Is that Your Final Answer: Testing Perceptual Asymmetry Biases on Responses to Likert-Scales

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Abstract

The present study explores the effects that pseudoneglect, a perceptual asymmetry bias, has on responses to Likert-scales. Pseudoneglect is the tendency for neurotypical individuals to mis-bisect horizontal lines, generally erring to the left of veridical center. The present study hypothesized that a general leftward bias would be seen in participant responses to Likert-scales. The study sample consisted of 20 participants (11 male, 9 female) who were tested using two versions of the National Student Survey (NSS)—an original and an altered version. A leftward bias was revealed between scale versions in two of five response categories. However, further analysis of responses that had changed between scale types was not significant. There was also no significant difference of overall satisfaction between scale versions. Although one analysis presented evidence for a leftward bias, the overall results cannot support evidence of pseudoneglect as further analyses failed to reach statistical significance. Implications for these findings and suggestions for further research are discussed.

Keywords: Likert-scale, perceptual asymmetry, pseudoneglect, neuropsychology, perception, spatial processing

Visual perceptual asymmetries have become an increasingly popular field of study, yet it remains unclear which neural mechanisms contribute to specific perceptual asymmetries. Researchers are working to refine these neurological theories that may influence lateral biases of perceptions, such as pseudoneglect (Chokron & Imbert, 1993; Jewell & McCourt, 2000; Kinsbourne, 1970). Pseudoneglect is the tendency for neurotypical individuals to mis-bisect horizontal lines, generally erring to the left of veridical center (Bowers & Heilman, 1980). Perceptual asymmetry biases may impact lives every day through driving (Benedetto, Pedrotti, Bremond, & Baccino, 2013), seating preference (Nicholls, Thomas, & Loetscher, 2013), and spatial navigation (Nicholls, Loftus, Mayer, & Mattingly, 2007). These lateral biases may also influence how individuals respond to items on Likert-scale questionnaires (Barrow, Baldwin, Bourne, & Wegner, 2011; Nicholls, Orr, Okubo, & Loftus, 2006). For example, if a program's funding is contingent upon obtaining favorable survey results, this criterion might be more easily met by placing favorable response categories on the left side of a Likert-scale, therefore facilitating a leftward bias. Biased results could skew data in many professions that utilize Likert-type questionnaires (e.g., social sciences, health sciences, and marketing), as well as the results of exams in education

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systems, which are often organized in a horizontal linear fashion.

The growing popularity of research on perceptual asymmetries such as pseudoneglect has begun to study beyond neurological underpinnings and toward the everyday implications they hold. Pseudoneglect may affect Likert-type questionnaires by contributing to a leftward bias in the responses recorded (Nicholls et al., 2006). Nicholls et al. (2006) asked 292 undergraduate students to complete a Likert-type questionnaire, the National Student Survey (NSS), which inquired about the quality of an undergraduate course. The results reported a significant leftward bias on participant responses. Hand preference was eliminated as a potential bias, but, due to the between-subjects design, it was assumed that any individual differences (e.g., direction of visual scanning) were not significant—a possible limitation to their study (Bultitude & Davies, 2006; Jewell & McCourt, 2000). Barrow et al. (2011) found similar results in studying participant preferences over a selection of visual art. Using a device similar to a Likert-scale to rate the art, participants indicated a consistent leftward bias in their preference ratings. With few exceptions (e.g., Barrow et al., 2011; Nicholls et al., 2006), the current literature on pseudoneglect has given little focus towards Likert-scale biases. Instead, much of the literature aims to explain neurological factors that contribute to pseudoneglect.

The activation-orientation hypothesis posits that both cerebral hemispheres in humans produce an attentional bias toward the contralateral fields of vision (Kinsbourne, 1970). Because the right hemisphere is dominant in spatial processing, it is more active than the left hemisphere during spatial tasks (e.g., line bisection, landmark, and grayscale judgment tasks). Pseudoneglect is theorized to stem from this asymmetry in hemispheric activation, as it would tend to direct attention slightly more to the left visual field—the visual field primarily processed in the right hemisphere. Experimental methods used in supporting the activation-orientation hypothesis have included transcranial direct current stimulation during a grayscale judgment task (Loftus & Nicholls, 2012), functional magnetic resonance imaging during a landmark task (Cicek, Deouell, & Knight, 2009), and tachistoscopic presentation of a landmark task, paired with an attention cueing paradigm (Bultitude & Davies, 2006). Although Nicholls et al. (2006) mostly discussed the activation-orientation hypothesis, they did propose an additional theory.

Perceptual lateral biases may be dependent upon habitual reading and writing direction, known as visual scanning (Chokron, Bartolomeo, Perenin, Helft, & Imbert, 1998; Chokron & Imbert, 1993; Jewell & McCourt, 2000). In a meta-analysis of pseudoneglect studies, Jewell and McCourt (2000) found systematic visual scanning significantly affected task results. As such, the left-to-right reading habit typical in Western countries may be guiding the leftward bias seen in pseudoneglect. Chokron and Imbert (1993) tested whether reading habits influenced a series of line bisection tasks with French and Israeli participants. A leftward bias was reported for French participants (i.e., left-to-right readers) and a rightward bias for Israeli participants (i.e., right-to-left readers). Because human brain structures do not differ between individuals with different visual scanning habits, scanning preference should not affect the lateralization of hemispheric activity during spatial tasks (Chokron & Imbert, 1993). In a similar study, two groups (left-to-right readers and right-to-left readers) were subjected to each direction of visual scanning, yet scanning direction predicted directional bias in all conditions (Chokron et al., 1998). Arguing against the visual-scanning theory, Nicholls and Roberts (2002) found that native reading direction had no effect on a luminance judgement task, as both Hebrew and English readers exhibited a leftward perceptual bias. If a left-to-right scanning bias influences leftward biases in Likert-type questionnaires, then a rightward bias would likely be present on responses to Likert-scales when scanning from right-to-left (Nicholls et al., 2006). However, the current literature lacks studies investigating this proposition.

Though supportive evidence has been produced in favor of both discussed theories, neither appears to be superior in comparison to the other. Discrepancies in the current literature could be due to uncontrolled variables. Jewell and McCourt (2000) found a wide range of experimenter, participant, and methodological variables that may skew the results on perceptual asymmetry tasks. Alternatively, the underlying cause of pseudoneglect may be an interaction between visual scanning and hemispheric specialization. The relatively recent interactive theory suggests that neurological factors (i.e., hemispheric lateralization) combine with cultural factors (i.e., native reading direction) to facilitate perceptual asymmetry biases (Rinaldi, Di Luca, Henik, & Girelli, 2014). This would result in a leftward bias for both reading populations, but an attenuation of the effect would be seen in right-to-left readers (Rinaldi et al., 2014). Further research is needed to validate the interactive account of pseudoneglect.

Building on Nicholls et al. (2006), the current experiment will compare the response category means in two versions of the NSS to detect the influence of perceptual asymmetries. Whereas Nicholls and colleagues employed a between-subjects design, the current study will utilize a within-subjects design to account for potential individual differences between participants. Having each participant serve as their own comparison may be the most appropriate option given the subjective nature of questionnaires. Based on the relevant literature, the current study hypothesizes a leftward bias will be present in responses to Likert-scales as measured by the directional bias of (1) response category

means between the two scale versions, and (2) answers that were changed between scale versions.

Methods

Participants

Twenty student participants (11 males, 9 females) took part in the experiment. Four participants were recruited from the Undergraduate Psychology Participant Pool at the University of Saskatchewan and received one course credit in exchange for participation. The remaining participants were university students who met the inclusion criterion; these students received no compensation for their participation. The inclusion criterion stated that participants must have previously been enrolled in the course Introductory Psychology. The mean age was 21 (*SD* = 1.9) and ranged from 18 to 25 years. All participants provided informed consent. This experiment was conducted with ethical approval by the Behavioural Research Ethics Board at the University of Saskatchewan.

Apparatus and Materials

Two versions of the NSS were used with permission from Ipsos MORI. The NSS is a national survey that was commissioned by the Higher Education Funding Council for England (HEFCE) and is conducted annually. The NSS presents undergraduate students with questions pertaining to the quality of a chosen course. One version of the NSS used in this experiment copied the original version commissioned by HEFCE, in which each question was followed by a Likert-scale with a left-to-right order that began with "definitely agree" and proceeded towards "definitely disagree". The other version used was an altered version of the original NSS. The alterations involved changing the order (1) of the Likert-scales so that they were reversed in order, beginning with "definitely disagree" as the furthest left answer and ending with "definitely agree" as the furthest right answer; and (2) in which the questions were given.

The NSS questionnaires differed from the versions used by Nicholls et al. (2006) in two ways. First, the NSS questionnaires used in this study added a question pertaining to the university's students' union; this is present on the official version of the NSS as produced by HEFCE and was done to comply with the terms of use for NSS as outlined by Ipsos MORI. Second, the NSS questionnaires used in this study did not use numbers to indicate the five possible answers for each question. Removing the numbers was meant to prevent a numerical-value or ordering bias.

The questionnaires were presented via a paper copy and administered in private classrooms on the University of Saskatchewan campus.

Experimental Design

A within-subjects design was employed to study the effects of Likert-scale direction (original or reversed) on participant response categories (i.e., "Definitely Agree", "Moderately Agree", "Neutral", "Moderately Disagree", and "Definitely Disagree"). Participants took part in both conditions.

The experiment did not use the midpoint of the Likert-scale response boxes (i.e., "Neutral") as the point to measure biases from, as responding to a Likert-scale involves a non-spatial component that requires conscious thought and personal opinion (Hartley & Betts, 2010), and may be influenced by spatial processing (Nicholls et al., 2006).

If the midpoint was used as the point to measure from, then a leftward bias on the original scale would likely indicate that participants were satisfied with a particular undergraduate course experience, rather than indicating an effect potentially caused by pseudoneglect.

In contrast to Nicholls et al. (2006), this experiment compared the response categories that received significantly different response means between scale versions as the initial measure of directional bias.

Procedure

To begin, participants were given one version of the NSS. Participants assigned to an odd participant number were given the original version of the NSS first, and participants with an even participant number were presented with the altered version of the NSS first. This method was meant to counterbalance any biases that may have resulted from each participant completing the NSS versions in the same order. The experimenter explained to each participant that their task was to complete the NSS by applying their experiences of Introductory Psychology to the response of each question. Upon completion, participants were asked to submit their survey, at which point they would receive the remaining version of the NSS. The instructions to complete the second version were identical to those for the first and noted that the order of response categories had been reversed. Although participants were aware that the study was interested in perceptual asymmetries, discussion of literature on this topic (including pseudoneglect) was reserved until debriefing.

Participants were thanked and debriefed upon completion of the study.

Results

Presence of Directional Biases

A one-way repeated measures ANOVA revealed that overall satisfaction (i.e., total favourable response score) was not significantly different between scale versions, $F(1, 20) = .638$, $p = .434$. Furthermore, a Chi-square analysis testing for the association between scale direction (original or reversed) and response type (favorable [i.e., "Definitely Agree" and "Moderately Agree"] or unfavorable [i.e., "Definitely Disagree" and "Moderately Disagree"]) did not produce significant results, $X^2(1) = 2.105$, $p = .147$.

Figure 1 shows the pattern obtained when the data were broken down by response category. A paired-samples t-test compared the mean number of responses in each response category between the two scale versions. The results revealed a significant difference between the mean "Neutral" responses of the reversed NSS ($M = 6.3$, $SD = 2.25$) and the original NSS ($M = 4.85$, $SD = 2.43$); $t(19) = 5.25$, $p = <.001$, $d = 1.19$, with the original producing more responses.

A significant difference was also found between the mean "Moderately Disagree" responses of the reversed NSS ($M = 1.3$, $SD = 1.49$) and the original NSS ($M = 2.5$, $SD = 3.53$); $t(19) = -2.14$, $p = .045$, $d = 0.76$, with the reversed NSS producing more responses.

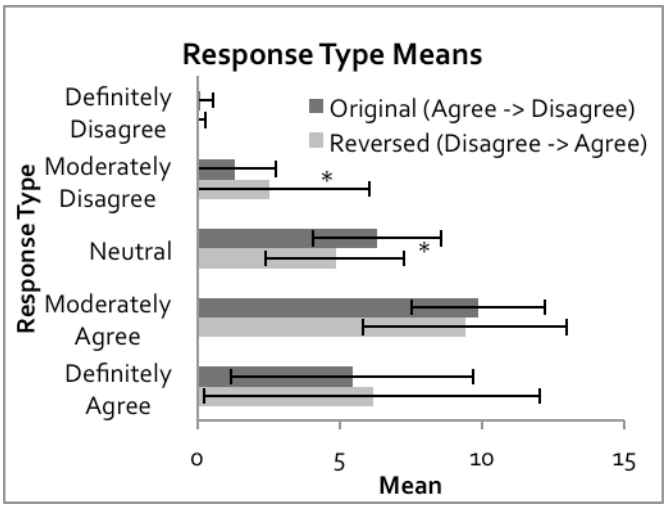

Figure 1: A comparison of mean response types between scale versions. A leftward bias is evident in both the original and reversed scales, indicated by the "Moderately Disagree" and "Neutral" response categories. *Note*: Means that significantly differ by scale type are denoted by an asterisk (*), $p < 0.05$

To analyze the responses that changed between scale types, a one-sample *t*-test was performed to examine the significance of the *change score* for each participant. The change score for each participant was calculated by subtracting the score on the reversed scale from the score on the original scale for each matched question, and then summing the values for all 23 questions. Although the results did indicate a small overall leftward bias in the direction of changed answers, this test was not significant, $t(19) = -.203$, $p = .841$

Discussion

The present study was heavily based on the research of Nicholls et al. (2006). Accordingly, it examined the possibility that pseudoneglect—a perceptual asymmetry bias—effects responses to Likert-scales. These effects were investigated by manipulating Likert-scale direction on the NSS and analyzing participant responses.

"Neutral" and "Moderately Disagree" were the only response categories that differed significantly between scale types, indicating that participants felt less certain about their responses on some questions than others. Focusing on these two response categories, we can see a leftward bias on both the original and reversed scales, where "Moderately Disagree" was selected more frequently when placed to the left of "Neutral" compared to when placed to the right of "Neutral", and "Neutral" is selected more frequently when placed to the left of "Moderately Disagree" compared to when placed to the right of "Moderately Disagree". The two responses may have been influenced by a leftward spatial bias, as more leftward responses (relative to one another) were chosen more frequently.

To further test for a leftward bias, a change score was calculated for each participant. However, analysis of the change score did not reveal a significant leftward bias.

The current study presents evidence of a leftward bias in Likert-scale responses that may be attributed to pseudoneglect, as indicated by the leftward bias reported for two of the response categories. However, a significant leftward bias was not found in the remaining Likert-scale responses or the change score. There was no association between scale version and response type (i.e., satisfied or unsatisfied). As such, the hypothesis that pseudoneglect would affect responses to Likert-scales was not fully supported. These results conflict with those of Nicholls et al. (2006), who found a higher rate of satisfaction in responses to a Likert scale with favorable answers located on the left of mid-point than on one with favorable answers located on the right.

The results of the present study do not necessarily indicate that participants' responses were unaffected by pseudoneglect. Other variables, such as strong personal opinions, may be able to overcome the modest effect that pseudoneglect produces, which could explain how the slight leftward bias indicated in the change score did not reach significance. The two-streams hypothesis of neural processing may explain the role of personal opinions in the

current study. The two-streams hypothesis considers attention to govern both stimuli and higher-order cognitive processes (Goodale & Milner, 1992). Both modes of processing are distinct from, but also interrelated with, each other. When examining visual processing, Toates (2006) found that ventral stream processing (associated with conscious awareness and higher-order control) took priority over dorsal stream processing (associated with stimulus-driven control). In light of this finding, the conscious opinions of participants about their Introductory Psychology class (higher-order processing) could have taken priority over effects of pseudoneglect (stimulus-driven processing).

Potential design issues in Likert-type questionnaires could explain why a consistent leftward bias was not found in the current study. Specifically, scale order and method of data analysis are two issues surrounding Likert-scales. Four separate forms of Likert-scales were analyzed by Hartley and Betts (2010). Each participant rated a structured abstract using one of four possible Likert-scales. The four Likert-scales differed in (a) presenting a positive verbal description (e.g. "Strongly Agree") first in comparison to a negative verbal description (e.g., "Strongly Disagree"), and (b) the order in which the scale numbers were presented. Scales beginning with a positive verbal description produced the highest mean scores. The researchers concluded that the position of the positive label had significant influence on the findings. The researchers subsequently found matching results in a similar study involving children (Betts & Hartley, 2012). Thus, counterbalancing scale order is crucial when administering Likert-type questionnaires.

Choosing a proper method to analyze Likert-scale data is important, as Likert-scales present participants with a limited number of relatively unequal units of measurement. For example, the current study asked participants to choose between "Definitely Agree" and "Moderately Agree", which may be different than choosing between "Moderately Agree" and "Neutral" (Hodge & Gillespie, 2003; Jamieson, 2004). Hodge and Gillespie (2003) stress caution over transforming ordinal-level Likert-scale data to interval- or ratio-level data for analysis.

The present study's experimental procedure may have reduced internal validity. The NSS asks questions about an undergraduate course—in this case, Introductory Psychology. Although all participants took Introductory Psychology, many had taken it over two years ago which would make it difficult to recall their experience.

Future studies could present participants with questions that do not require strong opinions, as the ambivalence in answering may allow for an effect caused by pseudoneglect to have a stronger influence on participant response. On the other hand, using questions that elicit strong opinions could create a more convincing demonstration if extreme responses were changed by experimental manipulation (e.g., position of a positive response). Future studies could also include a group of right-to-left readers in their sample to explore the role of visual scanning preference. Lastly, future studies may want to consider a topic besides "Introductory Psychology", as numerous instructors will likely have taught any given sample, which would introduce variation among participant experience.

The present study cannot lend full support to the theory that perceptual asymmetry biases affect responses to Likert-scales because only a portion of the analyses could provide supportive evidence. Since this topic has received little research, future studies are needed to make a persuasive argument for either side. The possibility remains that responses were affected by pseudoneglect, but masked by conscious cognitive processing (Toates, 2006); further research is necessary to investigate this possibility. Beyond Likert-scales, understanding perceptual asymmetry biases is important because they can help to map out specialized areas of the brain and its sensory pathways (Livingstone & Hubel, 1988). Additionally, they can lend insight to everyday tasks that rely on accurate visual perception (i.e., driving). Perhaps the most significant point that this study can offer is to exercise caution when incorporating Likert-type questionnaires into research. Additional measurement tools may be necessary given the questionable validity, reliability, and biasing factors inherent to Likert-type questionnaires.

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