Navigating Anchor Relevance Skillfully: Expertise Reduces Susceptibility to Anchoring Effects

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Abstract

50 years ago Tversky and Kahneman (1974) described anchoring as the phenomenon whereby an irrelevant numerical value influences a subsequent numerical judgment. Although expertise strongly influences the accuracy of judgments, its role in anchoring is still unclear with findings of reduced, similar, and stronger anchoring in experts compared to novices. Moreover, three prominent theories of anchoring, i.e., the Insufficient Adjustment Model, the Selective Accessibility Model, and the Scale Distortion Theory, make different predictions regarding the influence of expertise on anchoring. To address this inconsistency and to test these theories of anchoring against each other, we manipulate individuals' expertise prior to a perceptual estimation task. Additionally, we manipulate anchor relevance and anchor extremity. In two preregistered experiments, we find that experts do indeed show less anchoring compared to novices, and that more extreme anchors lead to stronger anchoring effects. However, we do not find an effect of anchor relevance in either experiment. These results add to the growing body of literature showing that expertise reduces anchoring effects. Morevoer, although no anchoring theory is clearly supported in the experiments, the results are mostly consistent with the Insufficient Adjustment Model assuming ranges of plausible values and the Scale Distortion Theory. Our findings highlight the importance of expertise in judgments in general and anchoring in particular. Thus, theories of anchoring should take expertise into account as a strong inhibitor of anchoring effects.

Keywords: expertise, relevance, anchoring, accuracy, heuristics

Word count: 6512

Navigating Anchor Relevance Skillfully: Expertise Reduces Susceptibility to Anchoring Effects

Anchoring was first described 50 years ago by Tversky and Kahneman (1974). It describes the phenomenon that an unrelated numerical value influences a subsequent numerical judgment. Since then, anchoring has been extensively studied in various contexts, e.g., in legal decision making or wisdom of crowds (Bystranowski et al., 2021; Honda et al., 2024), and has been applied in different tasks concerning, e.g., real-estate markets, legal sentences, or COVID infections (Englich & Soder, 2009; Frech et al., 2019; Honda et al., 2024). The anchoring effect has implications for various applied settings, such as negotiating prices and salaries, or estimating the number of future customers and product sales, and is a highly robust phenomenon, as confirmed by several meta-analyses and literature reviews (Bystranowski et al., 2021; Furnham & Boo, 2011; Guthrie & Orr, 2006; Röseler & Schütz, 2022; Schley, 2023).

Although extensively researched, the role of expertise in anchoring is not yet clear. There is considerable evidence showing that experts do exhibit anchoring to some degree (Mussweiler et al., 2000, Study 1; Englich & Soder, 2009; Smith et al., 2013; Wilson et al., 1996). However, it is unclear whether experts show higher, similar or lower levels of anchoring compared to novices (Englich et al., 2006; Englich & Soder, 2009; Northcraft & Neale, 1987; Smith et al., 2013; Smith & Windschitl, 2015; Wilson et al., 1996). Moreover, most of these findings are based on measured knowledge or the definition of expertise as professional experience. Thus, the results of these studies provide mostly only correlational evidence. Even meta-analyses and literature reviews come to different conclusions about the effect of expertise on anchoring ranging from weaker effects over similar effects to inconclusive effects for expertise on anchoring (Bystranowski et al., 2021; Furnham & Boo, 2011; Guthrie & Orr, 2006; Röseler & Schütz, 2022; Schley, 2023). Thus, further research is needed to clarify this effect, ideally using a task that does not include knowledge as an indicator of expertise, but instead implements an experimental manipulation of expertise.

Despite half a century of research on anchoring, there is still no unifying theory of anchoring. Several different theories have been proposed, the most prominent being the Insufficient Adjustment Model (IAM, Tversky & Kahneman, 1974), which has been extended to include a range of plausible values (IAM-PL, Epley & Gilovich, 2001), the Selective Accessibility Model (SAM, Mussweiler & Strack, 1999a, 1999b), and the Scale Distortion Theory (SDT, Frederick & Mochon, 2012). These theories and models make similar predictions for anchoring under many circumstances (e.g., anchor extremity or anchor relevance; Röseler & Schütz, 2022), but they make different predictions when it comes to the influences of expertise on anchoring. These predictions range from a reduced anchoring effect for experts, over no difference in anchoring between experts and novices, to larger anchoring effects for experts compared to novices.

In the following, we will first describe the three most prominent theories of anchoring, namely IAM (incl. IAM-PL), SAM, and SDT. We then describe findings on expertise and anchoring and derive predictions for expertise-related anchoring from these theories. In two studies in which we manipulated participants' expertise as a skill rather than knowledge, we show that expertise does indeed reduce anchoring. Lastly, we discuss implications for research on anchoring and expertise in particular, and for theories of anchoring in general.

Theories of anchoring

With the highly active research on anchoring in the past decades also came the development of various theories that attempt to explain the phenomenon (Bahník et al., 2022; Mussweiler et al., 2004). In the following, we describe the three most prominent of these theories and models, namely IAM (incl. IAM-PL), SAM, and SDT.

The Insufficient Adjustment Model

The Insufficient Adjustment Model was proposed by Tversky and Kahneman (1974) to explain the original discovery of the phenomenon. The IAM assumes that individuals use the anchor as a starting point for their judgment and adjust away from the anchor to arrive at the numerical judgment that is being asked. However, the model does not describe how long individuals adjust and when they stop adjusting to provide a final judgment. A possible solution to this issue was proposed by Epley and Gilovich (2001). Thy extended the IAM with a range of plausible judgments that each individual holds for a given judgment task. Individuals are supposed to adjust until they reach this range of plausible values. However, even this model extension is insufficient, as recent research suggests that adjustment may not be unidirectional (Röseler et al., 2023).

The Selective Accessibility Model

The Selective Accessibility Model (Mussweiler & Strack, 1999a, 1999b) explains anchoring as a phenomenon of information accessibility. The model posits that anchor-consistent information becomes more accessible than anchor-inconsistent information when an anchor is presented, Consequently, when individuals sample information to provide a numerical judgment, they do so more in favor of the anchor. This results in anchoring because the sampled information, and thus the judgment provided, is biased toward anchor-consistent information. However, the SAM has recently been challenged by findings that failed to replicate the impact of priming on anchoring (Harris et al., 2019).

The Scale Distortion Theory

The Scale Distortion Theory (Frederick & Mochon, 2012) proposes that anchoring occurs because individuals rely on the scale provided by the anchor to make their judgments. Thereby, the numerical value itself does not directly influence judgments, but it leads to a shift in judgments that are considered for the task at hand. This scale distortion is expected to be overridden when a new anchor is presented. However, this critical assumption has recently been challenged by Bahník (2021), who found that anchors caused anchoring effects across trials.

The theoretical accounts described above make many similar predictions and are not easy to disentangle (Röseler & Schütz, 2022). However, there are some variables for which these theories still make different predictions. These include, among others, the influence of expertise and anchor relevance.

