Original Article

Sex Differences in the Effects of Anxiety and Anxiety Sensitivity on Visual Perception

Savaş Yılmaz[1], Ömer Faruk Akça[1], Burak Açıkel[1], Ayhan Bilgiç[1], Emine Zinnur Kılıç[2]

ABSTRACT

Objective: Most previous studies investigating the relationship between visual perception and anxiety have found that anxiety-provoking stimuli are perceived as relatively larger in size. Thus, the present study used neutral stimuli to investigate the relationships among anxiety, anxiety sensitivity (AS), and visual perception in a group of male and female university students. Methods: The Visual Size Perception Assessment Test (V-SPAT), which requires subjects to define a neutral figure in a dichotomous manner (i.e., tall/short, large/small, wide/narrow, crowded/deserted) was administered to all participants (n:76). Additionally, the anxiety level and AS of each participant was determined using the Beck Anxiety Inventory (BAI) and the Anxiety Sensitivity Index-3 (ASI-3), respectively. Results: The BAI and ASI-3 total and cognitive scores of female participants were correlated with perceptions of "deserted", whereas their ASI-3 social scores were correlated with perceptions of "short". The ASI-3 cognitive scores of male participants were correlated with perceptions of "crowded", and their ASI-3 physical scores were correlated with perceptions of "tall". The present findings indicate that the visual perception of neutral objects is correlated with anxiety and AS. Conclusion: Furthermore, these data revealed sex differences in the relationship between AS and visual perception in that males perceived the objects as larger and females perceived them as smaller.

Key words: Size perception, anxiety, anxiety sensitivity, sex differences, visual perception

Anksiyete ve Anksiyete Duyarlılığının Görsel Algı Üzerindeki Etkisi ve Cinsiyetlere Göre Farklılıkları

ÖZET

Amaç: Görsel algı ve anksiyete ilişkisini araştıran çalışmalar, anksiyeteyi tetikleyen uyaranların cisimlerin daha büyük olarak algılanmasına neden olduklarını bildirilmiştir. Bu çalışmada, nötral (anksiyete tetiklemeyen) görsel uyaranlarla, anksiyete, anksiyete duyarlılığı ve görsel algı ilişkisinin değerlendirilmesi amaçlanmıştır. Metod: Üniversite öğrencilerinden oluşan gönüllülere (n:76), nötral figürlerin dikotomize edilerek sınıflandırılmasını amaçlayan (uzun/kısa, büyük/küçük, geniş/dar, sık/seyrek) Görsel Büyüklük Algısı Değerlendirme Testi uygulanmıştır. Test sonrasında katılımcılara Beck Anksiyete Ölçeği (BAÖ) ve Anksiyete Duyarlılığı İndeksi-3(ADI-3) uygulanarak katılımcıların anksiyete ve anksiyete duyarlılığı düzeyleri belirlenmiştir. Bulgular: Kadınlarda, BAÖ, ADI-3 toplam ve ADI-3 bilişsel puanları seyrek algılama ile, ADI-3 sosyal puanları da kısa algılama ile ilişkiliydi. Erkeklerde ise ADI-3 bilişsel puanları kalabalık algılama ile ADI-3 fiziksel puanları da uzun algılama ile ilişkiliydi. Bu çalışmanın bulguları görsel algının nötral objelerde de anksiyete duyarlılığı ve anksiyete ile ilişkili olduğunu göstermiştir. Sonuç: Bununla birlikte bu ilişki cinsiyetlere göre farklılık göstermektedir. Yüksek anksiyete duyarlılığına sahip olan erkekler cisimleri daha büyük olarak algılarken, kadınlar daha küçük algılama eğilimindedirler.

