Anchoring, Stress and Gender:

An Examination of the Effects of Gender and Perceived Stress Level on the Use of Self-Generated Anchors

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Abstract

Several different explanations have been suggested as the mechanism behind the anchoring heuristic. The first to be proposed was anchoring and adjustment, although since its introduction it has largely fallen out of favour and has been replaced by theories of selective accessibility and attitude change. Despite this, evidence has recently emerged indicating a separate mechanism for self-generated anchors when compared to the classic paradigm of externally provided anchors. In their case it seems that the anchoring and adjustment explanation is applicable, and furthermore that the extent of adjustment could be manipulated in experiments by acutely inducing stress. This paper looked at whether this same pattern could be found due to everyday variations in perceived stress. In addition, as previous research has found women to have greater stress responses and different tendencies in decision making, it was investigated whether perceived stress may mediate a relationship between gender and adjustment, and whether gender has a direct effect on adjustment. Data was gathered via a survey which was distributed using snowball sampling (N = 184) and made using the online software Qualtrics. The PSS-10 was used to measure stress levels, and five estimation questions prompting the use of self-generated anchors were sourced from previous research and used to measure extent of adjustment. None of the proposed relationships between gender, stress, and adjustment were found in the data gathered. Further research is undoubtedly required to conclusively determine whether this was due to an actual absence of effect, or to methodological limitations in the present research.

Keywords: Anchoring, heuristics, self-generated, stress

Anchoring, Stress and Gender: An Examination of the Effects of Gender and Perceived Stress Level on the Use of Self-Generated Anchors

You may imagine that all the decisions taken in large organizations and businesses are fully rational and extensively reasoned. You would be forgiven for thinking that this must be the case since they are able to keep such a complex system of inter-dependent parts running smoothly and consistently making a profit year after year. However, despite what it may seem, everyone takes unconscious shortcuts when making decisions, and that includes everyone at these companies. For example, imagine yourself having been accepted for your ideal job at your dream company. All that is left to do now is negotiate your pay, and it is up to you to make the initial offer as to what you would be satisfied with. Surely your initial suggestion would not make too much of a difference in what they are willing to pay? As you may have guessed by now, this is in fact not the case. Research has consistently shown that the first offer in negotiations generally has a surprisingly large effect on the outcome (Loschelder et al., 2016) (Thorsteinson, 2011). A high initial suggestion tends to result in a higher agreed value, and the opposite is true for low suggestions. In this case, this is the result of people unconsciously taking these values as a reference point (also known as an *anchor point*, but this will be discussed later) for what could be construed as a reasonable value. This is just one example of how these shortcuts, or *heuristics*, can affect decision making in a business environment, but there are many, many more. In order to limit the possibility of negative consequences from their use it is important to better understand how they work and in what situations we tend to rely on them most. This paper aims to do that for a specific type of shortcut which we call *anchoring*, and more specifically, as it is so omnipresent in the workplace, the effect of stress will be examined.

Heuristics

A heuristic is a mental shortcut which allows us to reduce the amount of time and effort spent on making a decision by using previous experience to create rules which are true a large amount of the time (Dale, 2015). For a large proportion of the time the use of heuristics is highly beneficial as it reduces both the amount of time and cognitive effort we spend on choices while the results are generally close enough to the true value to be useful. It should be noted, however, that although heuristics give quick and generally accurate answers, there is always the danger of them producing cognitive biases and errors in our conclusions. An example of this can be seen through the availability heuristic, in which estimations on the likelihood of certain events are made based on the ease upon which examples come to mind. A classic example of when this heuristic can produce misleading conclusions was shown by Tversky and Kahneman (1974) when they asked participants in an experiment whether a randomly chosen word from the dictionary was more likely to be begin with the letter ‘k’, or have the third letter be ‘k’. Even though there are many more words which have ‘k’ as the third letter, it is easier for people to think of examples where words begin with ‘k’, thus those words were estimated to be more likely. Another commonly cited example of the availability heuristic producing misleading conclusions is that people often vastly overestimate the frequency of plane crashes when compared to car crashes, as plane crashes are so highly reported on by the media when they do happen, that these instance spring much more freely to mind.

There is a sufficient body of research indicating that both stress and gender may influence the use of heuristics, therefore this relationship will be examined in the current study. In the context of organisational psychology it is important to investigate this as heuristics will undoubtedly be used in workplace decision making and understanding the processes behind the phenomenon would help reduce the instances in which their use has a negative outcome (through an incorrect decision being made). Stress was considered

important to examine as some level of stress in the workplace is basically considered to be unavoidable, and it is important to more fully understand the possible (positive and negative) effects this could have on the way decisions are made during work. Gender was considered important as previous studies have shown differences in the way males and females tend to make decisions eg. females being more risk-averse (Powell & Ansic, 1997) (Johnson & Powell, 1994), and how they are affected by and experience stress (Bangasser & Wiersielis, 2018). Thus, it was considered a factor that was quite likely to be intertwined in the relationship between stress and the use of heuristics.

Anchoring and Proposed Explanations

Anchoring is a heuristic in which people are overly influenced by reference points (anchors) when making estimations or decisions about unknown values, resulting in their estimate being closer to the anchor value than it would otherwise be. In a classic example by Tversky and Kahneman (1974) participants were first asked whether the percentage of African nations in the United Nations was higher or lower than an arbitrarily given figure. They were then asked to give an absolute estimate of the figure. The results of the experiment clearly showed that the absolute estimates were influenced by the arbitrary figure they were presented beforehand.

The exact mechanisms through which anchoring occurs have been debated since the effect has become well known. The initial study on anchoring performed by Tversky and Kahneman (1974) proposed the method of anchoring and insufficient adjustment. This supposes that when people are presented with an initial value they adjust from that value in the direction they think the actual value lies until they reach a plausible value, usually resulting in an insufficiently adjusted answer as it lies on the outer bounds of what they consider to be plausible (Tversky & Kahneman, 1974).

However, since then other theories have suggested that this theory may not adequately explain anchoring in all situations. For example, Strack and Mussweiler (1997) suggested the selective accessibility model. This proposes that during the comparative task "participants test the possibility that the target possesses the anchor value and try to construct a mental model that includes information that is maximally consistent with the anchor value" and as a result of this "such self-generated information will subsequently be highly accessible and provide a basis for relevant judgments" (Strack & Mussweiler, 1997, p.444). To put it in other words, by testing the hypothesis that the anchor is the correct value people asses ways in which the answer may be similar to the anchor value resulting in them activating aspects of the target value which are congruent with the information provided by the anchor.

Recently, studies have also suggested that some anchoring effects may be the result of attitude change. This is hypothesized to occur by the provided anchor triggering a positive attitude change to the attributes of that anchor making following estimations more likely to lean towards that value. This conclusion was reached as in these experiments extreme anchor values (far outside the range of plausible values) resulted in less smaller anchoring effects than moderate anchors. Both anchoring and adjustment, and the selective accessibility paradigms suggest that more extreme anchor values should result in greater anchoring effects (Blankenship, Wegener, Petty, Detweiler-Bedell, & Macy, 2008) (Wegener, Petty, Detweiler-Bedell & Jarvis, 2001). The results were instead found to be similar to the inverted-U pattern found in attitude change research wherein extreme (and less plausible) information had a smaller effect on attitude than more moderate values. For example, telling people that only four hours of sleep a night was needed results in a greater attitude change than telling people that only one hour of sleep was necessary (Bochner & Insko, 1966).

Self-Generated Anchors

The current consensus on the causes of the standard anchoring effect is that it is largely explained by the selective accessibility model. While this may be true, other research has indicated that the insufficient adjustment explanation of anchoring may be relevant in some situations. Epley and Gilovich (2001) found that when anchors were self-generated instead of externally provided there was evidence for the use of adjustment. An example of a self-generated anchor would be asking someone what the freezing point of vodka is. They may not know exactly what the answer is, however, most people would be aware that it is less than the freezing point of water and that the freezing point of water is zero degrees. Thus, they use the freezing point of water as an anchoring point and adjust from there. This paradigm differs from an externally provided anchor in that people are always aware that the anchor they use is incorrect. As a result of this, self-generated anchors are not mentally 'tested' for plausibility and the heightened accessibility for attributes relevant to the anchor does not occur, meaning the mechanism of selective accessibility model does not work in cases of self-generated anchors. This implies the existence of two distinct mechanisms for the anchoring effect depending on whether the anchor was externally provided or self-generated.

The case for this difference in mechanisms between externally provided and self-generated anchors was further supported by Epley and Gilovich (2005) while also providing evidence for adjustment (in the case of self-generated anchors) being an effortful process which is influenced by motivation to more elaborately process the problem. They found that the use of externally provided anchors was not affected by attempts to increase effortful thought (through forewarnings and incentives), while the use self-generated anchors was affected by these same measures. These results fit in with what we know about these two explanations as selective accessibility results from largely unconscious processes (Higgins & Kruglanski, 1996) and thus should be unaffected by increases in effortful thought, while the opposite is true for anchoring and adjustment. This would mean that in cases where the

anchoring and adjustment paradigm is true factors which take up limited cognitive resources should reduce the amount of adjustment used or (as was the case in this experiment) the encouragement of effortful processing would increase the amount of of adjustment. Previous research had failed to find these effects when examining the standard paradigm of external anchor values (Chapman & Johnson, 1994) (which is part of the reason why the selective accessibility model was initially suggested) while these effects were present in the paradigm of self-generated anchors (Epley & Gilovich, 2005), further implicating a difference in working mechanism between externally provided and self-generated anchors, namely; selective accessibility and adjustment respectively.

Interpreting Heuristics Through the Dual Process Model

It may also be useful to examine the use of heuristics through the lens of the dual process model. Many researchers have proposed the idea that we are able to process information and make decisions using two distinct but intertwined parallel systems in our brain, specifically the type 1and type 2 systems (Epstein, Pacini, Denes-Raj, & Heier, 1996), although many researchers call them by other names such as: intuitive-experiential, analytical-rational and automatic-controlled to name a few (Stanovich & Toplak, 2012). Processing that occurs using the type 1 system is thought to be implicit, unconscious, fast, associative and highly related to affect while type 2 processing is considered slow, effortful, logical, conscious, explicit and flexible (Stanovich & Toplak, 2012). In a more practical sense type 1 systems reflect snap judgements and instinctual responses while type 2 processes involve logically analysing a problem.

Type 1 reasoning is believed to be evolutionary very old and shared between us and other animals. It includes instinctual processing and the processing formed by associative learning processes. System 2, on the other hand, is thought to have evolved relatively recently

and be a unique indicator of the way humans process information and make decisions. It allows abstract, hypothetical thinking which allows us to come to conclusions which would be impossible with the instinctual type 1 processing. The two types of processing are not mutually exclusive and often work in parallel with each other. Despite often being more accurate, the negatives of type 2 processing include a slow speed and the use of a much greater amount of cognitive energy due to making use of our working memory system (Evans, 2003). Due to this greater use of cognitive resources, type 2 processing is hindered when these resources are taken up by other factors, which is something to be considered going forward.

This pertains to anchoring in that the two main paradigms of anchoring we have discussed (selective accessibility and adjustment) each relate to one of these processes. Selective accessibility is a largely unconscious, automatic process, which would relate to type 1 processing, while adjustment seems to be more effortful and deliberate, relating it to type 2 processing. This comparison is supported by the previously mentioned findings which suggest that in cases where we expect adjustment to be used, reliance on the anchor can be changed by manipulating the amount of cognitive effort put into the estimation, while this is not true in cases where selective accessibility is the expected mechanism.

Possible Effects of Stress

One of the factors that would be expected to limit cognitive resources and therefore reduce the level of adjustment when adjusting from self-generated anchors would be stress. This effect was investigated by a study by Kassam, Koslov and Mendes (2009) in a laboratory experiment in which they artificially induced acute stress in participants and asked them to answer a series of questions which required the use of self-generated anchors to

answer accurately. The results confirmed that higher acute stress levels resulted in lower levels of adjustment from the anchors.

This leaves an interesting gap in the research. It has been shown that acutely induced stress reduces the cognitive resources available for adjustment to take place and therefore increases reliance on the anchoring heuristic. However, the effect that daily stress levels has on this phenomenon has yet to be investigated and thus will be the topic of this study.

This is relevant to the work setting as some level of stress is an unavoidable aspect of most jobs and if it is true that stress increases reliance on anchoring (and therefore increases the chance of incorrect conclusions), then it is not a huge leap to envision ways this could have a negative effect on the quality of decisions made at work. For example, one study found that both relevant and irrelevant anchors influenced judgements of performance and effort exerted when solving problems (Switzer & Sniezek, 1991), thus stress could easily affect the outcome of important performance reviews and evaluations for employees. Furthermore, we have already briefly discussed how anchoring could effect the result of negotiations (Loschelder et al., 2016) (Thorsteinson, 2011), but it should definitely be noted that this could affect not only relatively small decisions like employee pay or vacation days, but also more consequential negotiations such as the acquisition of a company. When looking at the effect of stress on work-related decisions it should also be considered that stress may affect these decisions in multiple ways, and not exclusively through an effect on anchoring. For example, while stress may negatively influence the quality of decisions in some ways, it is also highly plausible that a work-related stressor may cause an increase in motivation to solve the stress-inducing problem, reducing stress levels in the long-term. Paradoxically, this increase in motivation caused by stress could also hypothetically reduce reliance on anchors

due to an increase in effortful processing, which may override the opposite effects of stress on anchoring.

From this evidence an initial hypothesis can be generated. It is expected that people experiencing higher levels of perceived daily stress will adjust away from the anchor to a lesser extent. Adjustment in both the correct and incorrect directions will be equally considered as it can be assumed that in both cases adjustment is in the direction that is thought to be correct.

Possible Effects of Gender

Furthermore, studies have indicated that stress sensitivity may be higher in females than males (Bangasser & Wiersielis, 2018). Stress sensitivity refers in this case to the reaction of the body to stressful events in generating hormones such as Corticotropin-releasing factor (CRF) which cause the stress reaction in the human body. This is further demonstrated by a study which found that female rats had greater base levels of cortisol (a hormone directly related to stress levels) and a greater increase in cortisol levels in response to stressful events (Rincón-Cortés, Herman, Lupien, Maguire & Shansky, 2019). Therefore, the effect of gender on this relationship will also be investigated. From previous research it is expected that females will have an elevated stress response to their daily stressors, meaning they would experience higher levels of perceived stress, which in turn cause them to use the anchoring heuristic to a greater extent.

This leads to the second hypothesis. It is expected that women experience higher levels of perceived daily stress, which in turn causes a smaller level of adjustment away from the anchor. In other words, it is expected for perceived daily stress to mediate the relationship between gender and the amount of adjustment away from the anchor.

In addition to this there is some evidence that gender may moderate the effect of stress in some situations, although current research has not looked at this effect regarding the use of heuristics. For example, it has been previously found that when making decisions women are generally more risk averse when compared to men (Borghans, Golsteyn, Heckman & Meijers, 2009). These findings suggest the possibility of a main effect of gender on the amount of adjustment. If it is assumed that being risk-averse relates to sticking more closely to 'known' or 'safe' values it can be postulated that women, who are more risk-averse, will adjust a smaller distance away from the anchor point. From this a third hypothesis can be generated: it is expected that there will be a main effect of women adjusting less from the anchor point than men.

Furthermore, it was found that acute stress increased this difference between genders (Lighthall, Mather & Gorlick, 2009). For these reasons, gender will also be investigated as a moderator of the relationship between perceived stress and magnitude of adjustment. However, the relationship will be examined in an exploratory way, as an inspection of available research did not indicate a likely direction for the effect.

Research Question and Hypotheses

What is the relationship between gender, perceived daily stress and the amount of adjustment used when estimating answers using a self-generated anchor? In order to answer this question, two hypotheses will be tested.

1. Higher levels of perceived daily stress levels will cause people to adjust a smaller amount away from self-generated anchor points.
2. Women experience higher levels of perceived daily stress, and this results in diminished adjustment away from self-generated anchors. i.e. perceived daily stress mediates the relationship between gender and the amount of adjustment.

3. Women will adjust a lesser distance from the anchor point in a main effect independent of the mediation effect mentioned above.

In addition to this, an exploratory analysis will be performed to see if Gender has a moderating effect on the relationship between perceived stress and heuristic use.

Figure 1

Conceptual Model for Three Main Hypotheses

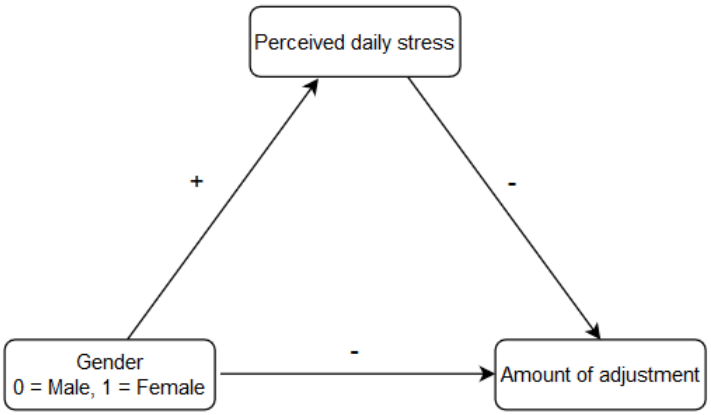
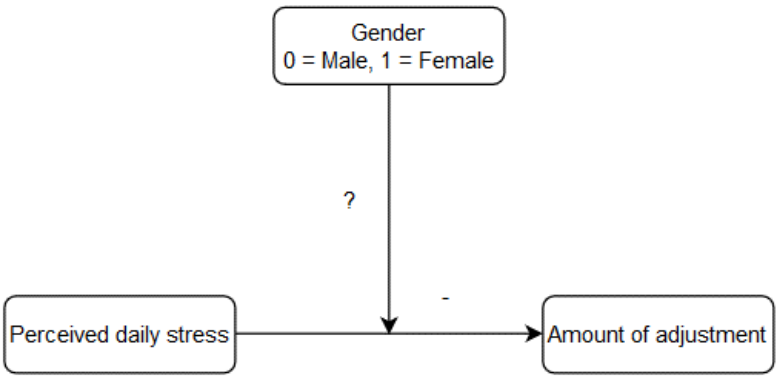


Figure 2

Conceptual Model for Exploratory Analysis



Methods

Participants

The software G*Power was used to determine the appropriate number of participants needed to achieve the desired power (β = .95). G*Power did not have the option to calculate power for a mediation analysis, so as a replacement the power was calculated using the multiple linear regression option with two predictor variables. Based on previous research (Kassam, Koslov & Mendes, 2009) it was decided that a small to medium effect size was to be expected (~.08). The G*Power analysis reported that a research sample size of $N = 197$ participants was necessary to achieve the desired power.

Responses to the survey were collected from April 19th until June 27th 2020. A snowball sampling technique was used, meaning participants were also greatly encouraged to share the survey with as many friends, family members, and co-workers as possible. The survey was distributed through various channels including WhatsApp, Facebook, email, reddit, and the SONA (a system for students of University Utrecht to receive credits in return for participating in studies). The only pre-requisite for participation in the survey was that respondents needed to be at least 18 years old.

Respondents who did not answer every question, who did not agree to the informed consent or who identified as a gender other than male or female were not included in the analysis. It was decided to not include non-binary genders in the analysis for a number of reasons, 1) There was very little theoretical precedent indicating how to hypothesize expected outcomes 2) There was a very small number of non-binary responses ($n = 2$), making them unsuitable for analysis, and 3) Including any more than two groups in the gender variable would complicate the analysis.

In total, $N = 224$ people responded to the survey, though as mentioned above, a number were excluded from the analysis resulting in a total sample size of $N = 184$. This final sample consisted of 79 males, and 105 females. The mean age of participants was $M = 35.92$ ($SD = 15.05$), and ages ranged from 19 to 80. The mean age of women in the sample was $M = 31.93$ ($SD = 12.32$) and the mean age for men was $M = 41.24$ ($SD = 16.70$). Due to this relatively large age difference between males and females it was decided to add age as a covariate to the analysis models in order to account for the possibility of age acting as a confounder.

Most participants were employed full time ($n = 85$), but there were also many students ($n = 61$), part-time workers ($n = 26$, self-employed ($n = 19$) and retired persons ($n = 13$). The most common highest levels of education achieved were a bachelor's ($n = 68$), master's ($n = 60$), secondary/high school ($n = 38$), and PhD ($n = 17$). The majority of participants currently resided in The Netherlands ($n = 99$), and in addition to this there were a number of responses from the United Kingdon ($n = 42$), Sri Lanka ($n = 12$), the USA ($n = 13$), and Germany ($n = 8$)

Design and Procedure

This study employed a quantitative, cross-sectional research design, and gathered data using online self-report surveys. The survey was created, distributed, and the response recorded using the online software *Qualtrics*. It generally took between five and ten minutes to fill out and consisted of 30 individual questions. Participants were told the study was on the effects of stress on estimation decisions.

Upon starting the survey participants were first presented with a form detailing the purpose of the survey (research on the effect of stress on estimation decisions) and what sort of information would be asked of them (demographic details, questions assessing their stress

levels, and a number of estimation questions). After being told about the purpose and method of the survey, informed consent was obtained, and the survey proper was started. For those who did not agree to the informed consent the survey was stopped immediately. To ensure complete responses and the validity of the data, it was not possible to skip any item on the survey.

Measures

The independent variables of this study were perceived stress levels and gender, while the dependent variable was the amount of adjustment used when answering estimation questions using a self-generated anchor. In addition to this age was added to the models as a covariate.

Perceived stress levels were measured using the *Perceived Stress Scale*-10, a 5-point likert measure with 10 questions intending to measure "the degree to which individuals appraise situations in their life as stressful" in the past month (Lee, 2012). Some example questions from this scale include; "In the last month, how often have you felt that you were unable to control the important things in your life?" and "In the last month, how often have you found that you could not cope with all the things that you had to do?". Possible responses ranged from "1 = *Never*", to "5 = *Very often*". A previous meta-analysis on the reliability of the PSS found both Cronbach's alpha and test-retest reliability to consistently score >.70 (Lee, 2012). Cronbach's alpha was also calculated for the responses in this study and was found to be α = .86, which combined with the results of the meta-analysis, indicate a high level of consistency in responses, and minimal levels of random measurement error. To get a single perceived stress score for each participant the responses to the Perceived Stress Scale were summed, with a '*Never*' response equalling one, and '*Very Often*' equalling five. This

coding was reversed for questions 4, 5, 7 and 8 of the PSS, so in those cases the reverse of the above was true.

Gender was measured by simply asking participants to say which gender they identified with, given the choices of: male, female, and other.

The amount of adjustment was measured by asking five questions which could require the use of self-generated anchors to answer accurately. These questions were taken from previous studies which have investigated adjustment in relation to self-generated anchors (Epley & Gilovich, 2001) (Epley & Gilovich, 2006) (Simmons, LeBoeuf and Nelson, 2010) (Inbar & Gilovich, 2011). It was decided that a number of the questions in these studies were be too biased towards American audiences (e.g. “When was Washington elected president?”), and were thus excluded, resulting in the five questions which were deemed to be appropriate for most world-wide cultures. These questions can be seen in Table 1.

A single adjustment value for each participant was calculated in the following manner. For each question, the absolute amount adjusted away from the anchor was divided by the correct adjustment amount for that question and then multiplied by 100, thus creating a percentage value representing how much they adjusted relative to how much was necessary to arrive at the correct answer. Absolute values were used to ensure that if people were to mistakenly adjust in the wrong direction it would not affect the results. While this would mean their answers were actually incorrect, previous studies on self-generated anchors dealt with these responses in the same way, so it was decided to keep the same methodology (Epley & Gilovich, 2001) (Epley & Gilovich, 2006). Respondents who over-adjusted were assigned percentage values above 100. Finally, the individual question percentages for each participant were averaged, resulting in a single value showing the average percent adjustment of each participant.

Participants were also asked two additional questions for each estimation they made, relating to how they came to their answers. First they were asked whether they knew the anchor value (e.g. “Do you know the boiling point of water on the ground?”), and if they answered yes, they were then asked whether they used this value when coming to their answer. This was done as a way of testing whether participants were in fact using anchoring and adjustment methods in their calculation, instead of purely guessing.

In addition to these measures directly relevant for the analysis, a number of demographic questions were also included such as: year of birth, highest level of education achieved, employment status and current country of residence.

Table 1

Estimation questions included in survey requiring the usage of a self-generated anchor

Question	Anchor Value	Actual Value
Boiling point on Mount Everest	100°C	71°C
Freezing point of vodka	0°C	-27°C
Length of a year on Mars (days)	365 days	869 days
Gestation period of an elephants (months)	9 months	22 months
Highest recorded body temperature	37°C	46.5°C

Statistical Analysis

The analysis was performed using *Statistical Program for Social Sciences (SPSS)* version 23, and the additional *PROCESS* macro, version 3.4. In particular, *PROCESS* Model

4 (simple mediation analysis) was used to test the three main hypotheses, while Model 1 (simple moderator analysis) was used to investigate the possibility of gender acting as a moderator in the relationship between perceived stress and adjustment.

It was decided that the analysis should be run twice. Once including everyone from the sample who agreed to the informed consent, completed the entire survey, and identified as male or female (N = 184), and a second time including only the responses where participants indicated the use of anchoring and adjustment when coming to their answers (N = 168). This was determined in two ways. First, when participants answered both that they knew and used the relevant anchor when coming to their answer (thus indicating the use of *anchoring*), and second, when they did not estimate the answer to be the exact same as the anchor value (indicating *adjustment*) . For the second analysis the average percent adjustment was only calculated from the responses where these criteria were met (thus including only the answers where the use of anchoring and adjustment were indicated). For example, if a participant's responses indicated the use of anchoring and adjustment in two out of the five questions, their average adjustment score would be calculated exclusively from those two questions, and the other answers would not be used. If they did not indicate the use of anchoring and adjustment in any of their answers they were then completely excluded from the analysis.

Outliers were identified using the following rules of thumb: *Std. Residuals* > 3.00, *MD* > 13.82 and Cook's D > .022. Data points which exceeded the cut-off for two or more of these values were removed from the analysis using listwise exclusion.

Results

Assumptions

Several assumptions also had to be tested to ensure the validity of the analysis. Since *PROCESS* mediation and moderation analyses are on based Ordinary Least Squares (OLS) regression, the assumptions for multiple linear regression were tested.

Assumptions of Analysis Including All Participants

The only assumption broken was that of multivariate normality. However previous research has shown multiple regression to be quite robust in regards to violations of multivariate normality, and that "the assumption of normally distributed errors is not required for multiple regression to provide regression coefficients that are unbiased and consistent" (Williams, Grajales & Kurkiewicz, 2013, p.3). Furthermore, when the sample size is larger (approaching $N = 200$) "violations of this normality assumption often do not noticeably impact results" (Schmidt & Finan, 2018, p.2). Keeping this in mind, we can comfortably ignore the violation of multivariate normality regarding its effects on the reliability of our results. One data point exceeded the cut-off point for both Cook's *D* and *Std. Residuals* and was therefore identified as an outlier and removed from the analysis using list-wise exclusion.

Assumptions of Analysis Including Only Responses Where Anchoring Was Indicated

Again, only the assumption of multivariate normality was violated. As mentioned above, violations of multivariate normality generally do not cause a problem with the sample size used in this analysis. Four data points exceeded the cut-off point for both Cook's *D* and *Std. Residuals* and were therefore removed using list-wise exclusion.

Descriptive Statistics

Descriptive Statistics of Dataset Including All Participants

Descriptive statistics, overall and split by gender, for average adjustment and perceived stress are shown in Table 4. There was no correlation found between average adjustment and perceived stress, r (182) = .00, p = .962.

Table 4

Descriptive Statistics for All Participants of Average Adjustment and Perceived stress: Overall and Split by Gender,

	Overall				Male				Female			
Variable	*Min*	*Max*	*M*	*SD*	*Min*	*Max*	*M*	*SD*	*Min*	*Max*	*M*	*SD*
Average adjustment	11.92	347.19	82.80	53.25	11.92	347.19	82.37	55.26	22.36	246.88	83.13	51.94
Perceived stress	11	47	27.24	6.18	11	43	26.63	5.99	15	47	28.46	6.07

Descriptive Statistics of Dataset Including Only Responses Where Anchoring Was Indicated

Descriptive statistics, overall and split by gender, for average adjustment and perceived stress are shown in Table 5. There was essentially no correlation found between average adjustment and perceived stress, r (166) = .03, p = .722.

Table 5

Descriptive Statistics for Responses Where Anchoring was Indicated, of Average Adjustment and Perceived stress: Overall and Split by Gender,

	Overall				Male				Female			
Variable	*Min*	*Max*	*M*	*SD*	*Min*	*Max*	*M*	*SD*	*Min*	*Max*	*M*	*SD*
Average adjustment	19.87	304.09	85.31	53.92	19.87	301.97	87.31	57.53	26.70	304.09	83.74	51.15
Perceived stress	11	47	27.49	6.12	11	43	26.07	6.02	15	47	28.61	6.00

Analysis

Mediation Hypothesis: Gender, Stress, and Adjustment

The first hypothesis tested was that higher levels of perceived daily stress levels will result in less adjustment away from self-generated anchor values. This was followed by the hypothesis that women experience higher levels of perceived daily stress, and this results in less adjustment away from self-generated anchor values. i.e. perceived daily stress mediates the relationship between gender and amount of adjustment. Finally, the hypothesis of a main effect of gender on amount of adjustment independent of the hypothesized mediation effect was also tested.

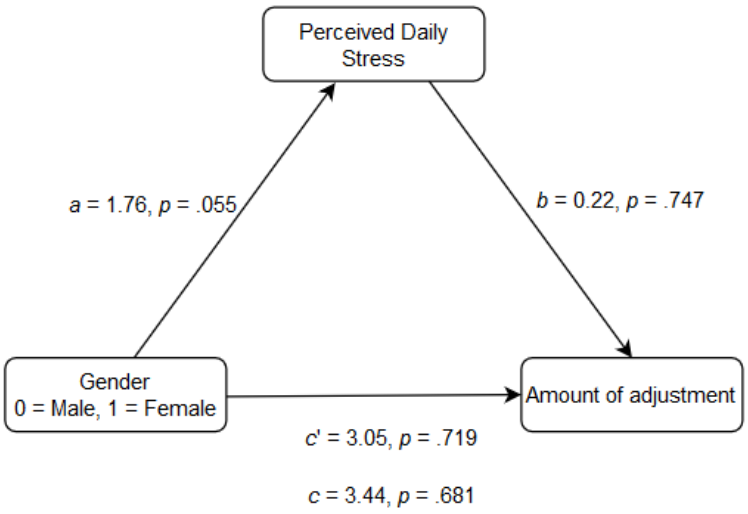
These hypotheses were tested with a simple mediation analysis using model 4 of the *PROCESS macro* in *SPSS*. Gender was entered as the independent variable, perceived stress as the mediator, and average adjustment as the dependent variable. As there was a large age difference between males and females, age was also added as a covariate to the model.

Including All Participants

As can be seen in Figure 3, female respondents were found to have higher levels of perceived stress at a level that was approaching significance (a = 1.76, p = .055), while increased levels of perceived stress had no influence on the average amount of adjustment used when coming to their answers (b = 0.22, p = .747). A bias corrected bootstrap confidence interval using 5000 samples was generated in order to test the significance of the indirect effect (ab = 0.39), however this interval crossed zero (95% *CI* [-1.863, 3.120]), meaning this effect would not be considered significant. Furthermore, there was no evidence to suggest the presence of a direct effect of gender on the average adjustment amount when considering the effect of perceived stress (c' = 3.05, p = .719). Finally, the total effect of the model was also found to be insignificant (c = 3.44, p = .681)

Figure 3

Process Model for Mediation Analysis Including all Participants



Hypothesis one stated that higher perceived stress levels would increase reliance on the anchoring heuristic, meaning the average adjustment would be lower. The results did not support this hypothesis as the b path of the mediation model was not significant.

Hypothesis two stated that women would adjust less from the anchor point, and that this effect would be mediated through increased levels of perceived stress. This hypothesis was also rejected as although the *a* path between gender and perceived stress neared significance, the *b* path between perceived stress and average adjustment, and the overall indirect *ab* path were both found to be insignificant.

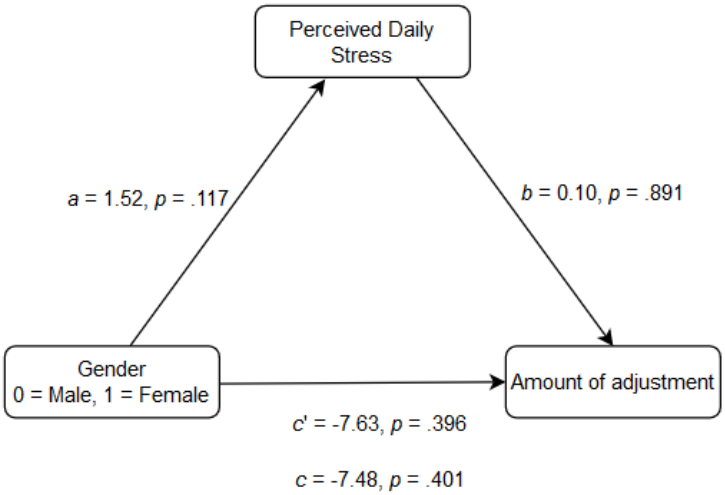
Hypothesis three expected that there would be a main effect of gender on the amount of adjustment shown however this was also rejected as the *c'* path was not significant.

Only Including Responses Where Anchoring Was Indicated

As can be seen in Figure 4, in this analysis female respondents were not found to have higher levels of perceived stress ($a = 1.52$, $p = .117$). Furthermore, increased levels of perceived stress were not found to increase the average amount of adjustment used when coming to their answers ($b = 0.10$, $p = .891$). A bias corrected bootstrap confidence interval using 5000 samples was generated in order to test the significance of the indirect effect ($ab = 0.15$), however this interval crossed zero (95% *CI* [-2.55, 2.67]), meaning this effect would not be considered significant. Furthermore, there was no evidence to suggest the presence of a direct effect of gender on the average adjustment amount when considering the effect of perceived stress ($c' = -7.63$, $p = .396$). The total effect of the model was also found not to be significant ($c = -7.48$, $p = .401$).

Figure 4

Process Model for Mediation Analysis Only Including Responses Where Anchoring Was Indicated



Hypothesis one stated that higher perceived stress levels would increase reliance on the anchoring heuristic, meaning the average adjustment would be lower. The results did not support this hypothesis as the *b* path of the mediation model was not significant.

Hypothesis two stated that gender would decrease average adjustment levels, and that this effect would be mediated through levels of perceived stress. This hypothesis was not supported as the *a* path between gender and perceived stress, the *b* path between perceived stress and average adjustment, and the overall indirect *ab* path were all found to be insignificant.

The third hypothesis predicted that there would be a main effect of gender on the amount of adjustment shown however this was also rejected as the *c'* path was not significant.

Exploratory Moderation Analysis

Previous evidence suggested the possibility of gender moderating the effect of perceived stress on average adjustment. This was investigated by performing a simple moderation analysis using model 1 of the *PROCESS* macro, in *SPSS*, with perceived stress as the independent variable, average adjustment as the dependent variable and gender as moderator. In addition to this, age was added as a covariate.

Including All Participants

The interaction effect between perceived stress and gender was not found to be significant (b_3 = -0.25, p = .852). Similarly, the main effects of perceived stress (b_1 = 0.37, p = .726) and gender (b_2 = 9.88, p = .793) on adjustment amount were not found to be significant. In conclusion, the analysis failed to find significant main effects between either perceived stress or gender and average adjustment, and in addition did not find a moderation effect by gender.

Only Including Responses Where Anchoring Was Indicated

The interaction effect between perceived stress and gender was not found to be significant (b_3 = -0.15, p = .914). Similarly, the main effects of perceived stress (b_1 = 0.19, p = .864) and gender (b_2 = -3.37, p = .934) on adjustment amount were not found to be significant. In conclusion, the analysis failed to find significant main effects between either perceived stress or gender and average adjustment, and in addition did not find a moderation effect by gender.

Discussion

Previous research had found that acutely induced stress caused more reliance on the anchoring heuristic, and thus less use of adjustment when making estimation decisions

involving the use of self-generated anchors. The present research investigated whether this was also the case with self-reported perceived stress that was not acutely induced. Furthermore, a mediation model with perceived stress mediating a relationship between gender and the amount of adjustment, and a main effect of gender on adjustment were also examined. In addition, it was also investigated in an exploratory manner whether gender moderated the relationship between perceived stress and the amount of adjustment.

All three hypotheses were rejected as there was no significant main effect of perceived stress or gender on adjustment amount, and both the direct and indirect mediation routes of gender on adjustment amount were found to be insignificant. Interestingly, in the analysis including all participants there was a near significant effect of gender on perceived stress, indicating that women had higher levels of perceived stress than men did. Finally, there was also no significant moderation effect found in either of the two exploratory analyses.

Overall, these results generally do not support findings found in previous research on the topic. Neither stress nor gender was found to influence the use of the anchoring heuristic, and no mediation effect was present. In other words, the results do not support the idea that the mechanism behind the anchoring heuristic in the context of self-generated anchors can be adequately explained through anchoring and adjustment. If this mechanism were true it would be expected that factors limiting the expenditure of the ‘mental energy’ required for adjustment, such as stress in this case, would increase reliance on the anchor, which was not the case. The only finding that was even close to significant and supported by previous research was that women would have higher perceived stress levels than men, which although it was not one of our main hypotheses, was a necessary condition for the hypothesized mediation effect to be present. It is of course also possible that positive results were not found

due to problems inherent to the methodologies of this research. These will be further discussed.

Limitations of the Present Research

There were certainly several important limitations in this research which are important to note when considering why previous results were not replicated, or discerning what knowledge can be gleaned from these results. For example, one possible reason for this incongruency is that this study looked at self-reported perceived stress while previous studies looked at acutely induced stress in laboratory conditions. It is very plausible that stress does indeed affect adjustment, but the variability present in daily stress levels among participants was not large enough to demonstrate this when compared to the acutely induced levels of stress present in previous studies.

Another consideration is that, as the research design was cross-sectional, it is impossible to derive a causal relationship from the results, and furthermore we should be wary of any associations found in the results, as they only measure a snapshot in time, and often do not represent the 'full story'(Setia, 2016). If a longitudinal study were to be conducted, it may be possible to observe individual fluctuations in reliance on anchoring as their stress levels vary over time. This would be an interesting topic for future research to tackle, although a larger bank of possible questions using self-generated anchors would have to be developed as currently all the research on the topic relies on the same limited number of questions.

It should also be noted that in their research Epley & Gilovich (2005) demonstrated that motivation and incentives significantly increase the amount of adjustment in the paradigm of self-generated anchors. Thus it is also a consideration that due to the informal and impersonal nature of online surveys, participants may have in many cases lacked the

motivation to truly strive for the best answer possible and instead settled for the nearest plausible answers. To add to the credibility of this proposal, all the previous research on this topic has been done in-person, so it is certainly a factor that could have affected the results. If future research were to further investigate this topic using the same survey format, it would be recommended to provide a monetary incentive for participants to try and ensure they are motivated and take the tasks seriously.

Another clear limitation was in the sampling method used: in this case, snowball sampling. This has the advantages of being low-cost, efficient and a relatively easy way to gain many responses. However, this came at the cost of having a clearly identified target population, and consistent known characteristics among respondents (and knowing the size of this population). In addition, this has the possibility of introducing sampling bias, wherein people who are asked to pass along the survey do so to people who are relatively similar to themselves, however it is not possible for us to actually be aware of the traits which are similar or dissimilar among the participants. It is worth considering that the anchoring and adjustment effect may present itself in a different manner among wildly differing populations, and thus when combining data from so many different people a clear pattern cannot be found. In addition, people of different ages and backgrounds may have different pre-existing knowledge relating to the estimation questions that were asked, which could influence their accuracy. It would be recommended for future researchers on this topic to recruit participants from a largely homogenous population, and if the relationships can be demonstrated with certainty in these, then to expand to more varied populations.

Furthermore, a very important consideration is that this study exclusively used self-report measures. Previous studies on this topic have manipulated stress by acutely inducing it, and thereafter measured physiological responses to be sure that their manipulation did in fact induce a stress response (Epley & Gilovich, 2001) (Epley & Gilovich, 2005). It is a definite

possibility that self-report measures of stress are not as reliable as objective physiological responses, or that for example, a self-report measure may accurately measure differences in stress levels between an individual at different times, but not objective differences between individuals. It should also be considered that due to societal expectations of gender, men may respond to a self-report stress scale in a socially desirable way that indicates they experience less stress than they do. This gives less credibility to the almost significant effect found in which females experienced higher levels of stress.

Another consideration is that this study adjusted slightly the scale used for measuring adjustment when compared to previous studies. As all the previous studies done were performed in North America, there were several questions that were removed for being too focused on an American audience. While this shouldn't have drastically affected the results it should be noted. For future researchers based outside of North America who wish to investigate this topic it would be recommended to develop a set of questions more suited to the cultural knowledge of their specific location. Additionally, if the same questions are to be used in the future it would be highly suggested to further validate the scale and test their reliability in producing a consistent measure of people's level of adjustment. Currently, no such validation has been attempted, and this severely limits the practical use of any results in this field.

Finally, it should be noted that the data was gathered during what was essentially the peak of the COVID-19 pandemic, which was a highly tumultuous time for virtually everyone around the world. This was a highly unprecedented event and would have certainly affected the results gathered. It was a time of high stress and uncertainty for many people, so the stress people were reporting may not have been representative of the levels generally experienced in day to day life. In addition, COVID-10 was a very long-lasting stressor, but for many people may not have induced intense stress responses for its entire duration. This could result

in people's responses to the PSS indicating higher stress levels, but with this not being accompanied by heightened relevant physiological responses which may be necessary to induce a difference in adjustment levels. Furthermore, during such a far-reaching global event, it is possible that people simply did not take the survey as seriously as they may have otherwise done.

Conclusions

This study did not provide evidence supporting the effect found in previous studies wherein higher stress levels increased the reliance on the anchoring heuristic in situations involving self-generated anchors. Furthermore, the proposed mediation effect involving gender was also not found. However, this should not be reason to discredit these ideas as the numerous limitations of the study methodology and design put the credibility of these studies results into question. For future studies to have a better chance of documenting this effect it is recommended they: have a greater sample size and sample from a more homogenous population, develop their own measures to measure adjustment and/or try to maximize participant's motivation to come to the correct answer, choose a sampling method with less inherent bias and use a measure of stress not reliant on self-reports.

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