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Feedback and spider size estimation: A quantitative investigation into whether fear and feedback influences size estimation in spiders

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Abstract

This paper investigated the link between trait fear in spider phobic participants and size estimation of an imagined spider. However, previous research has suggested that there is a strong association between fear and size estimation bias in phobic individuals, which could be mediating spider phobia. To reduce this bias, false verbal feedback was given to spider phobic participants to test whether spider size estimation can be reduced through convincing participants that they are less afraid of spiders than the average person. Participants were either in the no feedback or feedback condition. The feedback condition were told that they are less afraid of spiders than the average person. All participants completed the Fear of Spiders Questionnaire, the feedback condition received feedback while the no feedback condition continued to the scenarios. Participants had to imagine 11 spider related scenarios and had to rate the size of the imagined spider using a response scale of household objects. A strong correlation between trait levels of fear measured by the FSQ and size estimation was found. Size estimations were not significantly different in the no feedback and feedback condition, indicating that the feedback did not reduce fear levels and size estimations in phobic participants. The findings support the link between fear and size estimation bias but does not support the theory that feedback can reduce this bias and subsequently spider phobia. This suggests that fear alone does not mediate spider phobia, therefore, other elements like disgust may play a role in the avoidance process too.

Keywords: Feedback, size estimation, fear, size bias, spider

Introduction

Individuals can have phobias of a multitude of things such as heights, social situations, and animals like snakes and spiders which can originate from childhood schemas and develop into adulthood (Broeren, Lester, Muris, & Field, 2011). The fear of spiders is one of the most common specific phobias (Davey, 1991),with around 30% of women and 20% of men in the UK feeling frightened and anxious thinking about an encounter with a spider (Davey,1994). The exact logic behind spider phobia is unknown but evidence suggests that the phobia is mediated by not only fear but by other emotions such as disgust (Davey, 1992). It has been found that spiders elicit significantly greater fear and disgust than any other arthropod group (Geredes, Uhl, & Alphers, 2009) implying that they have a special disgust-evoking status (Vernon, & Berenbaum, 2002). Matchett and Davey, (1991) have argued that phobias arise from believing that animals associated with uncleanliness and spreading of disease are viewed as disgusting, and therefore are avoided. They discovered that there was a positive correlation between disgust sensitivity and animal phobia scores, suggesting that a disease-avoidance process could be the foundations of specific phobias. It has also been found that spider phobic individuals have been known to avoid food that has come into contact with a spider (de Jong, Andrea, & Muris,1997; Mulkens, de Jong, & Merckelbach, 1996), implying avoidance and unwanted contact with any contaminated object.

The disgust-avoidance theory suggests that the fear exhibited in spider phobic individuals is not related to fear of physical harm but related to unwanted contact with a disgusting object (van Overveld, de Jong, & Peters, 2006). This implies that disgust is a secondary emotional reaction to fear (Edwards, & Salkovskis, 2006; Sawchuk, Lohr, Westendorf, Meunier, & Tolin, 2002) which eventually causes the avoidance of spiders. Hence, both fear and disgust may play a role in the avoidance pattern which eventually leads to a specific phobia. However, another factor which current research is suggesting could be mediating spider phobia is perceptual biases. Fearful individuals may not just be interpreting certain stimuli in a threatening way but could actually be viewing it differently (Teachman, Stefanucci, Clerkin, Cody, & Proffitt, 2008). These perceptual biases are shown in spider phobic individuals since they have been found to give larger size estimations of spiders (Shiban, Fruth, Pauli, Kinateder, Reichenberger, & Mühlberger, 2016; Leibovich, Cohen, Henik 2016) and overestimate the speed at which they move towards them (Basanovic, Dean, Riskind, & MacLead, 2019; Riskind, Kelley, Harman, Moore, & Gaines,1992). These perceptual biases cause individuals to view the spider with more fear, leading to subsequent avoidance.

This hypothesis is supported by research investigating the correlation between height-related fear and the overestimation of vertical heights. It was found that the overestimation of distance and size of vertical heights correlated with trait and state levels of height-related fear (Stefanucci, & Proffitt, 2009). They suggested that fear may play a role in perceiving the vertical extents as larger and potentially more dangerous. Viewing the heights as larger, elicits more fear towards heights, causing avoidance of possible future encounters, potentially causing acrophobia (phobia of heights). This positive correlation between height overestimation and fear was found to be magnified when they incorperated imagery into the scenarios (Clerkin, Cody, Stefanucci, Proffitt, & Teachman, 2009; Teachman, Stefanucci, Clerkin, Cody, & Proffitt, 2008). This implies that creating a mental representation of a more risky

scenario such as falling off a cliff edge can amplify the immediate danger of the scenario which produces an increase in the apparent vertical extent.
Vasey, Vilensky, Heath, Harbaugh, Buffington, and Farzio, (2012) investigated this size estimation bias through comparing trait levels of fear and state levels of fear with size estimations of spiders. Participant's trait levels of spider fear were determined using the Fear of Spiders Questionnaire (Szymanski, O'Donohue, 1995). Their state levels of fear refers to the intensity of fear felt during the encounter with a live spider. Firstly, participants encountered a live spider in an uncovered glass tank and were asked to approach the spider. They were then instructed to guide the spider around the tank using a probe. The spider tank was then covered up, and they were asked to estimate the spider's size. To estimate the size, they drew a single line on a large index card to give an estimate of the spider and were told to measure it in its most elongated position. Results revealed that there was only a marginal association between trait fear and size estimations and that the intensity of fear felt during the encounter was a stronger predictor for size perception.

However, Vasey et al. (2012) highlighted how memory and attentional biases could have potentially affected their results so it is unclear whether participants who reported more intense levels of fear actually viewed the spider as larger. For the memory bias they stated that size estimations heavily relied on their ability to remember the spider that they had just encountered, which could have led to inaccuracies. For the attentional bias, they implied that participants who were more fearful may have had a lack of attentional allocation to the threatening stimuli so might not have spent a long amount of time directly looking at the spider. These biases could have accounted for why their results were not significant since there could have been some inaccuracies in the size estimation of the spiders.
Shiban et al., (2016) aimed to expand on the findings of Vasey et al., (2012) since they tested whether a size estimation bias would be present when the spider was left uncovered when participants had to rate the size. The spider was placed 3 meters away from the participants and was uncovered when they had to give an estimate the size of the spider directly in front of them. Participants were given a sheet with 10 different categories of sizes, ranging from 4-22cm where they pointed at the category in which they thought best corresponded to the actual size. Results revealed that phobic individuals overestimated the size of the spider by 81%, with non-phobic individuals still overestimating it by 40%. The study excluded any memory biases since they allowed participants to make a direct comparison between the size of the spider in front of them and their size estimation. However, it is apparent that there is a lack of research investigating whether there is a size estimation bias for a mental representation of a spider (Leibovich, Cohen, Henik, 2016). Therefore, future research is necessary to investigate whether there is a positive correlation with spider fear and size of an imagined spider.

If the size estimation bias demonstrated in spider phobic individuals is contributing to the maintenance of fear and anxiety, increasing awareness of this bias has potential therapeutic value. Vasey et al. (2012) mentioned perceptual feedback as an effective way of demonstrating the discrepancies between what phobic individuals perceive and what truly exists. Evidence suggests that feedback in the form of heart rate and skin conductance can reduce anxiety levels in individuals with animal phobia and panic disorder (Gilbert, 1986; Nunes, & Marks, 1975; Goessl, Curtiss, & Hofmann, 2017). Feedback helps individuals to become aware that they are susceptible to misperceiving stimuli as threatening and it may reduce the probability of them responding to their misconceptions with fear and anxiety (Story, & Craske, 2008). Not only can feedback be used to treat misconceptions but has even been found to reduce tension headache symptoms, implying that it has major therapeutic benefits which go beyond treating specific phobias (Holryd, Penzien, Hursey, Tobin, Rogers, Holm, & Chila, 1984).

Valins and Ray, (1967) tested whether delivering false feedback can decrease avoidance in snake-fearful individuals. Two experiments were conducted where subjects were given false heart rate feedback explaining that they had a low heart rate in response to viewing images of snakes (experiment 1) and viewing actual snakes (experiment 2). In between the snake conditions, the word “SHOCK” was presented to them, followed by a mild electric shock. In conjunction with the presentation of the word “SHOCK”, subjects were convinced that their heart rate had increased. Results revealed that the experimental subjects who were exposed to the false feedback exhibited more approach behaviour towards the snake following the experiments as opposed to the control subjects. The control subjects received identical feedback, however, were instructed that it was purely irrelevant background noise. They concluded that if you led snake-fearful individuals into believing that they were physically relaxed and unresponsive when encountering a snake, they exhibited less snake avoidance. Valins and Ray, (1967) suggested that you can modify avoidance behaviour towards feared stimuli through manipulating fundamental cognitions about an individual’s internal reactions to a phobic stimulus.

Additionally, false feedback can be implemented to reduce anxiety symptoms. Costa, Adams, Jung, Guimbretière, and Choudhury, (2016) tested whether manipulating an individual’s perception of their heart rate would influence their levels of anxiety. They used an “EmotionCheck” device in which would give participants vibrations on their wrist imitating their heart rate. For the control group, they received no feelings of vibrations when wearing the device. In the vibration condition participants received vibrations and not given any additional information explaining the vibrations. However, in the slow heat rate condition participants felt the same vibrations but were told that it represented their current heart rate. Finally, in the real heart rate condition, participants were given vibrations based on their true heart rate and were accurately informed about this. Results revealed that the slow heart rate group exhibited a smaller increase of anxiety on average as opposed to the other three conditions. This implies that the slow heart rate condition exhibiting lower levels of anxiety resulted from their belief that the vibrations accurately represented their true heart rate. Alongside Valins and Ray, (1967) this provides substantial evidence that convincing fearful individuals that they are not exhibiting high levels of arousal in response to fear or anxiety-provoking through biofeedback can reduce their physiological symptoms.

In contrast, Ehlers, Margraf, Roth, Taylor, and Birbaumer,(1988) issued inaccurate heart rate feedback to individuals suffering with panic attacks to investigate whether it can induce anxiety. They started off by giving participants true heart rate feedback and then after five minutes, delivered the false feedback by manipulating their true heart rates. Results showed that participants who received the manipulated false heart rate feedback, exhibited increased anxiety and physiological reactions. This suggests that when individuals are informed about bodily changes, they begin to blindly believe the changes which leads to an increase of anxiety and physiological arousal. These results highlight how feedback can be used therapeutically to decrease fear, anxiety and avoidance or induce anxiety symptoms. The possible benefits of giving spider phobic individuals false feedback have not yet been tested, however it could be used to convince phobic individuals that they are not as afraid of spiders as they previously thought. This could cause them to view the threatening stimuli with less fear, subsequently decreasing avoidance and potentially reduce phobic behaviour.

There is mixed evidence that levels of spider fear are associated with size estimations since Shiban et al. (2016) found that trait levels of spider fear positively correlate with size estimations of spiders. However, Vasey et al. (2012) stated that state levels of fear is a stronger predictor for size. Previous studies also used live spiders for participants to compare the size to, however no study has yet been conducted where participants have to rate the size of a mental representation of a spider. Therefore, the current study aims to investigate whether trait levels of fear measured by the FSQ will positively correlate with size estimations of a mental representation of a spider. Additionally, research investigating feedback suggests that issuing feedback can increase anxiety levels (Ehlers, Margraf, Roth, Taylor, C & Birbaumer, 1988) or decrease them (Valins, & Ray, 1967; Story, & Craske, 2008; Holryd, Penzien, Hursey, Tobin, Rogers, Holm, & Chila,1984). However research heavily focuses upon feedback in the form of heart rate however, due to the COVID-19 pandemic this was unachievable. Currently there is no research investigating whether the administration of verbal false feedback can lower spider phobic individuals fear levels and influence them to give smaller size estimations as opposed to non-phobic individuals. Hypothesis 1 predicts that high trait spider fear levels measured by FSQ scores will correlate with larger size spider estimations. Hypothesis 2 predicts that participants who are given feedback explaining that they are less afraid of spiders than the average person will believe that they are not as afraid of spiders as they might have thought, so give smaller size estimations than participants who receive no feedback.

Methodology

Participants

A total of 108 undergraduate Psychology students (93 females, 15 males) participated in the study which ages ranged from 18 to 47 (M=21.94, SD= 6.69). Participants signed up to complete the study through the University's participation pool where they received half a point for their participation. Since all participants were enrolled in the psychology course, their knowledge of psychological experiments was consistent, reducing the variability of the data we received.

Materials

The programme which was used to create and run the experiment was Qualtrics. Participants were shown an information sheet (see Appendix A) which outlined the entire experiment. This was not shown for a set amount of time, and they had to press the arrow button to continue. Participants were given the Fear of Spiders Questionnaire (FSQ) (see Appendix B) containing 18 self-report items to assess the levels of spider phobia an individual might possess. It uses a 7-point Likert scale (where 1 = Strongly Agree and 7 = Strongly Disagree). With regard to psychometric properties, the FSQ has demonstrated an internal consistency of 0.92 (Szymanski, O'Donohue, 1995) and a test-retest reliability of 0.91 (Muris, & Mercklebach, 1996). Participants had to respond to each individual question, without leaving any blanks or it would not continue onto the next part of the experiment. The response scale that was used to rate the size of the spider was created on Qualtrics and ranged from a tic tac to a dinner plate (see supplementary file) Following the completion of the study, they were then shown a debrief (see Appendix D) which explained the true intentions of the study, explaining why deception was unavoidable.

Design

The study used a between subject design. The independent variable was feedback condition (no feedback or feedback). The dependent variable was their spider size estimation scores.

Procedure

They were first presented with the brief which explained what was going to happen in the experiment. This was followed by the consent question where if they answered 'no' the study would automatically end and would return to the SONA system. The FSQ questionnaire was presented to all participants for an infinite amount of time. If not all the questions were answered, the specific question would be flagged, and the study would not continue until it has all been completed. Participants were randomly allocated into either the 'No Feedback' or 'Feedback' condition. For the 'No Feedback' condition, participants were not given any information about their performance from the questionnaire and were thanked for their participation and then moved onto the question section. For the 'Feedback' condition they were told that 'Your 'Fear of Spiders' score shows that you are less afraid of spiders than the average person' and then continued on to the question section. The first scenario was presented on the screen for 1000ms and explained that they had to imagine the following scenario. An example of a scenario is "Imagine you are sitting outside in your garden when you notice a spider crawling along the patio. It is a metre or two away from you but is getting closer." After being presented for 1000ms, it automatically continued onto the size estimation section. Participants were asked what size the spider was that they had just imagined, compared to these household objects. The pictures of the 8 objects ranged from a tic-tac to a dinner plate and were presented horizontally across their screen. Each picture was the same size (519 x 519 pixels). Participants had to click the circle to the left of the object to indicate what object they thought accurately represented their imagined spider. The size estimation section had no time restraints so would only continue when they had given their answer. This was then repeated for ten times. Participants were then presented with the debrief which explained the use of deception and informed them that if they wanted to enquire about their true results, they could contact any of the experimenters.

Data Analysis

The Fear of Spiders Questionnaire consisted of 18 questions which used a 7-point Likert scale (where 1 = Strongly Agree and 7 = Strongly Disagree). For each participant, a sum of their responses from each of the 18 Fear of Spiders questions was found and were used for the analysis. For the size estimation, the scale ranging from a tic-tac to a dinner plate was converted into a numeric scale ranging from 1-8.

Similarly, to the FSQ scores, a sum was found for each participant of their size estimation response scores and was also used for analysis.

The median FSQ score for all participants was found (60.5) so for participants who scored above the median score in the FSQ, the feedback of 'Your 'Fear of Spiders' score shows that you are less afraid of spiders than the average person' would be false. Therefore, their score shows that they are more afraid of spiders than the average participant in the group. For participants who scored below the median score, the feedback would be true since they are less afraid in comparison to the average participant. This means that only participants who scored above the median will be analysed since we only expect to find an effect in this group.

Results

Table 1 shows the descriptive statistics for all participants in both conditions where half of participants received feedback and half received no feedback. Table 1 shows that both conditions had very similar mean size estimations and FSQ scores.

Table 1: Mean and standard deviation for all participants who either received feedback or no feedback

Condition		N	Mean	Std. Deviation
No Feedback	Size Estimation	54	39.35	10.05
	FSQ Scores	54	63.28	32.97
Feedback	Size Estimation	54	39.93	11.18
	FSQ Scores	54	62.28	32.97

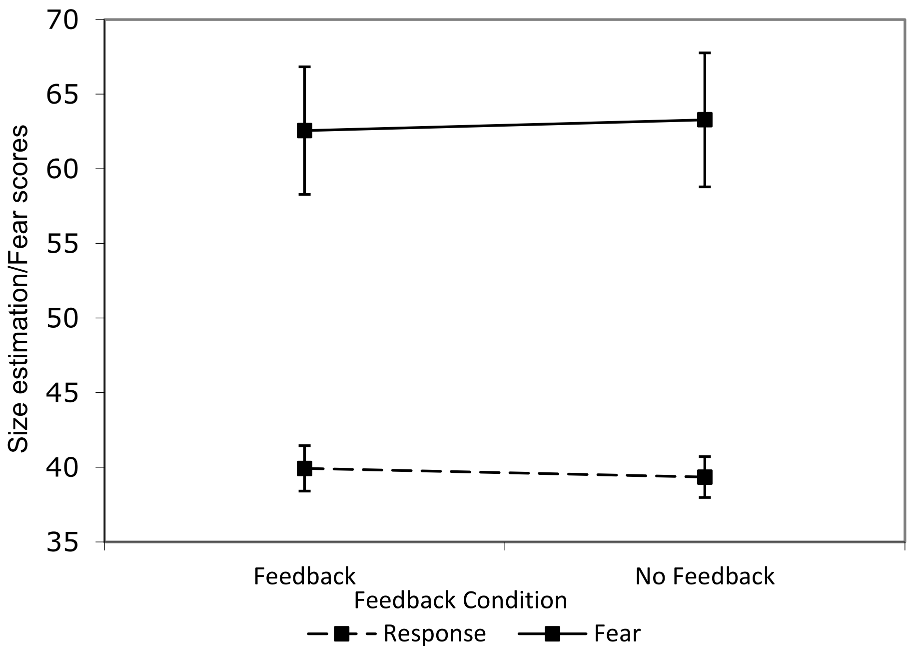

Figure 1: A plot to show the mean FSQ and size estimations for all participants in both conditions. Error bars represent the standard deviations.

Figure 1 also highlights that the size estimations were very similar whether participants were given feedback or not. The standard deviation shows that participants size estimation responses did not differ that much from the mean in both conditions. However, the FSQ scores showed more variation in both conditions.

An independent t-test was conducted to investigate whether there was a difference of FSQ scores for participants who received feedback (M=62.56, SD=31.42) and those who received no feedback (M=63.28, SD=32.97). T-test results reveal that there was no significant difference between the two conditions, t(105.75) = 0.12, p = .91, with a negligible effect size (.02) Therefore, the FSQ scores were very similar in both the no feedback and feedback condition.

Analyses was then conducted to see whether there was a correlation between participants FSQ scores and size estimation scores. Results revealed that as FSQ scores increased spider size estimation increased in both the feedback, r = .45, BF = 61.76, p < .001, and no feedback condition, r = .44, BF = 46.90, p < .001. A strong overall correlation between FSQ scores and size estimation was also found in the whole dataset, r = .58, BF= 266985545, p < .001, this is also shown by figure 2.

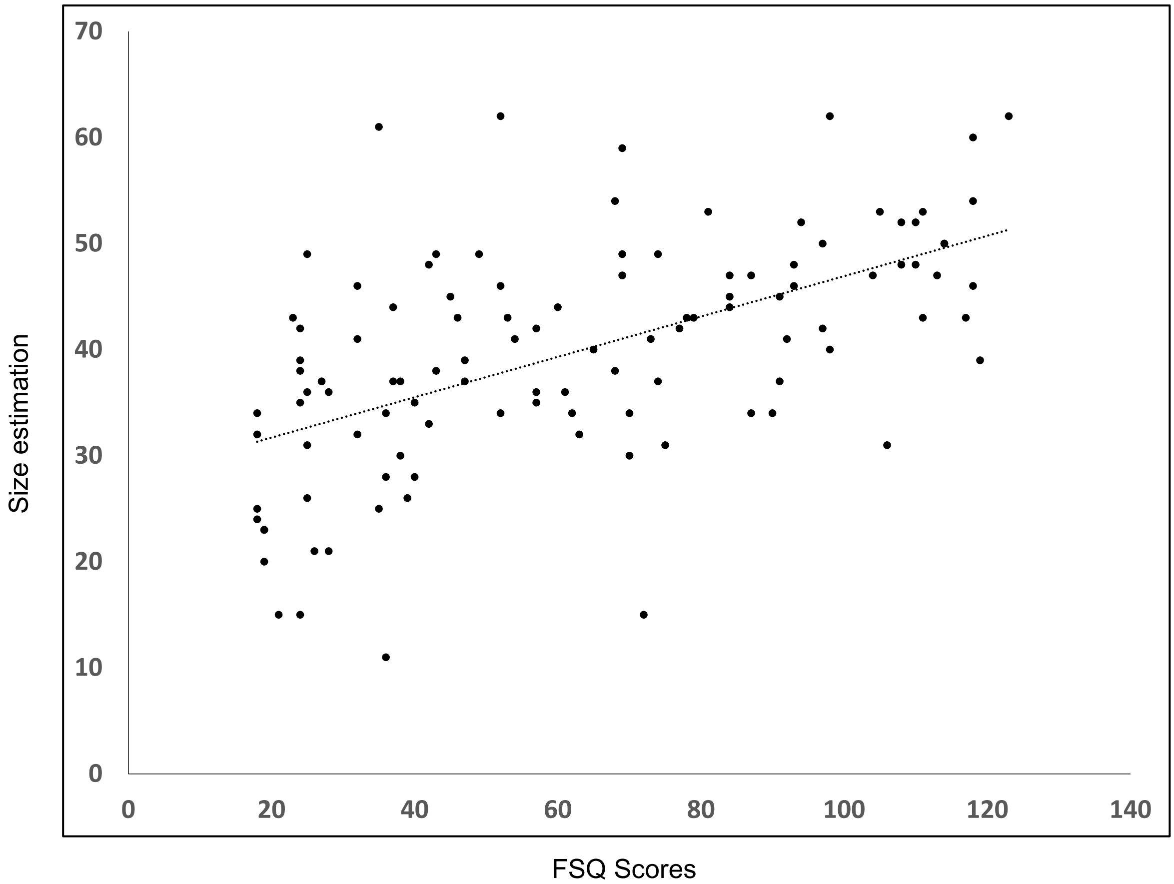

Figure 2: Scatterplot depicting the relationship between Size estimation and FSQ Scores for all participants in both No Feedback and Feedback conditions.

Descriptive statistics for participants who scored above the median fear score (60.5) are shown in table 2.

Table 2 : Mean and standard deviation for size estimation and FSQ score in both feedback and no feedback conditions for participants who scored above the median FSQ score.

Condition		N	Mean	Std. Deviation
No Feedback	Size Estimation	27	43.96	6.68
	FSQ Scores	27	92.89	15.89
Feedback	Size Estimation	27	44.89	10.82
	FSQ Scores	27	88.74	20.74

An independent t-test was conducted to see whether the size estimation scores were significantly different in the no feedback or feedback conditions. T-test results reveal that there was no significant difference found between the spider size estimations in the no feedback condition (M=43.96, SD=6.68) and the feedback condition (M=44.89, SD=10.82), $t(43.30) = 0.38$, $p = 0.71$. There was a negligible effect size (0.1).

Further analysis was conducted to investigate whether we accept our hypothesis that there will be smaller size estimations in the feedback condition. We calculated Bayesian t-tests using the BayesFactor package (Morey & Rouder, 2018), within the R environment (R Core Team, 2018). Results revealed that spider size estimations were not smaller in the feedback condition (BF= 0.29), therefore there is substantial evidence for the null hypothesis that there is no difference between the two conditions.

Discussion

The first aim of the experiment was to investigate whether trait levels of spider fear measured through the Fear of Spiders Questionnaire would correlate with size estimation of spiders. As predicted, FSQ scores did show a strong correlation with size estimation of spiders in both the feedback and no feedback condition. Therefore, hypothesis 1 was supported so the null can be rejected. This finding confirms the theory that there is a strong link between fear and size estimation and is consistent with results produced by Shiban et al., (2016) who found that more spider phobic individuals gave larger size estimations compared to less spider phobic individuals. However, it partially conflicts with the findings of Vasey et al., (2012) who found that the association between trait levels of spider fear and size estimation was marginal yet non-significant, but state levels of fear and size estimations were significantly correlated.

The current findings add new information to previous findings since a size estimation bias was found when participants had to rate the size of an imagined spider. A possible explanation to why Vasey, et al., (2012) did not find a significant correlation with trait fear and size estimation is that participants had to estimate the size of a live spider that was then covered. A problem with rating the size of a live spider while covered is that it may be susceptible to being influenced by other cognitive biases such as memory and attention. Vasey et al., (2012) mentioned how these biases could have caused inaccuracies in the spider size estimations. However, this is unlikely since evidence suggests that phobic individuals might actually demonstrate enhanced attentional capture (Öhman, Flykt, & Esteves, 2001) and memory (Reinecke, Becker, & Rinick, 2010) towards stimuli which would produce a more accurate size estimation.

Shiban et al. (2016) excluded this memory bias since they allowed participants to make a direct size comparison to a live spider which was left uncovered. Similarly to Shiban et al., (2016) the current study attempted to remove memory biases, since participants did not have to rely on their memory to estimate the spider size, since they rated the size of a spider created in their imagination. However, despite the evidence that fear could be driving this size estimation bias, it is still susceptible to other biases such as arousal which could also be altering size perception (Guess, Steffanucci, de Benedictis-Kessner, & Stevens, 2010).Therefore future research is still required to investigate whether the size estimation bias is purely perceptual and phobic individuals do actually view the spider as larger or if a multitude of different cognitive biases such as arousal could be influencing the overestimation of phobic stimuli. Even if phobic individuals are viewing the spiders as larger, it is also necessary for future research to investigate the extent to which this size estimation bias is affecting the development and maintenance of spider phobia. Through reducing this bias, it could help decrease avoidance behaviour exhibited in spider phobic individuals.

The secondary aim of the experiment was to investigate whether phobic participants who were given false feedback would believe that they are not as afraid of spiders as they might have thought, so would rate the size of their imagined spider as smaller compared to non-phobic participants. It was found that the feedback given to phobic participants had no effect on their size estimation of spiders. Therefore, hypothesis 2 which predicted that it would influence their size estimations to be smaller was not supported and the null hypothesis was accepted. This finding suggests that inaccurate verbal feedback is not able to reduce this size estimation bias through convincing spider phobic participants that they are less afraid of spiders than the average person. This finding is not consistent with the majority of the previous findings that false feedback can be used therapeutically to reduce levels of fear and anxiety (Costa, Adams, Jung, Guimbretière, & Choudhury, 2016; Di Loreto, & McDonough, 2013; Holryd, Penzien, Hursey, Tobin, Rogers, Holm, & Chila, 1984; Valins, & Ray, 1967). However a possible explanation to why the current study did not find the same results is due to methodological differences. The current study used verbal feedback explaining that their "'Fear of Spiders' score shows that you are less afaid of spiders than the average person" whereas previous studies typically use biofeedback in the form of heart rate.

Heart rate feedback has the capability of decreasing avoidance behaviour (Valins, & Ray, 1967) and anxiety symptoms (Costa, Adams, Jung, Guimbretière, & Choudhury, 2016) and can also induce physiological arousal (Ehlers, Margraf, Roth, Taylor, & Birbaumer, 1988). Individuals are less likely to question the authenticity of biofeedback which gives it a more compelling nature, making it more effective. Furthermore, if participants are told that their heart rate is lower than if they were experiencing fear, because they are not as physiologically aroused by a frightening stimulus they begin to believe that they must not be as afraid as they thought (Telch, Valentiner, Ilai, Petruzzi, & Hehmsoth, 2000). Using heart rate feedback to convince participants that their levels of arousal is lower than someone who is afraid of spiders might have changed their perceptions about their fear levels and influenced them to give smaller size estimations since they did not view the spider with as much fear. However, Oosterwijk, Lindquist, Adebayo and Barrett, (2016) aimed to influence participants behaviour through administering false feedback about participants mental states when viewing negative stimuli. Participants were led to believe that their mental states were either fear, disgust or morbid fascination when they were viewing the stimuli. To convince participants that this was their mental state, they claimed it was ‘decoded’ from their brain activity. Participants believed the false feedback for 70% of the trials, implying that their false feedback influenced participants emotional reasoning. It is apparent that the effectiveness of feedback is dependent upon telling participants about their bodily states, for example, heart rate or mental states. The current study attempted to convince phobic participants that they were less afraid of spiders than the average person through revealing their FSQ score. However, revealing a questionnaire score was not sufficient enough to change their perceptions about their own fear levels and reduce the size estimation bias exhibited in spider phobic participants. Therefore, to reduce fear levels and subsequently size estimations of spiders, feedback should include information about bodily states. This could be more effective in convincing phobic participants that they are not physiologically aroused and so are not experiencing fear in the presence of phobic stimuli and so would view it as less threatening.

A limitation of the current study which could be improved is that the response scale used did not allow participants to accurately pinpoint the exact size of the spider they imagined. There were no dimensions listed for participants to choose the size from, only pictures showing a range of household objects ranging from a tic-tac to a dinner plate. Since there was no live spider present to compare the size to, participants might have completely guessed since they had no reference point to base it off. To ensure that participants can give an accurate estimation, the response scale could have included some form of dimensions (e.g. mm) or references points such as different sized spiders to allow them to give a more accurate representation of their imagined spider size.

Overall, findings of the current study confirmed the first hypothesis that trait fear is linked to size estimations. However, it did not confirm the second hypothesis that false verbal feedback can be used to reduce this size estimation bias through reducing their perceived fear levels. The reason for the failure of the second hypothesis may actually be due to underestimating the role of disgust in spider phobia. The feedback in the current study only aimed to reduce fear levels in phobic participants, which would have unaffected their levels of disgust and could explain why their size estimations were not smaller. As previously discussed, it is thought that both fear and disgust contribute towards spider phobia (Woody, & Teachman, 2000). Self-reported symptoms of spider phobia are found to be substantially reduced when fear and disgust levels were changed (Olatunji, Huiding, de Jong, & Smiths, 2011) indicating that they may independently mediate changes in symptoms of spider phobic individuals

Conclusions

In conclusion, there is substantial evidence for the link between fear and a size estimation bias. Despite the current study failing to find evidence for the use of false feedback, previous research provides evidence that biofeedback can reduce anxiety and avoidance behaviour. In addition to fear, there is also evidence for a size estimation bias for beetles which were associated with feelings of disgust (Leibovich, Cohen, Henik, 2016), suggesting that this could eqaually be contributing to a size estimation bias as much as fear. Therefore, it is vital that future research investigates whether feedback that reduces both fear and disgust levels in spider phobic individuals would cause them to give smaller size estimations of spiders. This finding could have major therapeutic implications which can be used to reduce spider phobia in individuals and could be potentially be transferred to treat other animal phobias.

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References

Basanovic, J., Dean, L., Riskind, J. H., & MacLead, C. (2019). High spider-fearful and low spider-fearful individuals differentially perceive the speed of approaching, but not receding, spider stimuli. *Cognitive Therapy and Research*, *43(2), 514-521.*

Broeren, S., Lester, K. J., Muris, P., & Field, A. P. (2011). They are afraid of the animal, so therefore I am too: Influence of peer modeling on fear beliefs and approach-avoidance behaviours towards animals in typically developing children. *Behaviour Research and Therapy*, *49(1), 50-57.*

Clerkin, E. M., Cody, M. W., Stefanucci, J. K., Proffitt, D. R., & Teachman, B. A. (2009). Imagery and fear influence height perception. *Journal of anxiety disorders*, *23(3), 381-386.*

Costa, J., Adams, A. T., Jung, M .F., Guimbretière, F., & Choudhury, T. (2016). EmotionCheck: leveraging bodily signals and false feedback to regulate our emotions. *Proceedings of the 2016 ACM International Joint Conference on Pervasive and Ubiquitous Computing*, *(pp. 758-769).*

Davey, G. C. (1992). Classical conditioning and the acquisition of human fears and phobias: A review and synthesis of the literature. *Advances in Behaviour Research and Therapy*, *14(1), 29-66.*

Davey, G. C. (1994). Self-reported fears common indigenous animals in an adult UK population: The role of disgust sensitivity . *British Journal of Psychology*, *84(4), 541-554.*

Davey, G. C. (1991). Characteristics of individuals with fear of spiders. *Anxiety Research*, *4(4), 299-314.*

de Jong, P. J., Andrea, H., & Muris, P. (1997). Spider phobia in children: disgust and fear before and after treatment. *Behaviour Research and Therapy*, *35(6), 559-562.*

Di Loreto, S., & McDonough, K. (2013). The relationship between instructor feedback and ESL student anxiety. *TESL Canada Journal* , *20-20.*

Edwards, S., & Salkovskis, P. M. (2006). An experimental demonstration that fear, but not disgust, is associated with return of fear in phobias. *Journal of Anxiety Disorders*, *20(1), 58-71.*

Ehlers, A., Margraf, J., Roth, W. T., Taylor, C. B., & Birbaumer, N. (1988). Anxiety induced by false heart rate feedback in patients with panic disorder. *Behaviour research and therapy*, *26(1), 1-11.*

Geredes, A. B., Uhl, FG., & Alphers, G. W. (2009). Spiders are special: fear and disgust evoked by pictures of arthropods. *Evolution and Human Behaviour*, *30(1), 66-73.*

Gilbert, C. (1986). Skin conductance feedback and panic attacks. *Biofeedback and Self-regulation*, *11(3), 251-254.*

Goessl, V. C., Curtiss, J. E., & Hofmann, S. G. (2017). The effect of heart rate variability biofeedback training on stress and anxiety: a meta-analysis. *Psychological medicine* , *47(15), 2578.*

Guess, M. N., Steffanucci, J. K., de Benedictis-Kessner, J., & Stevens, N. R. (2010). A balancing act: Physical balance, through arousal, influences size perception. *Attention, Perception, & Psychophysics*, *72(7), 1890-1902.*

Holryd, K. A., Penzien, D. B., Hursey, K. G., Tobin, D. L., Rogers, L., Holm, J. E., & Chila, A. G. (1984). Change mechanisms in EMG biofeedback training: cognitive changes underlying improvements in tension headache. *Journal of consulting and clinical psychology*, *52(6), 1039.*

Leibovich, T., Cohen, N., Henik, A. (2016). Itsy bitsy spider? *Biological Psychology*, *121, 138-145.*

Matchett, G., & Davey, G. C. (1991). A test of a disease-avoidance model of animal phobias. *Behaviour Research and Therapy*, *29(1), 91-94.*

Morey., D. R., Rouder, N., J. BayesFactor. (2018). Retrieved from Computation of Bayes Factors for Common Designs. R package version 0.9. 12-4.2: https://CRAN.R-project.org/package=BayesFactor

Mulkens, S. A., de Jong, P. J., & Merckelbach, H. (1996). Disgust and spider phobia. *Journal of abnormal psychology*, *105(3), 464.*

Muris, P., & Mercklebach, H. (1996). A comparison of two spider fear questionnaires. *Journal of behaviour therapy and experimental psychiatry* , 27(3), 241-244.

Nunes, J. S., & Marks. (1975). Feedback of true heart rate during exposure in vivo. *Archives of General Psychiatry*, *32(7), 933-936.*

Öhman, A., Flykt, A., & Esteves, F. (2001). Emotion drives attention: detecting the snake in the grass. *Journal of experimental psychology: general*, *130(3), 466.*

Olatunji, B. A., Huiding, J., de Jong, P. J., & Smits, J. A. (2011). The relative contributions of fear and disgust reductions to improvements in spider phobia following exposure-based treatment. *Journal of Behavior Therapy and Experimental Psychiatry*, *42(1), 117-121.*

Oosterwijk, S., Lindquist, K. A., Adebayo, M., & Barrett, L. F. (2016). The neural representation of typical and atypical experiences of negative images: Comparing fear, disgust and morbid fascination. *Social Cognitive and Affective Neuroscience*, *11(1), 11-22.*

R Core Team. (2020). *R Foundation for Statistical Computing, Vienna, Austria*. Retrieved from R: A language and environment for statistical computing: https://www.R-project.org/.

Reinecke, A., Becker, E. S., & Rinick, M. (2010). Visual working memory and threat monitoring: Spider fearfuls show disorder-specific change detection. *Behaviour research and therapy*, *48(8), 770-778.*

Riskind, J. H., Kelley, K., Harman, W., Moore, R., & Gaines, H. S. (1992). The loomingness of danger: Does it discriminate focal phobia and general anxiety from depression? *Cognitive Therapy and Research*, *16(6), 603-622.*

Sawchuk, C. N., Lohr, J. M., Westendorf, D. H., Meunier, S. A., & Tolin, D. F. (2002). Emotional responding to fearful and disgusting stimuli in specific phobics. *Behaviour research and therapy*, *40(9), 1031-1046.*

Shiban, Y., Fruth, M. B., Pauli, P., Kinateder, M., Reichenberger, J., & Mühlberger, A. (2016). Treatment effect on biases in size estimation in spider phobia. *Biological Psychology*, *121, 146-152.*

Stefanucci, J. K., & Proffitt, D. R. (2009). The roles of altitude and fear in the perception of height. *Journal of Experimental Psychology: Human Perception and Performance*, *35(2), 424.*

Story, T. J., & Craske, M. G. (2008). Responses to false physiological feedback in individuals with panic attacks and elevated anxiety sensitivity. *Behaviour research and therapy*, *46(9), 1001-1008.*

Szymanski, J., O'Donohue, W. (1995). Fear of spiders questionnaire. *Journal of behaviour therapy and experimental psychiatry* , *26(1), 31-34.*

Teachman, B. A., Stefanucci, J. K., Clerkin, E. M., Cody, M. W., & Proffitt, D. R. (2008). A new mode of fear expression: Perceptual biases in height fear . *Emotion*, *8(2), 296.*

Telch, M. J., Valentiner, D. P., Ilai, D., Petruzzi, D., & Hehmsoth, M. (2000). The facilitative effects of heart-rate feedback in the emotional processing of claustrophobic fear. *Behaviour Research and Therapy*, *38(4), 373-387.*

Valins, S., & Ray, A. A. (1967). Effects of cognitive desensitisation on avoidance behaviour. *Journal of Personality and Social Psychology*, *74(p1), 345.*

van Overveld, M., de Jong, P. J., & Peters, M. L. (2006). Differential UCS expectancy bias in spider fearful individuals: Evidence towards an association between spiders and disgust-relevant outcomes. *Journal of Behaviour Therapy and Experimental Psychiatry*, *37(1),60-72.*

Vasey, M. W., Vilensky, M. R., Heath, J. H., Harbaugh, C. N., Buffington, A. G., & Farzio, R. H. (2012). It was as big as my head, I swear! Biased spider size estimation in spider phobia. *Journal of anxiety disorders*, *26(1), 20-24.*

Vernon, L. L., & Berenbaum, H. (2002). Disgust and fear in response to spiders. *Cognition & Emotion, 16(6), 809-830.*

Woody, S. R., & Teachman, B. A. (2000). Intersection of disgust and fear: Normative and pathological views. *Clinical Psychology: Science and Practice*, *7(3), 291-311.*

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