Expertise, anchor relevance, and anchor extremity

For numerical judgments in general, expertise is highly influential for the accuracy of the judgments provided (Mayer & Heck, 2023; e.g., Merkle et al., 2020). Beyond mere knowledge tasks, individuals with high expertise can make highly accurate predictions for events that have not yet occurred, thus providing judgments in situations where no correct answer is (yet) known (Da & Huang, 2020; Himmelstein et al., 2021). However, when it comes to the influence of expertise on the anchoring effect, findings are highly contradictory.

It has been shown repeatedly that experts do exhibit anchoring to some degree (e.g., Englich et al., 2006; Englich & Soder, 2009; Mussweiler et al., 2000, Study 1; Smith et al., 2013). However, the extent of anchoring in the light of expertise is unclear. A reduced anchoring effect with higher expertise (Smith et al., 2013; Smith & Windschitl, 2015; Wilson et al., 1996), a somewhat stronger anchoring effect with higher expertise (Englich & Soder, 2009; Northcraft & Neale, 1987) and a similar degree of anchoring across expertise levels have been found (Englich et al., 2006). Even meta-analyses and literature reviews come to different conclusions, indicating similar effects (Bystranowski et al., 2021; Furnham & Boo, 2011), weaker effects (Guthrie & Orr, 2006; Schley, 2023), or are unable to draw a conclusion based on few studies (Röseler & Schütz, 2022).

In addition, the studies that examine the effect of expertise on anchoring may be influenced by other variables. Schley (2023) suspects publication bias in research on anchoring effects. Older studies may also lack sufficient power due to small sample sizes (e.g., Englich & Soder, 2009). Beyond procedural issues, Röseler and Schütz (2022) suggests that moderators such as type of task or type of response scale additionally influence the extent and even direction of the anchoring effect which in turn should also be considered when investigating the relationship between expertise and anchoring. Another limitation of previous studies is that most of these results focus on (professional) experience as expertise or knowledge measured in these studies (e.g., Englich et al., 2006; Englich & Soder, 2009; Northcraft & Neale, 1987). for These studies, however, can only be interpreted correlationally since expertise was not experimentally manipulated. To overcome this issue, Smith and colleagues introduced a manipulation of knowledge before the anchoring task showing that participants who were provided knowledge about the correct answers to the presented tasks or closely related information were less influenced by presented anchors (Smith et al., 2013 Study 4; Smith & Windschitl, 2015). Even though an important contribution in clarifying the relationship between expertise and anchoring, other aspects of expertise, such as skills or abilities, have not yet been examined in the context of anchoring. Moreover, implementing a manipulation of expertise with knowledge poses the risk that participants recollect this information when providing numerical estimates rather than providing a genuine estimate.

Not only are empirical findings on the relationship between expertise and anchoring insufficient and contradictory, but also theories of anchoring make very different predictions in this area. The IAM as proposed by Tversky and Kahneman (1974) does not differentiate between experts and novices in terms of susceptibility to anchoring effects. This is because the IAM is based on the idea that individuals, regardless of their level of expertise, make initial estimates based on the provided anchor and then adjust away from that anchor to arrive at their final judgment. Merely positing that this adjustment process is typically insufficient, the IAM does not specify any moderating factors that might influence the extent of this adjustment. Therefore, according to the IAM, the anchoring effect should be equally prevalent among experts and novices. In contrast, the IAM-PL proposed by Epley and Gilovich (2001) suggests that experts may be less susceptible to anchoring because their range of plausible values is likely to be narrower than that of novices. This is due to their deeper and more specific knowledge base, which allows them to more accurately determine the range of plausible values and thus make more precise adjustments away from the anchor.

The SAM proposed by Mussweiler et al. (2000) posits a different relationship between expertise and anchoring. In the case of experts, their extensive knowledge base means that they have more information that could potentially be consistent with the anchor. Therefore, according to the SAM, experts should be able to activate a greater amount of anchor-consistent information and thus actually show even stronger anchoring than novices. Crucially, this reasoning could lead to counterintuitive expectations for tasks where correct answers can be known. If individuals have very high expertise, they might know the correct answer to the task, or at least provide a very accurate judgment. According to SAM, these individuals should also be the most susceptible to the anchors presented. However, showing a strong anchoring effect (even stronger than novices) when knowing the correct answer to the task is very unlikely. A similar reasoning could be applied to tasks for which no correct answer exists or is known. A real estate agent is less likely to be anchored by an initial offer than a person who is not typically involved in the real estate market. This notion is also supported by research on the wisdom of crowds, which shows highly accurate judgments for both types of tasks, those for which correct answers can be known (Merkle et al., 2020) as well as those for which correct answers cannot yet be known as in prediction tasks (Da & Huang, 2020; Himmelstein et al., 2021).

Finally, the SDT proposed by Frederick and Mochon (2012) suggests that experts are likely to show smaller anchoring effects compared to novices. This is because experts, due to their familiarity and understanding of the subject matter, are expected to have a more accurate perception of the scale on which they are providing their judgments. Therefore, when experts are presented with an anchor, their scales should be less distorted by the anchor, resulting in a smaller anchoring effect than for novices.

Based on these three theoretical accounts, and given our critique of the counterintuitive implications of the SAM, we hypothesize:

> *Hypothesis 1:* Individuals with higher expertise are less influenced by a presented anchor compared to individuals with lower expertise.

When it comes to the relevance of a presented anchor for the task at hand, the theories of anchoring are more consistent in their predictions. As IAM only suggests adjustment away from the presented anchor, there should be no difference between relevant and irrelevant anchors. However, the other three models described above, as well as a substantial body of literature (Röseler & Schütz, 2022; Schley, 2023), suggest that relevant anchors should yield larger anchoring effects—be it due to serving as a plausible value, making it easier to activate consistent information, or providing a more reasonable scale. Given the mitigating role of expertise in anchoring, investigating the effect of anchor relevance also allows us to shed light on scenarios in which susceptibility to anchoring differs. Thus, we expect a main effect of anchor relevance on anchoring:

Hypothesis 2: Relevant anchors lead to larger anchoring effects than irrelevant anchors.

We also include anchors of different extremity in our studies. All of the theories described above, as well as a large body of literature (Röseler & Schütz, 2022), suggest stronger anchoring for more extreme anchors. However, this relationship may be non-linear (Thorsteinson, 2011) as anchor values outside a plausible range may be discarded (Wegener et al., 2001), leading to a somewhat inconclusive overall relationship (Schley, 2023). As we do not implement severely extreme anchors for which discarding is likely, we expect a main effect of anchor extremeness on anchoring:

Hypothesis 3: More extreme anchors lead to larger anchoring effects than less extreme anchors.

The present studies

In two studies, we examine the influence of expertise, anchor relevance and anchor extremity on anchoring using a paradigm by Mayer et al. (2023) that allows to manipulate individuals' expertise before eliciting numerical judgments. Whereas trials in Experiment 1 more closely follow the procedure of sequential collaboration (Mayer et al., 2023; Mayer & Heck, 2024) providing anchor and estiamtion task simultaneously, trials in Experiment 2 follow a typical anchoring paradigm.

Experiment 1

To test our hypotheses, we use a paradigm that allows manipulating expertise. To this end, we apply a random-dots estimation task using material and follow procedures from Mayer et al. (2023). All hypotheses, conditions, and the data analysis were preregistered at https://aspredicted.org/GZQ_48M.

Methods

Participants

We collected data from 352 participants via a German panel provider. We excluded 40 participants according to our preregistered exclusion criteria, as 20 of them provided more than 20% extreme answers deviating more than 150% from correct answer, and another 20 of the remaining participants provided the same answer for more than 20% of items. The final sample consists of 312 participants of which 43.91% were female and 56.09% were male, with a mean age of 48.62 ($SD = 15.92$). Our participants had a diverse educational background with 31.09% having a college degree, 19.23% holding a high school diploma, 30.45% having vocational education, and 19.23% having a lower educational attainment.

Material

We used the same material as Mayer et al. (2023) presenting 35 images with 600×600 pixels depicting 100 to 599 dots for a random-dot estimation task (Honda et al., 2022). Of these 35 images, 5 images were used for practice trials, 5 images were used for a manipulation check, and the remaining 25 images were presented for the anchoring task. An additional 10 images served as motivational items in the anchoring task depicting only between 10 and 60 dots.

Design and Procedure

The experimental design was a 2 (expertise condition: novice vs. expert) $\times$ 2 (relevance condition: irrelevant vs. relevant) $\times$ 2 (anchor extremity condition: low vs. high) mixed design. Both, expertise and relevance condition were manipulated between participants whereas the anchor was manipulated within participants.

The study took on average 18.34 minutes ($SD = 7.38$) to complete. All participants were randomly assigned to either the expertise condition or the control condition and to either being presented with relevant or irrelevant anchors in the anchoring task. In the expertise condition, participants learned the technique of raster scanning to provide more accurate estimates of the number of presented dots. They were instructed to mentally lay a 3×3 raster over the presented image, select a resulting raster element containing a representative number of dots, count these dots, and multiply the result by nine. In the novice condition, participants read an essay about the importance of accurate estimates. After the expertise manipulation, participants performed a set of practice trials by providing five independent individual estimates. For the expertise condition, a raster was depicted over the presented image, whereas novices did not receive a raster. Next, participants completed a set of manipulation check trials in which they provided another five independent individual estimates that were used to check if experts indeed provided more accurate dot estimates than novices. For this task, no raster was presented in either condition.

Before the anchoring task started, participants were introduced to the relevance manipulation. They were told that before providing their estimates for the following items, they would be presented to either the estimate of a previous participant (relevant anchor, e.g., "A previous participant estimated for the following task: 38 dots.") or to a random fact which included the same number (irrelevant anchor, e.g., "A cat has 38 chromosomes."). The anchor was presented for at least 2 seconds before participants could continue to the estimation task. Anchors were selected such that they deviated either -70%, - 35%, 35%, or 70% from the correct answer. Next, participants were presented with the image depicting the dots and were asked to provide an estimate for which they had one minute at maximum before they were automatically directed to the next anchor and subsequent task. After completing all 35 (task and motivational) trials participants provided demographic information, were thanked, and debriefed that the presented judgments were preselected and manipulated for the experiment.

The procedure applied in anchoring trials for relevant anchors more closely resembled sequential collaboration in which the task and the judgment of a previous participants are presented simultaneously (Mayer et al., 2023; Mayer & Heck, 2024). Moreover, no comparative question was added, which is typical for many anchoring designs, thereby using a paradigm often referred to as basic anchoring (Schley, 2023).

As we presented images to our participants, the study was only accessible via PC, and participation was only possible for those accepting the terms and conditions of the study. The study was stopped already during participation for participants who, despite the instruction and repeated warnings, changed the browser window to other browser windows or programs more than five times.

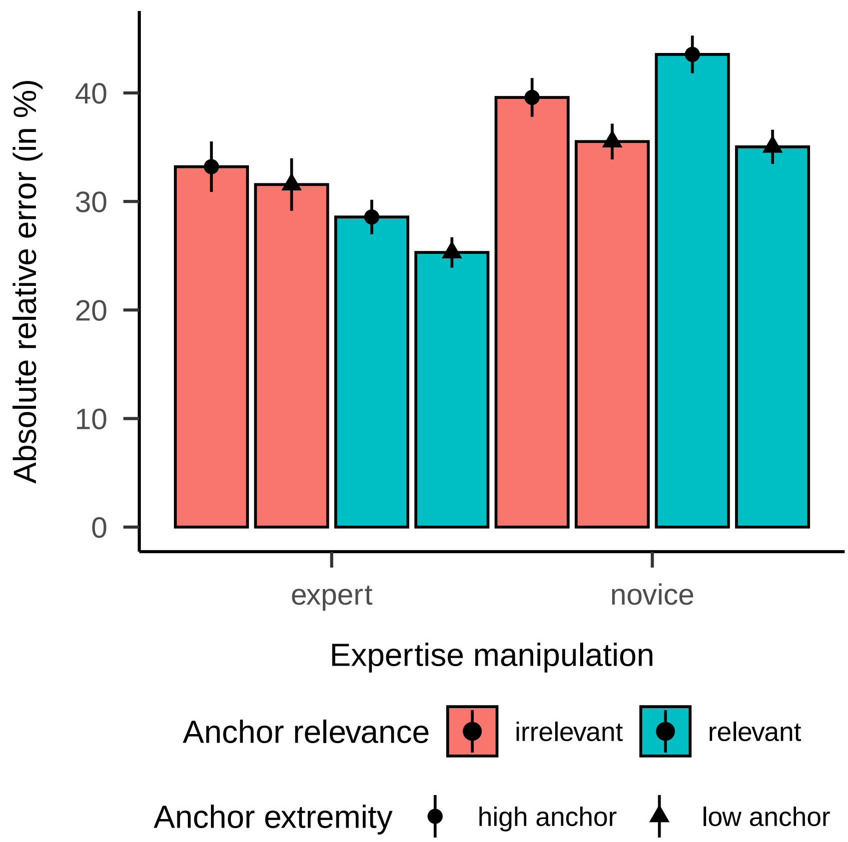
Results

We collected data of 9360 trials in the manipulation check and anchoring task trials. Except for trials that were timed out after 60 seconds, 9325 trials were used for the analysis. We computed the relative error as $judgment/correct * 100 - 100$ resulting in the percentage deviation from the correct answer. Thus, this variable is on the same scale as the manipulation of anchor extremity. Moreover, as preregistered, we computed the absolute relative error from the correct answers, which reflects the relative accuracy of the provided estimates.

First, we performed a manipulation check to ensure that our expertise manipulation was successful and experts provide more accurate dot estimates than novices. A linear mixed model with absolute relative error as dependent variable and expertise condition as independent variable was estimated including participant- and item-wise random intercepts. For this purpose, expertise condition was sum-coded with 0.5 for experts and -0.5 for novices. In line with the imposed manipulation, the model revealed a significant negative effect of expertise condition ($\hat{\beta} = -22.02$, 95% CI $[-29.04, -15.00]$, $t(311.09) = -6.15$, $p < .001$). Thus, the manipulation was successful and participants in the expert condition were indeed able to provide more accurate estimates in the 5 manipulation check trails than participants in the novice condition.

Figure 1

Effects of expertise, anchor relevance, and anchor extremity on absolute relative errors of estimates for Experiment 1.



Note. Points display empirical means with error bars showing the corresponding 95% between-subjects confidence intervals.

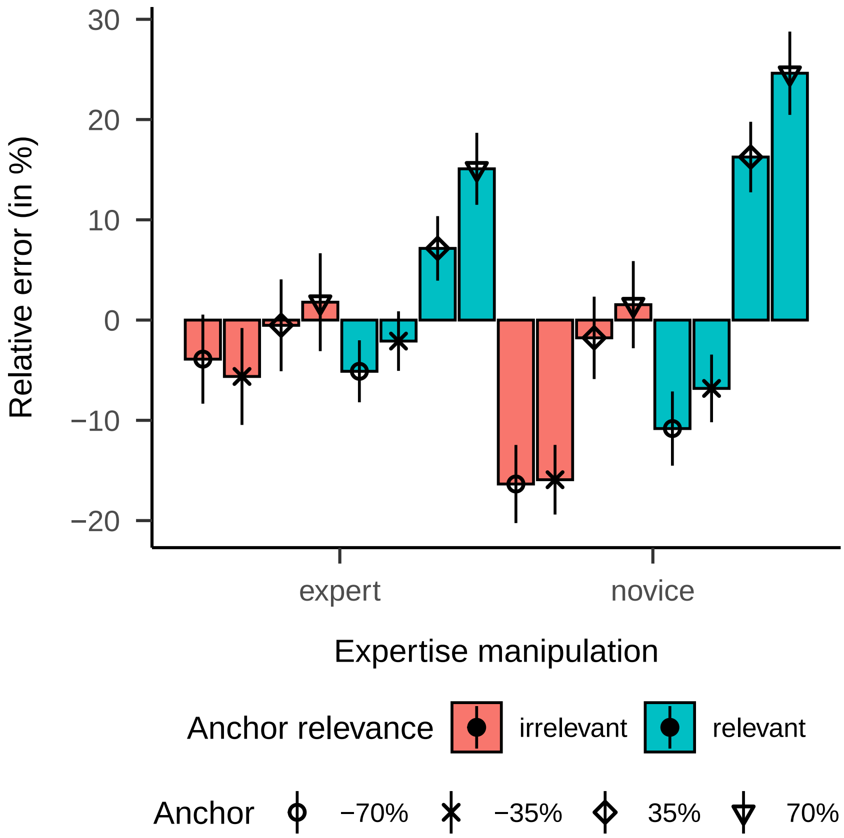
As preregistered, we computed a linear mixed model with absolute relative error in the anchoring task trials as dependent variable and expertise condition (coded as -0.5 for novices and 0.5 for experts), relevance condition (coded as -0.5 for irrelevant and 0.5 for relevant anchors), and anchor extremity (coded as -0.5 for low anchors deviating +/- 35% from the correct answer and 0.5 for high anchors deviating +/- 70% from the correct answer) as sum-coded independent variables. The model accounts for the nested data structure by including random intercepts for items and participants and a random slope of participants for the anchor extremity condition (Bates et al., 2015). In line with Hypothesis 1, the model showed a significant negative effect of expertise ($\hat{\beta} = -7.72$, 95% CI $[-11.16, -4.28]$, $t(310.44) = -4.40$, $p < .001$), indicating more accurate estimates provided by experts compared to novices. Moreover, a significant positive effect of anchor extremity emerged ($\hat{\beta} = 4.88$, 95% CI $[2.80, 6.97]$, $t(23.79) = 4.60$, $p < .001$), indicating more error and thus less accurate estimates for more inaccurate anchors, as expected in Hypothesis 3. However, in contrast to Hypothesis 2, we did not find an effect of anchor relevance on the absolute relative error ($\hat{\beta} = -2.39$, 95% CI $[-5.79, 1.02]$, $t(310.45) = -1.37$, $p = .171$). Empirical means and corresponding 95% confidence intervals are presented in Figure 1.

Moreover, we computed an exploratory linear mixed model to explore the effect of an interaction of expertise and anchor relevance in addition to the three main effects. The main effects remained similar with a significant negative effect of expertise ($\hat{\beta} = -8.83$, 95% CI $[-12.35, -5.30]$, $t(307.99) = -4.91$, $p < .001$), a significant positive effect of anchor extremity ($\hat{\beta} = 4.88$, 95% CI $[2.82, 6.95]$, $t(23.00) = 4.63$, $p < .001$), and no significant effect of anchor relevance ($\hat{\beta} = -1.79$, 95% CI $[-5.32, 1.73]$, $t(307.99) = -1.00$, $p = .319$). In addition, the model also revealed a significant negative interaction between expertise and anchor relevance ($\hat{\beta} = -7.23$, 95% CI $[-14.28, -0.18]$, $t(307.99) = -2.01$, $p = .045$), indicating less error and thus more accurate estimates for experts encountering relevant compared to irrelevant anchors and the opposite pattern for novices.

As our results showed an interaction between expertise and anchor relevance but not the expected main effect, we further explored the role of anchor relevance. Presumably, absolute relative error was not an appropriate dependent variable because taking absolute relative error masked when judgments were provided around the correct answer. An effect of anchor relevance may be better observed for a variable more closely matching the manipulation of the presented anchor. Thus, we conducted an exploratory analysis using relative error as a dependent variable to match the scale of the presented anchors.

Figure 2

Effects of expertise, anchor relevance, and anchor extremity on relative errors of estimates for Experiment 1.



Note. Points display empirical means with error bars showing the corresponding 95% between-subjects confidence intervals.

Figure 2 displays the relative errors for expertise, anchor relevance, and all four anchors presented in the study. As the presented anchors as well as the dependent variable are now on the same scale (namely, relative error), the effect of anchors on the provided estimates became clearer. Descriptively, the results indicated stronger anchoring effects (i.e., larger errors in the direction of the presented anchors) both for novices compared to experts and for relevant compared to irrelevant anchors. To test these visual impressions, we computed a linear mixed model with relative error as dependent variable and expertise, anchor relevance and anchor as independent variables. Expertise and anchor relevance were again sum-coded, whereas the different deviations of the anchor from the correct answer were implemented as a continuous, numeric predictor. Again, we added random intercepts of participants and items and a random slope of participants for the anchor extremity condition. As anchors were implemented with positive and negative deviation to the correct judgment to both increase as well as decrease participants' estimates, we did not expect to find main effects of expertise or relevance in this model. Instead, we examined the interactions of both expertise and anchor relevance with anchor extremity condition. Thus, if experts were less influenced by anchors than novices, the linear slope of anchor should be less steep for experts than for novices, indicating an interaction of expertise and anchor extremity. The same reasoning holds for anchor relevance with steeper slopes for relevant than for irrelevant anchors.

As expected, we did not find a main significant effect of expertise on relative error ($\hat{\beta} = 1.53$, 95% CI $[-4.80, 7.86]$, $t(309.75) = 0.47$, $p = .637$), indicating that both experts and novices showed the same overall level of error in their estimates, which was close to zero as indicated by the intercept of the model ($\hat{\beta} = -0.10$, 95% CI $[-4.57, 4.37]$, $t(82.79) = -0.04$, $p = .966$), and are not differently biased in any way. Nonetheless, the model showed a significant positive effect of anchor relevance on relative error ($\hat{\beta} = 10.27$, 95% CI $[3.99, 16.54]$, $t(309.75) = 3.21$, $p = .001$). In line with Hypothesis 3, the model revealed a significant positive effect of the presented anchor ($\hat{\beta} = 0.15$, 95% CI $[0.09, 0.21]$, $t(23.08) = 5.13$, $p < .001$), indicating that relative errors are smaller for less extreme anchors, both for anchors negatively deviating from the correct answer and for anchors positively deviating from the correct answer.

Moreover, in line with Hypothesis 1, a significant negative interaction between expertise and the presented anchor emerged ($\hat{\beta} = -0.11$, 95% CI $[-0.14, -0.09]$, $t(7441.31) = -8.20$, $p < .001$), showing that the slope for the linear effect of the presented anchor was less steep for experts compared to novices. Similarly, we found a significant positive interaction between anchor relevance and the presented anchor ($\hat{\beta} = 0.11$, 95% CI $[0.09, 0.14]$, $t(7441.26) = 8.36$, $p < .001$), indicating that the presented anchors had a stronger effect on subsequent estimates if they were relevant rather than irrelevant. These interaction patterns are also separately displayed for each interaction in Figure A1.

Discussion

Overall, these results shed further light into the relationship between expertise, anchor relevance and the anchoring effect. We found that experts who were trained to provide more accurate estimates in this experiment are less prone to anchoring than novices. Moreover, an additional exploratory analysis revealed both a mitigating effect of expertise as well as an aggravating effect of anchor relevance on the anchoring effect.

However, the design we used here was not a typical anchoring design, as no comparative question was implemented (so-called basic anchoring, Schley, 2023). Meta-analyses show that basic anchoring overall shows smaller anchoring effects (Röseler & Schütz, 2022; Schley, 2023). Thus, the effects reported in this first experiment may only hold for basic anchoring or a design more closely resembling sequential collaboration (Mayer & Heck, 2024).

Experiment 2

In this experiment, we examine the effects of expertise, anchor relevance and anchor extremity in an anchoring design incorporating a comparative question. Entering a comparative question most likely increases the effect of anchoring (Röseler & Schütz, 2022). In order to make both experiments as comparable as possible, the same material was used and the procedure was only modified to insert the comparative question. Hypotheses, conditions, and data analysis were preregistered at https://aspredicted.org/ZLS_V9X.

Methods

Participants

We collected data from 275 participants. In line with our preregistration, we excluded 20 participants, as 12 of them provided more than 20% extreme answers deviating more than 150% from correct answer, and another 8 of the remaining participants provided the same answer for more than 20% of items, resulting in a final sample of 255. 40.39% of participants were female and 59.61% male, with a mean age of 48.43 (SD = 15.10). 3.53% of participants had a college degree, 40% a high school diploma, 14.12% vocational education, and 42.36% a lower educational attainment.

Material, Design and Procedure

We used the same material and design as in Experiment 1. The overall procedure remained the same with an expertise manipulation, 5 practice trials, 5 manipulation check trials, and 25 anchoring task trials before providing demographic information and being debriefed. However, we modified the anchoring task so that it now included a comparative question to more closely resemble the typical procedure in anchoring research. Again, participants were first introduced to the anchor for at least 2 seconds before they could continue to the comparative question. They were presented with the image for which they should provide an estimate of the number of dots and the comparative question whether this image had more or less dots than the value presented in the anchoring statement. As participants may not remember the exact value presented as an anchor, the value was again presented along with the comparative question resembling a classical anchoring paradigm. The time limit to answer the comparative question was 15 seconds in order to prevent participants from already making an estimate, e.g., applying the raster scanning technique in the expert condition. After answering the comparative question, participants continued with the estimation task for which they had 60 seconds to complete before the next trial started, like in the previous experiment. The second experiment took on average 20.74 minutes (SD = 7.29) to complete.

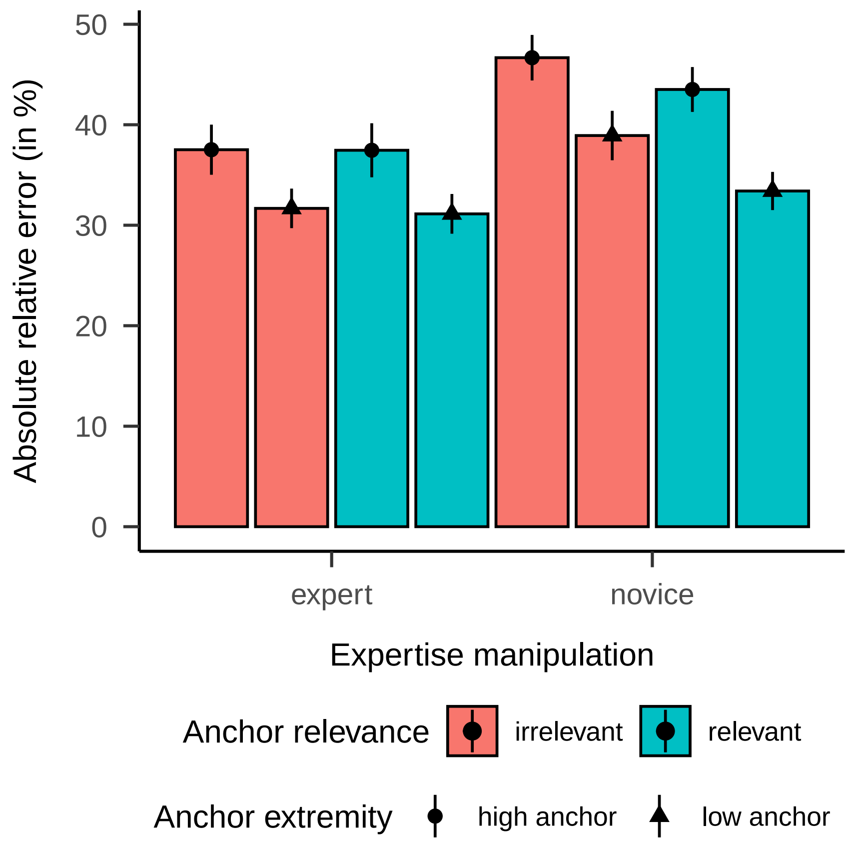
Results

We collected data of 7650 trials in the manipulation check and anchoring task trials. In this study, all trials remained for the analysis as there were no trials to be excluded due to being timed out after 60 seconds. As we conducted the same analyses as for Experiment 1, we again computed relative error and absolute relative error as dependent variables.

Before analyzing the data for our hypotheses, we conducted a manipulation check to ensure that expertise was manipulated as expected, so that participants who were introduced to the raster scanning technique indeed provided more accurate judgments. A linear mixed model revealed a significant negative effect of expertise on absolute relative error ($\hat{\beta} = -23.80$, 95% CI $[-31.23, -16.38]$, $t(253.01) = -6.29$, $p < .001$), indicating that experts indeed provided more accurate judgments in the manipulation check trials than novices. Thus, the manipulation of expertise was successful.

Figure 3

Effects of expertise, anchor relevance, and anchor extremity on absolute relative errors of estimates for Experiment 2.



Note. Points display empirical means with error bars showing the corresponding 95% between-subjects confidence intervals.

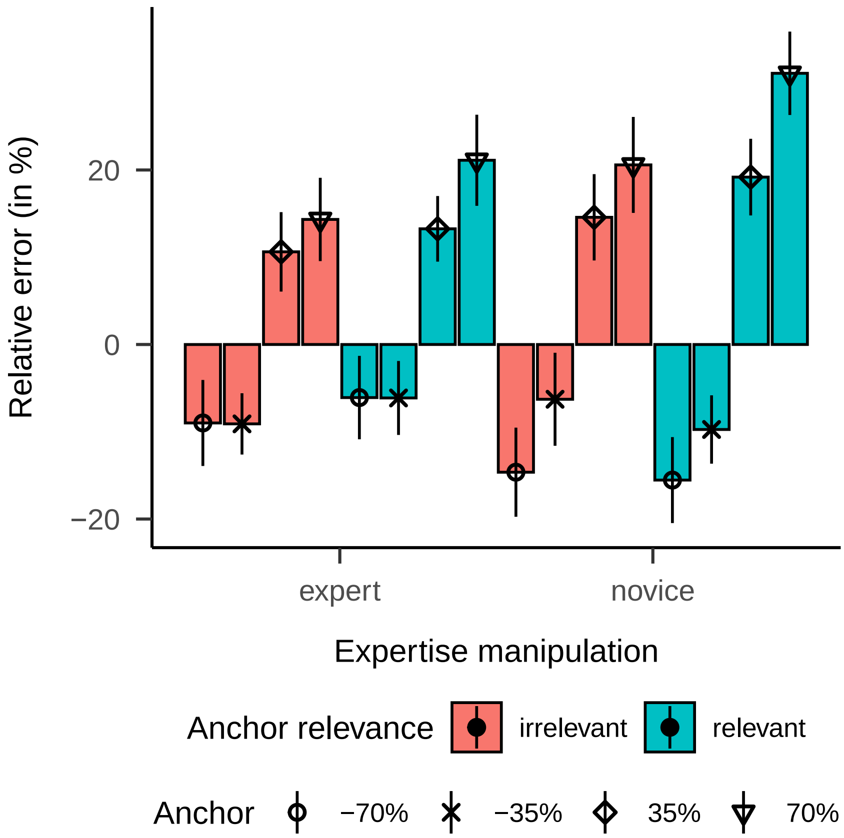
Figure 3 displays the results of Experiment 2 for absolute relative errors. Again, experts showed less anchoring, as indicated by more accurate judgments than those provided by novices. Moreover, extreme anchors seem to lead to more inaccurate judgments, whereas anchor relevance does not seem to influence judgment accuracy. These visual impressions were confirmed by a linear mixed model with expertise, anchor relevance and anchor extremity (all sum-coded) as independent variables and absolute relative error as dependent variable. In line with Hypothesis 1, we found a significant negative effect of expertise ($\hat{\beta} = -5.30$, 95% CI $[-9.14, -1.47]$, $t(254.30) = -2.71$, $p = .007$), indicating that experts showed less absolute relative error than novices. However, there was no evidence for Hypothesis 2, as the effect of anchor relevance on absolute relative error was not significant ($\hat{\beta} = -2.69$, 95% CI $[-6.52, 1.15]$, $t(254.32) = -1.37$, $p = .171$). The model provided evidence for Hypothesis 3 by revealing a significant positive effect of anchor extremity ($\hat{\beta} = 7.37$, 95% CI $[4.53, 10.20]$, $t(24.00) = 5.09$, $p < .001$), indicating stronger anchoring effects for more extreme anchors.

We again computed an exploratory model including an interaction of expertise and anchor relevance in addition to the main effects already tested. Effects remained essentially the same with a significant negative effect of expertise ($\hat{\beta} = -5.24$, 95% CI $[-9.08, -1.41]$, $t(253.44) = -2.68$, $p = .008$), no main effect of anchor relevance ($\hat{\beta} = -2.83$, 95% CI $[-6.67, 1.01]$, $t(253.44) = -1.45$, $p = .149$), and a significant positive effect of anchor extremity ($\hat{\beta} = 7.37$, 95% CI $[4.53, 10.20]$, $t(24.00) = 5.09$, $p < .001$). In contrast to Experiment 1, no interaction effect of expertise and anchor relevance on absolute relative judgments emerged ($\hat{\beta} = 4.64$, 95% CI $[-3.04, 12.31]$, $t(253.44) = 1.18$, $p = .237$).

Again, we also performed an exploratory analysis to further explore the relationship of expertise, anchor relevance, and presented anchor on the relative error of provided judgments to shed further light into the anchoring effect. The linear mixed model showed no main effect of expertise ($\hat{\beta} = -2.29$, 95% CI $[-9.48, 4.90]$, $t(254.32) = -0.62$, $p = .533$) or anchor relevance ($\hat{\beta} = 1.72$, 95% CI $[-5.46, 8.89]$,

Figure 4

Effects of expertise, anchor relevance, and anchor extremity on relative errors of estimates for Experiment 2.



Note. Points display empirical means with error bars showing the corresponding 95% between-subjects confidence intervals.

$t(254.33) = 0.47$, $p = .640$), indicating no general tendency in over- or underestimation depending on these conditions. As expected in Hypothesis 3, we found a significant positive linear effect of the presented anchor ($\hat{\beta} = 0.25$, 95% CI $[0.18, 0.32]$, $t(23.01) = 7.42$, $p < .001$), showing that more extreme anchors lead to larger relative errors in participants' judgments. Moreover, in line with Hypothesis 1, the model revealed a significant negative interaction between expertise and the presented anchor ($\hat{\beta} = -0.11$, 95% CI $[-0.14, -0.07]$, $t(6083.66) = -6.35$, $p < .001$), indicating that experts show a less pronounced reaction to anchors than novices. Lastly, a significant positive interaction of anchor relevance and the presented anchor emerged ($\hat{\beta} = 0.05$, 95% CI $[0.02, 0.08]$, $t(6083.66) = 3.13$, $p = .002$), indicating that relevant anchors produced stronger anchoring effects than irrelevant anchors. Both interaction effects are also separately displayed in Figure 4.

Overall, the presented anchors lead to corresponding relative errors in subsequent judgments. Thereby, judgments of experts again showed less relative errors than those of novices, and relevant anchors showed more relative errors than irrelevant anchors. Moreover, experts again seemed to somewhat discard the extreme anchor of -70% whereas novices did not.

Discussion

Even after implementing a comparative question into the experimental procedure, results were similar to Experiment 1 both for the confirmatory and exploratory analyses. Nonetheless, the anchoring effects appear to be much stronger in this experiment, as expected based on corresponding evidence from meta-analyses (Röseler & Schütz, 2022; Schley, 2023). Whereas experts in Experiment 1 were almost unaffected by irrelevant anchors, this was not the case in Experiment 2. Thus, the comparative question seems to have a strong impact on the perceived importance of the presented anchors.

General Discussion

In this research, we tackled inconclusive results about the role of expertise in anchoring. To shed light on this relationship, we introduced a manipulation of expertise as a skill. In two experiments, we applied a random-dots estimation task for which half of the participants were trained in raster scanning to help them with providing more accurate judgments. The results of these experiments demonstrate that experts provide more accurate judgments and are less influenced by anchors than novices. Moreover, extreme anchors lead to larger anchoring effects than less extreme anchors. An exploratory analysis also revealed that relevant anchors lead to larger anchoring effects than irrelevant anchors. These results add to the literature on expertise and anchoring, providing further evidence for a mitigating effect of expertise as well as an aggravating effect of relevance on anchoring.

Our results are in line with previous findings (Smith et al., 2013; Smith & Windschitl, 2015; Wilson et al., 1996) as well as meta-analytic findings (Guthrie & Orr, 2006; Schley, 2023) that provide evidence for a mitigating effect of expertise on anchoring. However, there are also considerable differences between the experiments reported here and studies showing similar strong anchoring in both experts and novices (Englich et al., 2006; Englich & Soder, 2009). In our studies, estimation tasks had correct answers that participants could potentially provide. In contrast, in tasks like sentencing decisions (Englich & Soder, 2009) or real estate values (Northcraft & Neale, 1987), there are no correct answers, so that experts can merely provide judgments within a more reasonable range than novices. Thus, the extent to which correct answers to the task at hand are available in general or potentially available to participants during the task may play a role for the effect of expertise on anchoring.

Moreover, anchoring seems to be overall stronger, even in experts and for irrelevant anchors, when comparative questions are included (Experiment 2). This may be due to experts not being able to apply their expertise (i.e., raster scanning) before answering the comparative question due to time constraints. The presented anchor value may thereby gain more importance than it may have gained if there was no comparative question. Thus, there may be a mechanism at play that could even result in similar strong anchoring in both experts and novices under conditions hindering experts to apply their expertise to the task such as time pressure.

Although we do not find effects of anchor relevance in the confirmatory analysis, the exploratory analysis shows effects of anchor relevance in line with our hypothesis. This result is also in line with many previous experiments that found larger anchoring effects for relevant anchors (see meta-analysis by Schley, 2023). Presumably, the dependent variable of absolute relative error was not suitable to analyze this hypothesis. As absolute relative errors are computed at the level of an individual, it masks potential over- and underestimation especially for less extreme anchors, thereby erasing the effects of anchor relevance. Thus, absolute relative errors as a measure of overall estimation accuracy fall short in revealing differences in the strength of anchoring for anchor relevance.

As already frequently replicated (Röseler & Schütz, 2022), we found an effect of anchor extremity according to which more extreme anchors led to larger anchoring effects. However, we could also observe, although only descriptively, that extreme negative anchors, which are likely perceived as more extreme than extreme positive anchors due to the response scale being bounded by zero from below, were seemingly discarded mostly by experts and had no more effect on them than a less extreme negative anchor. This is in line with previous findings showing that extreme anchors are discarded at some point (Wegener et al., 2001). This specifically pronounced discarding of extreme negative anchors, however, may be due to the operationalization of deviations as relative distance to the correct answer. Instead, an alternative manipulation of extremity on a logarithmic scale may take better into account that a deviation of -70% from a particular value is perceived as a larger deviation than +70%. Future research should thus operationalize such deviations on a logarithmic scale to presumably produce more balanced deviations for examining the discarding of anchors more accurately.

Our research has also implications for anchoring in real-world settings like negotiations or predictions. For example, if one aims at influencing a recruiter in a job interview to one's own advantage, setting a relevant and more extreme anchor, such as the upper salary boundary of a competitor, may be beneficial. Conversely, if an organization is employing a recruiter, a candidate with profound knowledge and experience who can accurately estimate a realistic salary based on the abilities and skills of the interviewee is best suited for the position. Thus, considering both individual' expertise and anchor characteristics is important to arrive at accurate estimates in real-world settings.

As outlined above, in over five decades of research in this field, several theories of anchoring have been proposed (Bahník et al., 2022). However, there is no unifying theory yet that is able to describe most findings related to anchoring accurately.

Currently, the most prominent candidates for anchoring theories are IAM(Epley & Gilovich, 2001; -PL; Tversky & Kahneman, 1974), SAM (Mussweiler & Strack, 1999a, 1999b), and SDT (Frederick & Mochon, 2012). These theories make different predictions for the role of expertise and anchor relevance in anchoring, which implies that our results are also suitable to test these theories against each other. As we find both a reduction of anchoring effects for experts and irrelevant anchors, our results are mostly in line with IAM-PL and SDT. Nonetheless, both of these theories are currently challenged by other incompatible results (Bahník, 2021; Röseler et al., 2023). Thus, future research should tackle the inconsistencies in both theories and findings to develop a unifying theory of anchoring.

Besides their promising results, the experiments outlined above have some limitations. First, although the design applied allows to manipulate expertise, we only examined the effect in one paradigm. Thus, the generalizability to other tasks and materials is not guaranteed. Second, the effects of anchor relevance on anchoring are only found in the exploratory analyses, as our preregistered dependent variable was presumably not suitable for the analysis. Thus, these results cannot be considered confirmatory, despite being in line with previous findings on anchor relevance. Last, we operationalized anchor relevance as a random fact containing a number (no relevance) compared to the judgment of a previous participant (high relevance). However, the judgment of a previous participant may not (only) serve as an anchor for a subsequent estimate. Similar to advice taking (Bonaccio & Dalal, 2006) or sequential collaboration (Mayer & Heck, 2024), it may (also) be perceived as useful information that helps to answer the question at hand. Thus, presenting a value that can help with solving the task at hand such as the estimate of a previous participant may have an additional informational impact on individuals' estimates above and beyond anchoring.

Conclusion

This work adds to an ongoing debate in the anchoring literature about the mitigating role of expertise and the aggravating influence of anchor relevance on anchoring. In two experiments, we show that expertise that constitutes a manipulated skill mitigates anchoring effects. However, the aggravating effect of relevant anchors on anchoring could only be confirmed in exploratory analyses. These results not only shed light into the effect of expertise and relevance on anchoring, but also allow to test divergent predictions of competing anchoring theories.

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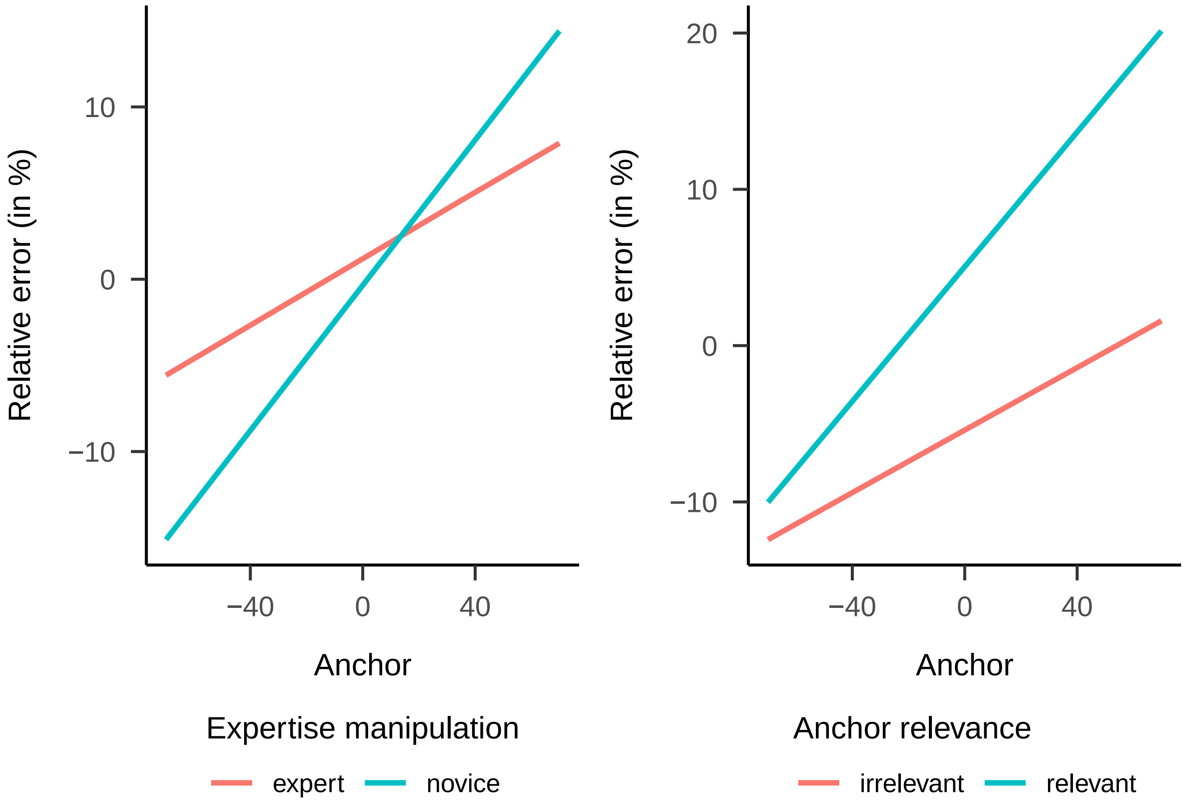
Appendix

Separating effects of expertise and anchor relevance on relative errors

Figure A1

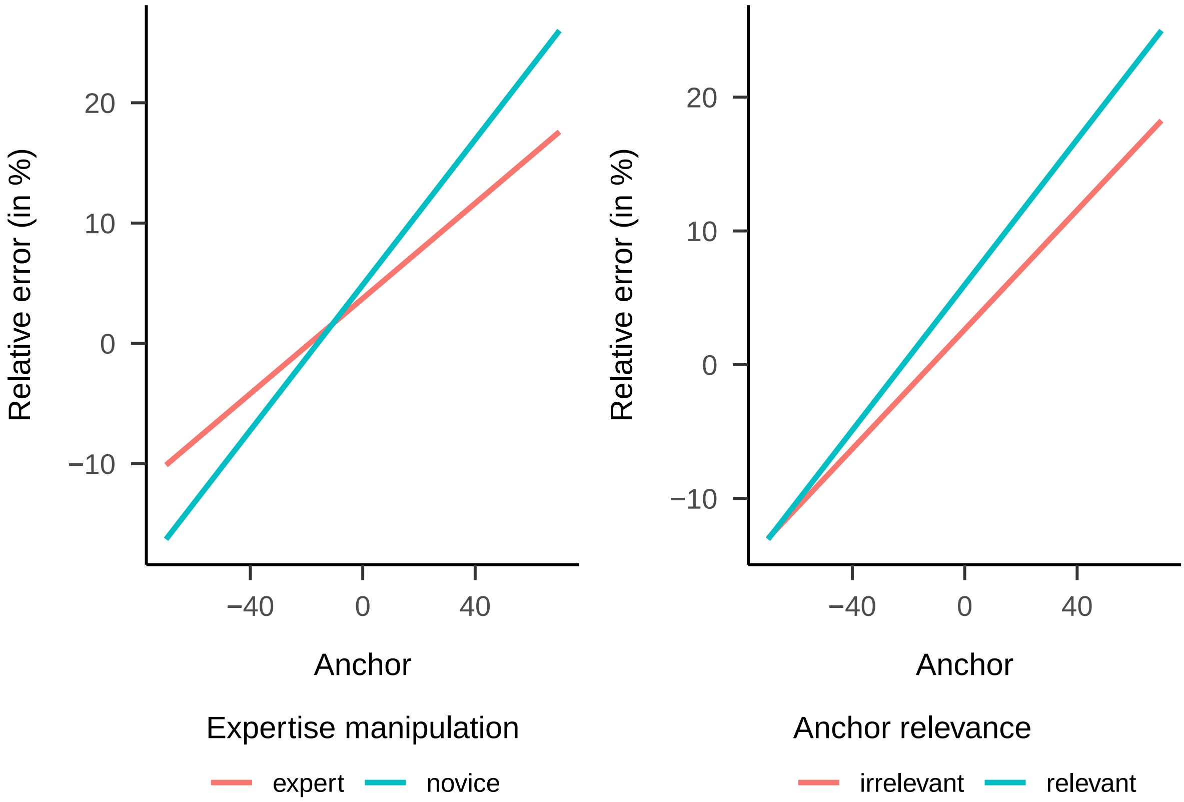
Separated effects of expertise and anchor relevance on relative errors of estimates for Experiment 1.



Note. Lines display slopes based on the linear mixed model with expertise, relevance, and presented anchors as independent variables and relative error as dependent variable.

Figure A2

Separated effects of expertise and anchor relevance on relative errors of estimates for Experiment 2.



Note. Lines display slopes based on the linear mixed model with expertise, relevance, and presented anchors as independent variables and relative error as dependent variable.