Anahtar kelimeler: Büyüklük algısı, anksiyete, anksiyete duyarlılığı, cinsiyet farkı, görsel algı

[1]Necmettin Erbakan University Meram School of Medicine, Department of Child and Adolescent Psychiatry, Konya.[2]Professor, Private Practice, İstanbul, Turkey

Correspondence: Savaş Yılmaz, M.D.,
Necmettin Erbakan Üniversitesi Meram Tıp Fakültesi Çocuk ve Ergen Psikiyatrisi Anabilim Dalı, 42090 Meram, Konya, Turkey
Tel: +90 332 2237935, Fax: +90 332 2237357
E-mail: drsavash@gmail.com

INTRODUCTION

Visual perception is a complex process that can be affected by a variety of factors, such as emotion, motivation, life experiences, condition, and the location of the person or perceived object (1). Most studies investigating the relationships among anxiety, fear, and visual perception have found that anxious individuals demonstrate cognitive biases, especially with regard to threat-relevant stimuli (2). Among individuals with specific phobias, a small snake may cause an exaggerated behavioural reaction, a harmless spider may appear to move at breakneck speed, and a neutral facial expression can suddenly appear to be a threatening stimulus (3). For example, a spider depicted in a video as crawling toward them is seen as faster (4) and larger (5) by individuals who fear spiders than by non-fearful individuals. Likewise, fearful individuals verbally report higher estimates of the flickering tongue movements of a snake and of the jumping movements of a spider compared with non-fearful individuals (6); these biases diminish following fear reduction. Similarly, subjects more frequently overestimate the height of a balcony after imagining themselves falling, particularly if they were already afraid of heights(3). Height is consistently overestimated when subjects are asked to estimate the distance from the top rather than from the bottom of a balcony (7), and this overestimation is thought to be due to fear.

Previous studies have demonstrated that perceptual distortions occur under anxiety-provoking conditions, but data regarding the relationship between anxiety and the perceived size of a neutral object remain limited. Additionally, questions about sex differences in visual perception under anxiety-provoking conditions remain untested, and the influence of anxiety sensitivity (AS), which reflects a constitutional vulnerability to anxiety disorders, on perception has yet to be studied. Therefore, the present study investigated the relationships among anxiety, AS, and the visual perception of the size of neutral objects in male and female young adults. We have hypothesized that anxiety and AS is associated with neutral visual perception. Additionally, we aimed to test whether this relationship is different between the sexes.

MATERIALS AND METHODS

Sample and procedure

Approval for this study was obtained from the Institutional Review Board of Meram Faculty of Medicine. A total of 76 young adults were recruited from the fourth and fifth grades students of a medical faculty, but two participants were excluded from the study due to inconsistent answers to the perception tests; thus, a total of 74 participants were included in the final analyses. In order to minimise confounding factors, such as intelligence and age, the participants were recruited from similar grades at the same faculty. The exclusion criteria included the use of psychotropic drugs and the presence of any disability that prevented participation in the study procedure (i.e., severe visual or hearing problems, inability to stand, or inability to complete the forms).

First, all participants were individually invited to a classroom where the procedures for assessing visual size perception were administered. Because we could not find a suitable test for our study design (assessing the size of a neutral object), we settled on a novel task. The Visual Size Perception Assessment Test (V-SPAT)—an instrument developed by the present authors—was explained to the participants prior to its administration. During the V SPAT, each subject stood 175 cm in front of a screen (125 × 140 cm; 115 cm above the ground) that presented a scene that was followed by the relevant subtest: tall/short, large/small, wide/narrow, and crowded/deserted. That is, in the tall/short test, the participant was asked to classify the image as "tall" or "short" immediately following its presentation. The tallest and shortest images (bars) were initially presented as guides, and participants were then randomly presented with bars of various heights. Subsequently, the same procedure was employed for the other subtests, which were administered in the following order: wide/narrow, large/small, and crowded/deserted. The guide images used in the V-SPAT test are presented in Figure 1. All images were produced using Microsoft Office 2007 PowerPoint software.

Each subtest consisted of 10 images: images in the tall/short subtest were 12.3–123 cm in height; images in the wide/narrow subtest were 13.7–137 cm in width, and images in the large/small test were 13.7–137 cm in diameter. In the crowded/deserted test, participants were presented with randomly presented scenes that contained between five and 50 circles that were 6.5 cm in diameter. Responses were recorded by one of the authors (SY).
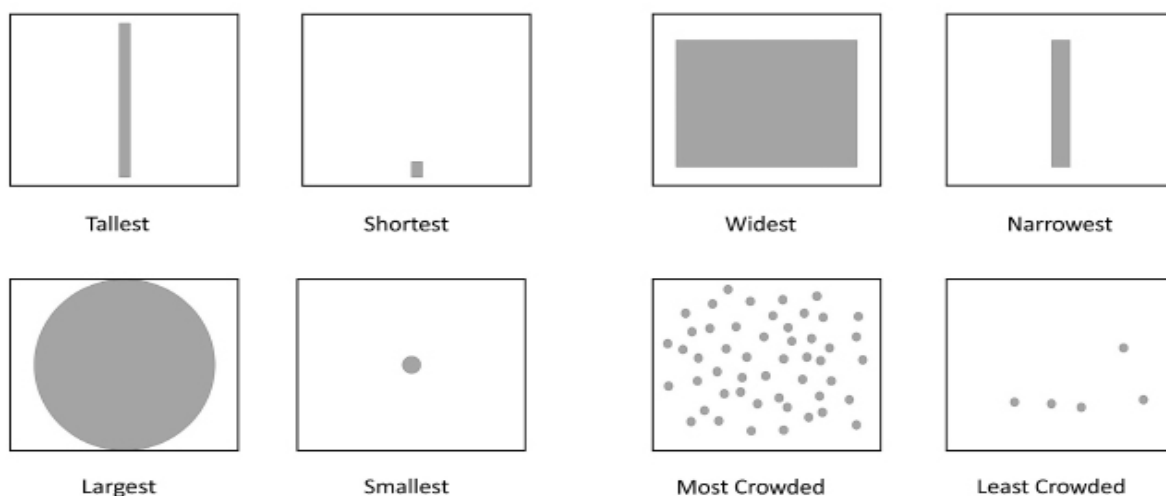
Figure 1. *Guide images shown to the subjects in the V-SPAT test*

Finally, the age, weight, and height of participants were recorded, and each participant completed the anxiety and AS scales.

Measures

Beck Anxiety Inventory (BAI): The BAI, which was developed by Beck at al. (8) and translated into Turkish by Ulusoy et al. (9), was used to assess the anxiety levels of participants. This self-administered instrument consists of 21 items rated on a Likert-type scale; total scores range between 0 and 63, and higher scores indicate higher levels of anxiety. The reliability (Cronbach's alpha) of the scale is 0.90.

Anxiety Sensitivity Index-3 (ASI-3): The ASI-3, which was developed by Taylor et al. (10), was used to assess AS. This 18-item measure consists of three six-item subscales (physical, cognitive, and social); total ASI-3 scores range between 0 and 54, and higher scores indicate higher levels of AS. A validation and reliability study of the ASI-3 has been conducted in Turkey (11).

Statistical analyses

All data analyses were performed using SPSS 17.0 statistical software (Chicago, IL, USA), and descriptive statistics were used in the analyses of the participants' demographic characteristics. The Kolmogorov-Smirnov test was used to determine the normality of distributions. The relationships among the BAI, ASI-3 and V-SPAT were examined using Spearman and partial correlation tests. The randomly shown images of the V-SPAT subscales, as well as the answers of the subjects, were ordered according to their sizes and the image which the subject described: tall/large/big/crowded were described as the subscale cutoff points. For example, participants who described the first seven images as "short" and the eighth and subsequent images as "tall" earned a score of 8 on the tall/short subscale, and all correlation tests were conducted based on these V-SPAT scores. