; if the participant gave that Walnut’s exterior a rating of 1, the distortion score would be -4). Distortion scores for the participants in the joint conditions were calculated by subtracting the relevant mean ratings from the joint control group, and distortion scores for participants in the sequential conditions were likewise calculated by subtracting the relevant mean ratings from the sequential control group.¹

**Comparison to Blanchard et al. (2014).** The results of the joint-information ranking condition were similar to those of Blanchard et al. in that distortion was a negative linear function of option rank ($\beta = -0.06$, $t(96) = -6.78$, $p < .001$), with the first-ranked option the most positively distorted ($M = 0.61$) and the sixth-ranked option the most negatively distorted ($M = -0.26$). However, in contrast to Blanchard et al.’s reported pattern (in which only the first-choice option was positively distorted and all the trailing options except the second were significantly negatively distorted), both the first- and second-choice options were significantly positively distorted ($t(96) = 5.74$, $p < .001$, and $t(96) = 2.34$, $p = .021$, respectively), and only the sixth-choice option exhibited significant negative distortion ($t(96) = -2.37$, $p = .020$). The pattern of distortion in the joint-information ranking group is depicted in Figure 3, along with the analogous results from Blanchard et al. (2014).

¹ Averaging the joint and sequential control ratings and using the resulting combined (non-group-specific) baseline ratings to calculate distortion scores gave essentially identical results, with no changes in statistical significance.
Overall trends. To test for the effects of the independent variables, we conducted a repeated measures linear regression with each participant’s distortion of each information item as the dependent variable. The predictor variables included the manipulated factors and participants’ tentative rankings of each option (different participants assigned these ranks differently). Contrast codes were used to test for differences in the joint (+1) and sequential (-1) conditions and the ranking (+1) and rating (-1) conditions.

For comparability between the ranking and rating conditions, the relative ratings for the six alternatives were used to infer participants’ rankings, with the highest-rated option becoming rank one, the second-highest becoming rank two, and so forth. Contrast
codes were used to test for linear (-5, -3, -1, +1, +3, +5) and quadratic (+5, -1, -4, -4, -1, +5) patterns across ranks one through six.\(^2\)

For simplicity, we report partial results in Table 1, including only the manipulated factors, the linear and quadratic contrasts, and the associated two-way interactions. There was a significant overall negative linear trend across ranks one to six as well as a significant overall quadratic trend, indicating that, while distortion did become more negative across the six rankings, this trend flattened out in the middle and lower rankings.

Table 1

_Coefficients from Repeated Measures Linear Regression for Predicting Information Distortion in Study 1_

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-0.058</td>
</tr>
<tr>
<td>Joint/Sequential</td>
<td>0.052</td>
</tr>
<tr>
<td>Rank/Rate</td>
<td>0.007</td>
</tr>
<tr>
<td>Joint/ Sequential x Rank/Rate</td>
<td>0.068</td>
</tr>
<tr>
<td>Linear Trend</td>
<td>-0.063***</td>
</tr>
<tr>
<td>Linear Trend x Rank/Rate</td>
<td>0.003</td>
</tr>
<tr>
<td>Linear Trend x Joint/ Sequential</td>
<td>-0.020***</td>
</tr>
<tr>
<td>Quadratic Trend</td>
<td>0.022***</td>
</tr>
<tr>
<td>Quadratic Trend x Rank/Rate</td>
<td>0.002</td>
</tr>
<tr>
<td>Quadratic Trend x Joint/ Sequential</td>
<td>-0.004</td>
</tr>
</tbody>
</table>

\(^*p < .05. **p < .01. ***p < .001.\)

\(^2\) We ran a full set of orthogonal contrast codes (linear, quadratic, cubic, quartic, and quantic); the cubic term was negative and statistically significant \((p = .012)\) but is not interpreted here. The quartic and quantic terms were not statistically significant.
Figure 4. Distortion across the six ranks in the joint-information (n = 195) versus sequential-information (n = 180) conditions (collapsed across the rating and ranking conditions). Error bars indicate ± 1 SE.

**Effect of information presentation (joint versus sequential) and evaluation of alternatives (ranking versus rating).** The effect for sequential versus joint information presentation, the effect for ranking versus rating the choice alternatives, and the interaction between information presentation and evaluation of alternatives were not statistically significant. As hypothesized, there was an interaction between the linear trend and the style of information presentation such that the slope of the linear trend was significantly steeper (i.e., the differences between adjacent ranks were greater) in the joint conditions than in the sequential conditions (see Figure 4). Contrary to the hypothesis that there would be a significant quadratic trend in the rating conditions but not the ranking conditions, there was no significant interaction between the quadratic trend and ranking versus rating alternatives (β = 0.002, t(371) = 0.52, p = .602). Although a visual inspection of Figure 4 suggests an interaction between the style of information
presentation and the quadratic trend, this interaction was not statistically significant ($\beta = -0.004$, $t(371) = -0.99$, $p = .322$), and the quadratic trend is in fact statistically significant in both the joint conditions ($\beta = 0.018$, $t(193) = 3.65$, $p < .001$), and the sequential conditions ($\beta = 0.023$, $t(178) = 4.85$, $p < .001$), although it appears that the trend in the sequential conditions was driven more by levelling off of the negative distortion in the third- through sixth-ranked options while the trend in the joint conditions was driven more by the high positive distortion of the first-ranked option.

Also notable is the fact that distortion for the second-ranked option in the joint conditions was significantly and positively distorted ($t(194) = 2.97$, $p < .01$) while the second-ranked option in the sequential conditions was not significantly distorted ($t(179) = 0.41$, $p = .680$). This difference might affect how easily a second-ranked option could supplant a first-ranked option; it is possible that presenting information jointly rather than sequentially provides an advantage to the second-ranked option.

**Summary**

Blanchard et al.’s (2014) findings were partially replicated with a few notable differences, particularly in the case of the second-ranked option, which exhibited positive distortion rather than no distortion. To our knowledge, this is the first study to document significant positive distortion of a non-leading alternative. Although the methods used in the joint-information ranking condition of the current Study 1 were similar to those of Blanchard et al., the materials were different, and the differing pattern of distortion may have resulted from a qualitative difference in the information items (for example, the fact that the items in the current Study 1 were not designed to be non-diagnostic).
Both rating (rather than ranking) alternatives and sequential (rather than joint) information presentation were hypothesized to weaken Blanchard et al.’s (2014) observed negative linear trend. Contrary to expectations, there was no significant effect of ranking alternatives versus rating alternatives on participants’ pattern of distortion. This result is consistent with Blanchard et al.’s follow-up study (p. 815), in which they report that the ranking of the alternatives did not lead to the spreading of the information ratings and hence the distortion scores. However, there was an interaction between the negative linear trend as a function of rank and the style of information presentation, with sequential presentation of information reducing the strength of the linear trend across the six rankings (see Figure 4). This is consistent with the hypothesis that sequential presentation would make comparisons across alternatives more difficult.
Study 2

Studies with two alternatives have found negative distortion of the trailing options (Blanchard et al., 2014; DeKay et al., 2014), whereas those with more than two alternatives have found no distortion of the second-ranked alternative (Blanchard et al., 2014) or positive distortion of that alternative (Study 1). This suggests that the pattern of antitrailer distortion may change as the number of alternatives is reduced from several to two; in particular, it suggests that distortion of the second-choice alternative may become increasingly negative. Discovering whether this altered pattern does in fact occur would be beneficial, as choice sets are frequently narrowed in real-life choice situations. This narrowing can be controlled by individuals (e.g., by screening out subpar choice alternatives) or by external forces (e.g., if an apartment is rented by someone else or if a political candidate is defeated in a primary). For this initial study, we investigated how distortion of the second-choice option might change when the other trailing options are discarded from the choice set. We allowed participants to choose which two options remained in their choice set, but we forced them to make this choice at a specific point approximately halfway through the decision process.

Study 2 had a 2x2 (information presentation [joint versus sequential] x narrowing condition [always-six versus narrows-to-two]) between-subjects design with two different control conditions. While the main focus of the study was the narrows-to-two condition, in which the choice set was narrowed from two to six, the always-six condition (which
never had its choice set narrowed) served as a comparison. The information presentation (joint versus sequential) variable was included primarily because it emerged as an interesting factor in Study 1 (see Figure 4), particularly with regard to the second-ranked option. However, the joint versus sequential comparison was not our focus in Study 2, and our presentation will ignore this complicating factor in the initial discussions of the results.

Hypotheses

**Always-six versus narrows-to-two.** We hypothesized that the always-six and narrows-to-two conditions would have a similar pattern of distortion prior to the narrowing point (with the second-ranked option either minimally or positively distorted) because the conditions will be identical prior to that point. After the narrowing point, we expected that the second-ranked option in the narrows-to-two conditions would become negatively distorted, whereas the second-ranked option in the always-six conditions would remain positively or minimally distorted. We expected that distortion of the first-ranked option would remain positive and similar in magnitude regardless of the number of alternatives left in the choice set. This would result in a 3-way interaction (narrowing condition [always-six versus narrows-to-two] by attribute position [early/pre-narrowing versus late/post-narrowing] by rank [first-ranked versus second-ranked]). See Figure 5 for predicted results.
Joint versus sequential. In Study 1, the second-ranked alternative in the joint condition was distorted positively whereas the second-ranked option in the sequential condition was not distorted either positively or negatively. We expected that this result would replicate in the conditions with six alternatives (both in the always-six conditions and in the early half of the narrows-to-two conditions). We hypothesized that, in the narrows-to-two conditions, distortion of the second-ranked option would become negative once the choice set had narrowed to two regardless of the previous amount/direction of the distortion.

Methods

Participants. Five hundred and fifty participants recruited from Amazon’s Mechanical Turk received $0.50 for completing the survey. Of those 550, 37 were excluded for incorrectly answering the practice questions at the start of the survey, and 4 were excluded for providing a ZIP code that did not match the state they provided. The final sample therefore included 509 individuals. Of those included, 58.5% were female and 78.6% were white. The mean age was 36.4 years ($SD = 13.0$).

Materials.
**Practice questions.** The practice questions were identical for those from Study 1. As in Study 1, only participants in the non-control groups completed the practice questions.

**Information items.** The information items were nine attributes for six different apartments, for a total of 54 items. They were based on the items for Study 1, with three of the original attributes being split in half to create the three additional attributes. For example, the “exterior” attribute from Study 1 was split into separate “architecture” and “landscaping” attributes (see the Appendix for details; as before, these labels were not shown to participants). Five of the attributes were “early” attributes, and the remaining four attributes were “late” attributes. Because participants did not have tentative leaders until after they viewed the first attribute, the uneven distribution of attributes resulted in an even distribution of distortion measurements, with four measurement opportunities on either side of the narrowing point. In all choice conditions, the same five attributes were used as early attributes and the same four attributes were used as late attributes. The attributes within each half were presented in random order.

As in Study 1, an individual participant always saw information about the six apartments in the same order, but half of the participants saw the items in one randomly determined order (e.g., Walnut always first, Cypress always second), whereas the other half saw the items in a reverse order (e.g., Cypress always fifth, Walnut always sixth).

**Procedure.** Participants were randomly assigned to one of six conditions.

Four conditions were experimental choice conditions in a 2x2 (information presentation [joint versus sequential] x narrowing condition [always-six versus narrows-to-two]) design.
One group was assigned to a \textit{joint-information always-six} condition (n = 85). The procedure for this group was nearly identical to that for the joint-information ranking group in Study 1 and was very similar to that used by Blanchard et al. (2014).

A second group was assigned to a \textit{sequential-information always-six} condition (n = 107). The procedure for this group was nearly identical to that for the sequential-information ranking group in Study 1.

A third group was assigned to a \textit{joint-information narrows-to-two} condition (n = 104). Participants in this condition followed the same procedure as the joint-information always-six participants for the first five attributes. At that point, they were told, “From this point on, you will only receive information and will only be asked about your first- and second-choice apartments. Given the information you have seen so far, please indicate the two apartments that you wish to continue considering.” For the remaining four attributes, they saw items relating only to the two options they had selected.

A fourth group was assigned to a \textit{sequential-information narrows-to-two} condition (n = 91), which followed a procedure similar to that for the joint-information narrows-to-two condition, only with a sequential-information presentation format in place of the joint-information format.

After they viewed all of the information items, participants in the four experimental conditions made a final choice of apartment.

The remaining two conditions were no-choice control conditions, one of which was a \textit{joint-information control} (n = 63) and one of which was a \textit{sequential-information control} (n = 59). These control conditions were similar to those in Study 1, except that they included more information items.
All participants completed demographic information, which included indicating their current state and current ZIP code. If the state and ZIP code a participant provided did not match, that participant was excluded from the final sample.

Results

Control conditions. Aggregated across all 54 information items, the mean ratings for the joint (M = 6.27) and sequential (M = 6.07) control groups were not significantly different, t(120) = 1.79, p = 0.075.

Calculating distortion. Control group ratings for each information item were averaged to obtain an “objective,” non-distorted rating for the individual information items. Different means were calculated for each of the information items in the joint control condition and the sequential control condition.

As in Study 1, these control ratings were subtracted from the ratings provided by experimental participants to obtain a measure of distortion. Distortion scores for the participants in the joint conditions were calculated by subtracting the relevant mean ratings from the joint control group, and distortion scores for participants in the sequential conditions were likewise calculated by subtracting the relevant mean ratings from the sequential control group.3

Comparison to Blanchard et al. (2014). The results of the joint-information always-six condition were similar to those of Blanchard et al. in that distortion was a negative linear function of option rank (β = -0.05, t(84) = -8.93, p < .001). The first-

3 As in Study 1, averaging the joint and sequential control ratings and using the combined (non-group-specific) baseline ratings to calculate distortion scores gave essentially identical results, with no changes in statistical significance.
ranked option was significantly and positively distorted ($t(84) = 2.21, p = .030$) and the second-ranked option was not distorted ($t(84) = .03, p = .975$). These results are similar to Blanchard et al.’s results (although different from the results of Study 1, in which the second-ranked option was positively distorted). However, unlike Blanchard et al.’s previous results, the third-ranked option was not significantly negatively distorted ($t(84) = -1.19, p = .236$). The pattern of distortion in the joint-information always-six group is depicted in Figure 6, along with the corresponding results from Study 1 and Blanchard et al.

Figure 6. Mean distortion across ranks 1 through 6 for the joint-information always-six group (n = 85), Study 1’s joint-information ranking group (n = 97), and Blanchard et al.’s (2014) Experiment 2. Error bars indicate ± 1 SE.

**Hypothesized difference for always-six versus narrows-to-two conditions.** As Figure 7 shows, there was a significant 2-way interaction between rank (first versus
second) and attribute position (early versus late) in the narrows-to-two condition, but no such 2-way interaction in the always-six condition. This difference leads to the hypothesized 3-way interaction for narrowing condition (always-six versus narrows-to-two), rank (first versus second), and attribute position (early versus late). Contrary to our hypotheses, however, this pattern did not result from the second-ranked alternative being distorted more negatively; rather, it resulted from the unanticipated spike in the distortion of the first-ranked option in the narrows-to-two condition. Overall, the always-six and narrows-to-two conditions were essentially equivalent prior to the narrowing point, as anticipated. Reducing the choice set from six to two options led to increased positive distortion of the first-choice option (more so than in the always-six condition).

![Graph showing information distortion for always-six and narrows-to-two conditions](image)

Figure 7. Early- and late-attribute distortion for the first- and second-ranked options in the always-six (n = 192) and narrows-to-two (n = 195) conditions. Error bars indicate ± 1 SE.

**Effects of information presentation and narrowing choice set.** To test for the effect of maintaining versus narrowing the choice set and also the effect of sequential versus joint information presentation on distortion for the first- and second-ranked options, we conducted a repeated measures linear regression on the data for the first- and
second-ranked options. Contrast codes were used to test for differences in the first-ranked (+1) and second-ranked (-1) alternatives, the always-six (+1) and narrows-to-two (-1) conditions, the joint-information (+1) and sequential-information (-1) conditions, and the difference between early-attribute (-1) and late-attribute (+1) distortion scores. Partial results appear in Table 2 with all nonsignificant effects omitted for brevity.

Table 2
Coefﬁcients from Repeated Measures Linear Regression Models for Predicting Information Distortion in Study 2

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Not Including Serial Position</th>
<th>Including Serial Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.170***</td>
<td>0.168***</td>
</tr>
<tr>
<td>Serial Position</td>
<td>---</td>
<td>0.014</td>
</tr>
<tr>
<td>Early/Late Attributes</td>
<td>0.142***</td>
<td>0.088</td>
</tr>
<tr>
<td>Rank 1/Rank 2</td>
<td>0.115***</td>
<td>0.118***</td>
</tr>
<tr>
<td>Always-six/Narrows-to-two x Early/Late Attributes</td>
<td>-0.055*</td>
<td>-0.055*</td>
</tr>
<tr>
<td>Always-six/Narrows-to-two x Rank 1/Rank 2</td>
<td>-0.054**</td>
<td>-0.054**</td>
</tr>
<tr>
<td>Always-six/Narrows-to-two x Early/Late Attributes x Rank 1/Rank 2</td>
<td>-0.052**</td>
<td>-0.052**</td>
</tr>
<tr>
<td>Joint/ Separate x Early/Late Attributes x Rank 1/Rank 2</td>
<td>-0.044*</td>
<td>-0.044*</td>
</tr>
</tbody>
</table>

* p < .05. ** p < .01. *** p < .001.

Note: The non-significant serial position and early/late-attribute effects were included for comparison between the two models, but all other non-significant simple effects and interactions were excluded from the reported models. A model containing only serial position demonstrated that serial position was a statistically significant predictor of distortion ($\beta = 0.031$, $t(386) = 5.80$, $p < .001$).

**Overall effects and two-way interactions.** The effect of early versus late attributes was positive and statistically significant, indicating that distortion was more positive for the last four attributes than for the first four attributes. Additionally, the effect of rank was positive and statistically significant, indicating that distortion for the first-choice
option was significantly more positive than distortion for the second-choice option. The effects of information presentation (sequential versus joint) and narrowing condition (always-six versus narrows-to-two) were not statistically significant.

There was a significant negative 2-way interaction between the narrowing condition (always-six versus narrows-to-two) and attribute position (early versus late) such that, although the early-attribute distortion was similar for the always-six and narrows-to-two conditions, the late-attribute distortion was more positive for the narrows-to-two condition than the always-six condition (see Figure 7). Given that the always-six and narrows-to-two conditions were identical prior to the narrowing point, their early-attribute similarity for distortion is unsurprising. We did not anticipate the more positive late-attribute distortion in the narrows-to-two condition, which was driven by the increased positive distortion of the first-choice option after the choice set was narrowed.

There was also a significant 2-way interaction between the narrowing condition (always-six versus narrows-to-two) and the first- and second-ranked alternatives, indicating that the difference in distortion for the first- and second-ranked alternatives was larger in the narrows-to-two than in the always-six condition. This interaction, too, appears to be largely driven by the increase in the positive distortion of the first-choice option for the late attributes in the narrows-to-two condition. In other words, both of these 2-way interactions are best understood in the context of the significant 3-way interaction that is evident in Figure 7.

**Joint versus sequential groups.** All of the results reported above were averaged over the joint and sequential conditions. Investigating these conditions separately adds an additional level of complexity to the results.
There was a significant 3-way interaction for information presentation (joint versus sequential), rank (first versus second), and attribute position (early versus late). These results are depicted in Figure 8, which is largely similar to Figure 7, but with information presentation condition rather than narrowing condition distinguishing between the left and right panels.

In the joint-information groups (see left panel of Figure 8), the early-attribute distortion for the first-ranked option was positive while the early-attribute distortion for the second-ranked option was negative ($M = 0.16$ for the first-ranked and $M = -0.11$ for the second-ranked; $t(188) = 3.14, p = .002$), whereas the late-attribute distortion for both the first- and second-ranked options was positive and somewhat similar in magnitude ($M = 0.38$ for the first-ranked and $M = 0.23$ for the second-ranked; $t(188) = 1.71, p = .088$).

In the joint-information groups, the two way interaction between attribute position (early versus late) and rank (first-ranked versus second-ranked) was not significant ($p = .448$).

In the sequential-information groups (see right panel of Figure 8), the early-attribute distortion for the first- and second-ranked options was similar and close to zero ($M = 0.06$ for the first-ranked and $M = -0.05$ for the second-ranked; $t(197) = 1.40, p = .163$), whereas the late-attribute distortion for the first-ranked option was significantly more positive than the late-attribute distortion for the second-ranked option ($M = 0.56$ for the first-ranked and $M = 0.14$ for the second-ranked; $t(197) = 5.16, p < .001$). In the sequential-information groups, the two way interaction between attribute position (early versus late) and rank (first-ranked versus second-ranked) was significant ($p = .007$). The fact that this interaction was significant in the sequential groups but not significant in the joint groups led to the three-way interaction among information presentation (joint versus
The results in Figure 8 were not anticipated. The fact that joint versus sequential presentation resulted in significant differences in both Study 1 and Study 2 suggests that this is a variable worthy of further study.

Figure 8. Early- and late-attribute distortion for the first- and second-ranked options in the joint- (n = 189) and sequential-information (n = 198) conditions. Error bars indicate ± 1 SE.

Given the pattern in Figure 8, it seems worth investigating whether the relationship depicted in Figure 7 holds separately for the joint and sequential conditions. In the joint-information groups, the hypothesized 3-way interaction (see Figure 7) for choice set (always-six versus narrows-to-two), rank (first versus second), and attribute position (early versus late) was not statistically significant (p = .541). By contrast, in the sequential-information groups, the hypothesized 3-way interaction for choice set (always-six versus narrows-to-two), rank (first versus second), and attribute position (early versus late) was statistically significant (p = .016). In other words, the hypothesized 3-way
interaction in Figure 7 held for sequentially presented information but not for jointly presented information. Despite this between-group difference in the hypothesized 3-way interactions, the related 4-way interaction (information presentation [sequential versus joint] x narrowing condition [always-six versus narrows-to-two] x rank [first versus second] x attribute position [early versus late]) was not statistically significant.

**Effect of serial position.** Since distortion was more positive overall in the late attributes than in the early attributes, there may be an effect of serial position on distortion such that distortion for both the first- and second-choice alternatives became steadily more positive across participants’ second through ninth attribute ratings (i.e., their distortion increased positively and relatively linearly as they progressed through the study). This raises the possibility that some of the effects attributed to the early versus late attribute split (and the associated narrowing of the choice set) are instead due to this serial position effect. To test for this effect, a contrast code for a positive linear trend across the eight positions (-7, -5, -3, -1, 1, 3, 5, 7) was added to the previously-described model. Results for this model also appear in Table 2.

Accounting for the effect of serial position rendered the simple effect of early-versus late-attribute distortion non-significant, but the remainder of the simple effects and interactions from the previous model remained essentially unchanged. ⁴

The effect of serial position was not simply the result of the narrowing aspect of this study, as it was also statistically significant in the always-six conditions ($\beta = 0.008$, $t(191) = 3.43$, $p < .001$; see the left panel of Figure 7). To our knowledge, this is the first

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⁴ Adding contrast codes for attribute position to the main model in Study 1 revealed no such effect of serial position ($p = .142$).
study which found a significant effect of serial position on distortion. It is possible that this serial position effect is the result of increasing confidence in the leader, as confidence has previously been shown to predict distortion (Carlson & Russo, 2001; Meloy & Russo, 2004; Russo et al., 1998, 2000; Simon et al., 2004). However, we did not collect confidence ratings for this study, so there is no way to confirm this. Another possibility is that the attributes assigned to the early half of the study were somehow different from the attributes assigned to the second half of the study. Indeed, that mean ratings for the early versus late attributes are significantly different in both the joint condition \( t(124) = 3.21, \ p = .002; M = 6.43 \) for the early attributes and \( M = 6.07 \) for the late attributes) and the sequential condition \( (t(116) = 4.34, p < .001; M = 6.32 \) for the early attributes and \( M = 5.76 \) for the late attributes), with the early attributes having higher control ratings in both instances. Although we attempted to balance diagnosticity across the early and late attributes, the lower control ratings for the late attributes indicate that the late attributes may have been less diagnostic than the early attributes, which may have contributed to the observed serial effect on distortion.

**Summary**

As in Study 1, Blanchard et al.’s (2014) findings were partially replicated with a few notable differences, particularly in the case of the third-ranked option, which was not significantly negatively distorted.

The predicted 3-way interaction (narrowing condition [always-six versus narrows-to-two] by attribute position [early versus late] by rank [first-ranked versus second-ranked]) was significant. However, contrary to expectations, narrowing a choice set from six to two alternatives had little effect on the second-ranked alternative. Rather, it
positively shifted distortion of the first-ranked alternative. This unanticipated result may have been partially driven by a serial position effect, which may in turn have been caused by unplanned differences in the relative diagnosticity of the early versus late attributes.

In addition, there were surprising results in regards to joint versus sequential presentation of information and serial position. These findings bear further investigation, although they may not be replicable.
Discussion

Comparison to Blanchard et al. (2014)

Blanchard et al.’s results were largely replicated in both Study 1 and Study 2, but the precise pattern of distortion differed between the studies, and neither pattern exactly replicated Blanchard et al.’s previous findings. Distortion was consistently a negative linear function of option rank, and the first-ranked option was always more positively distorted than the trailing options. In contrast to Blanchard et al.’s findings, however, the second-ranked option in the current Study 1 was positively distorted (rather than minimally distorted), and the third-ranked option in the current Study 2 was not significantly negatively distorted.

It is not clear what caused these minor differences in the pattern of antitrailer distortion. The specific attributes and information items varied across all of the studies, and it is possible that the specific magnitude and direction of distortion for trailing options is sensitive to these differences. It might be informative to investigate the effects of differing types of information on the distortion for trailing alternatives. Alternatively, some of these minor deviations may result from sampling error alone.

Blanchard et al. (2014) suggested that their observed pattern of proleader and antitrailer distortion did not support a motivational explanation, as individuals should be motivated to distinguish their tentative leader from the remaining options but should not be motivated to distinguish their sixth-choice option from the rest of the options. The
consistent replication of the negative linear trend across the six ranks does offer additional support for this conclusion. However, the finding that the amounts of distortion for the fourth- fifth- and sixth-ranked options in Study 2 were not significantly different from each other is somewhat consistent with a motivational explanation. Future studies to clarify this point would prove useful.

**Effects of information presentation and evaluation of alternatives**

The results of Study 1 suggest that how alternatives are evaluated (ranking versus rating) does not influence distortion, but that how information is presented (jointly versus sequentially) does. Specifically, presenting information jointly leads to a steeper negative trend across the rankings, with increased positive distortion for the first-ranked alternative and increased negative distortion for the sixth-ranked alternative. This is consistent with previous research, which has found that jointly-presented information becomes more “evaluable” (Bazerman et al., 1999; Hsee, 1996; Hsee & Leclerc, 1998).

The differing effects of joint versus sequential presentation of information on proleader and antitrailer distortion patterns suggest that the magnitude and pattern of information distortion could differ substantially between decision-making contexts where information is acquired in a scattered manner (e.g., casually browsing for a product in one or more stores) versus contexts where information is presented all at once (e.g., reading review websites that directly compare two or more brands of that product). It is unclear whether these differing effects persist when information is acquired over longer time periods, but if they do, it is possible that the distortion of information (and any resulting preference formations) could be very different for individuals who acquire incidental fragments of information over an extended time period (e.g., hearing
occasional talking points on the news) versus individuals who are presented with the same information in close temporal proximity (e.g., being exposed to those same talking points in an informational chart).

There are some notable limitations of this study, including the fact that both ranking and rating alternatives requires participants to consider all six options individually. If participants were asked to evaluate alternatives in a way that required less consideration – for example, simply indicating whether or not the alternatives were acceptable rather than assigning them a particular value – they may not distinguish among the trailing options, and the resulting distortion might be negative and essentially equivalent in magnitude for all of the alternatives that were considered unacceptable.

Effects of narrowing the choice set

Contrary to our hypotheses, narrowing did not significantly affect distortion of the second-ranked alternative, which became slightly positive on average; narrowing did, however, significantly increase the positive distortion of the first-ranked alternative. These results may be due to participants viewing the narrowing point as a decision point that indicated a positive evaluation of their top two options. Russo, Meloy, and Medvec (1998) previously found that, after making a choice, individuals engaged in positive postdecisional distortion that was less than half the magnitude of their predecisional distortion. Similarly, Chaxal, Russo, and Kerimi (2013) found that individuals engaged in positive postdecisional distortion that was lower (although not significantly so) than their predecisional distortion. If participants viewed the narrowing point as “choosing” both the first- and second-ranked options, the late-attribute portion of the narrows-to-two condition may have included elements of both predecisional distortion (which would be
more positive for the first-ranked alternative than the second-ranked alternative) and postdecisional distortion (which would be positive for both the first- and second-ranked alternatives). A more organic narrowing process that occurs at the participants’ own pace (and therefore does not require them to “choose” the remaining options quite as explicitly) might not result in this particular pattern of distortion. Additionally, such a design could provide evidence on how distortion for trailing options beyond the second-ranked option is affected as a choice set is reduced. Choice sets are often narrowed during a decision process, and the results these studies could have important implications for decisions across a variety of contexts, from product selection (where choice sets are frequently narrowed by individuals at their own pace) to choosing candidates for political office (where any given individual has relatively minimal effect on the narrowing of the choice set).

Overall, the distortion of information about trailing choice alternatives is more complex than we had initially anticipated. Contrary to our hypotheses, the distortion of trailing alternatives was not influenced by ranking versus rating the choice alternatives. However, the distortion of trailing alternatives was affected by joint versus sequential information presentation, both in anticipated ways (i.e., information presentation’s effect on the slope of the linear trend in Study 1) and unanticipated ones (i.e., information presentation’s complicated interaction with the narrowing of the choice set in Study 2). Additional research, especially on second-choice options and the effects of discarding choice options, is likely to prove informative and interesting.
References


## Appendix: Apartment Attributes

<table>
<thead>
<tr>
<th></th>
<th>Walnut</th>
<th>Cypress</th>
<th>Linden</th>
<th>Birch</th>
<th>Alder</th>
<th>Juniper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online</td>
<td>On an online review site, Walnut Apartment has a rating of 7.3 on location, 8.1 on noise, and 8.6 on maintenance, based on 12 reviews (on a scale of 0-10, where higher ratings are better). // The most recent review states &quot;I'm very pleased with the apartment and the area is fine (pretty green, actually). I'm only moving for job-related reasons.&quot;</td>
<td>On an online review site, Cypress Apartment has a rating of 7.7 on location, 9.2 on noise, and 7.1 on maintenance, based on 9 reviews (on a scale of 0-10, where higher ratings are better). // The most recent review states &quot;It has nice neighbors and quiet surroundings. There are other options, of course, but this one is a good find. Plus my mom approves.&quot;</td>
<td>On an online review site, Linden Apartment has a rating of 9.2 on location, 7.6 on noise, and 7.2 on maintenance, based on 21 reviews (on a scale of 0-10, where higher ratings are better). // The most recent review states &quot;It's conveniently located and a good value for the money. It felt more homey than I first expected, but maybe that's just me.&quot;</td>
<td>On an online review site, Birch Apartment has a rating of 7 on location, 8.6 on noise, and 8.4 on maintenance, based on 12 reviews (on a scale of 0-10, where higher ratings are better). // The most recent review states &quot;I like the area and would recommend the complex highly, especially given what else is out there.&quot;</td>
<td>On an online review site, Alder Apartment has a rating of 9.4 on location, 7.6 on noise, and 7 on maintenance, based on 17 reviews (on a scale of 0-10, where higher ratings are better). // The most recent review states &quot;It's in a good but busy location (close to shops/other attractions) and is reasonably priced for what you get.&quot;</td>
<td>On an online review site, Juniper Apartment has a rating of 7.1 on location, 8.8 on noise, and 8.1 on maintenance, based on 16 reviews (on a scale of 0-10, where higher ratings are better). // The most recent review states &quot;It's in a friendly neighborhood and I'm happy with the apartment/building. It's great that it's so close to my work.&quot;</td>
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<td><strong>Walnut Apartment's landlord</strong> does not respond until you've left two messages for him. When you finally meet in person, however, he seems to be very friendly and good-natured, and he is very efficient when he's filling out the required paperwork.</td>
<td><strong>Walnut Apartment</strong> has six large windows and very good lighting. It does not have ceiling fans. // It has an open floorplan and well-maintained hardwood flooring in the main living areas, but it has minimal storage space.</td>
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<td><strong>Cypress Apartment's landlord</strong> is initially very easy to get in touch with and is very professional over the phone. When you visit to look at the rental, she seems somewhat inefficient and disorganized.</td>
<td><strong>Cypress Apartment</strong> has five medium to large windows and ceiling fans in both the bedrooms and the living room. // It has two walk-in closets with a good deal of storage space and has typical, neutral carpeting. The ceilings are a bit higher than average.</td>
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<td><strong>Linden Apartment's landlord</strong> does not always pick up the phone when you call and can take three days to respond to your message. When you do finally get in touch with her, she seems very warm and obliging.</td>
<td><strong>Linden Apartment</strong> has four east-facing windows and one south-facing window. It has a ceiling fan in one of the two bedrooms but not in the living room. // It has a newly redone bathroom with tile flooring and new fixtures. The flooring is hardwood and well maintained.</td>
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<td><strong>Birch Apartment's landlord</strong> lives in an apartment onsite and is readily available. When you visit to look at the rental, she seems somewhat overwhelmed and can be somewhat brusque.</td>
<td><strong>Birch Apartment</strong> has three north-facing windows that receive only minimal sunlight through the day, so the interior is somewhat dim. // It has ceiling fans in both the bedrooms and the living room. It has old and somewhat scuffed hardwood flooring and nice woodwork in the main areas, carpet</td>
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<td><strong>Alder Apartment's landlord</strong> lives in a nearby apartment complex owned by the same rental company. She seems to be very competent and efficient, but she also seems to be aloof and unsympathetic when you meet in person.</td>
<td><strong>Alder Apartment</strong> has four south-facing windows, one of which is a bay window, so it can get pretty warm. // It has ceiling fans in both the bedrooms and the living room. It has an open floorplan and a recently remodeled bathroom. It has minimal storage space and slightly</td>
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<td><strong>Juniper Apartment's landlord</strong> has a rental office on the far side of town. When you talk to him, he seems to be very organized and professional.</td>
<td><strong>Juniper Apartment</strong> has three west-facing windows (including one bay window) and ceiling fans in the bedrooms. // It has a newly renovated interior with a modern-looking decor and brand new carpeting. It has minimal storage space.</td>
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<td>Kitchen</td>
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<td>Apartment's</td>
<td>Apartment has Colonial</td>
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<td>kitchen has an</td>
<td>Revival architecture, which</td>
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<td>open-plan design</td>
<td>is characterized by elaborate</td>
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<td>that includes the</td>
<td>front doors and a focus on</td>
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<td>living and dining</td>
<td>external symmetry. // It has</td>
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<td>area. The color</td>
<td>low-maintenance,</td>
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<td>Apartment has Chicago style</td>
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<td>woodtones, with</td>
<td>architecture, which is</td>
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<td>cabinets and a</td>
<td>cladding and limited exterior</td>
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<td>hardwood floor.</td>
<td>ornamentation. // It has</td>
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<td>The appliances</td>
<td>landscaping that is well</td>
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<td>are black.</td>
<td><strong>Linden</strong></td>
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<td><strong>Cypress</strong></td>
<td>Apartment has Shingle style</td>
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<td>Apartment's</td>
<td>architecture, which is</td>
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<td>kitchen has a</td>
<td>characterized by a plain</td>
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<td>contemporary</td>
<td>exterior and an emphasis on</td>
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<td>design with clean</td>
<td>horizontal continuity. // The</td>
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<td>sleek lines. The</td>
<td>grounds are somewhat</td>
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<td>appliances are</td>
<td>spacious, with a</td>
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<td>stainless steel,</td>
<td><strong>Birch</strong></td>
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<td>and the</td>
<td>Apartment has Tudor Revival</td>
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<td>backsplash is</td>
<td>architecture, which is</td>
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<td>made of</td>
<td>characterized by a steeply-</td>
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<td>decorative glass</td>
<td>pitched roof and half-</td>
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<td>tile.</td>
<td>timbering filled with</td>
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<td><strong>Linden</strong></td>
<td>herringbone brickwork. // On</td>
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<td>Apartment's</td>
<td>either side of the main</td>
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<td>kitchen has two-</td>
<td>walkway,</td>
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<td><strong>Alder</strong></td>
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<td>with staggered</td>
<td>Apartment's kitchen has a</td>
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<td>heights. It has</td>
<td>traditional design using warm,</td>
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<td>only a moderate</td>
<td>natural materials and glass-</td>
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<td>and-wood cabinets. It is</td>
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<td>spacious enough for a full</td>
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<td>counter space,</td>
<td>breakfast table.</td>
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<td>but features a</td>
<td><strong>Juniper</strong></td>
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<td>breakfast bar</td>
<td>Apartment's kitchen is</td>
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<td>by the window.</td>
<td>slightly smaller but still</td>
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<td><strong>Birch</strong></td>
<td>efficient and highly</td>
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<td>Apartment's</td>
<td>functional. It has cherry-</td>
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<td>kitchen has a</td>
<td>wood cabinets, classic latch</td>
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<td>modern, black-</td>
<td>hardware, a farmhouse sink</td>
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<td>and-white color</td>
<td>with a crosshandled faucet,</td>
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<td>and white appliances.</td>
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<td>carvings. // It has a central</td>
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<td>landscaping</td>
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natural landscaping consisting primarily of plants native to the area. There are some attractive annuals near the main entrances. maintained but rather plain, with small areas of grass and bushes and relatively few flowering plants. grassy lawn and a number of neatly trimmed boxwood hedges and trees. there are gardens filled with hostas and similar shade-tolerant foliage. features numerous flowering bushes, including azaleas and rhododendrons, as well as open grassy areas. courtyard with neat flowerbeds filled with local wildflowers and other perennials, but there is no other communal outdoor space.

### Amenities

<table>
<thead>
<tr>
<th>Amenity</th>
<th>Walnut Apartment</th>
<th>Cypress Apartment</th>
<th>Linden Apartment</th>
<th>Birch Apartment</th>
<th>Alder Apartment</th>
<th>Juniper Apartment</th>
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</thead>
<tbody>
<tr>
<td>Inexpensive coin-operated laundry machines available on every floor of the building. It also has a small indoor pool that is freely available to all residents.</td>
<td>Cypress Apartment has free laundry machines available in the basement. It also has a small fitness center that is free to all residents.</td>
<td>Linden Apartment has on-street parking only, but it seems to be readily available at all times of the day. Additional basement storage is available at no additional charge. There is also a game room with a pool table.</td>
<td>Birch Apartment offers free on-site parking and also offers covered parking for a small monthly fee. The apartment is a block away from a small community park with a pond, playground, and picnic shelter.</td>
<td>Alder Apartment offers free wireless Internet. It offers additional storage space for a small monthly fee.</td>
<td>Juniper Apartment offers free on-site parking provided that you register your car. It also offers free cable television to all residents.</td>
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“//” indicates where the attributes were split for Study 2.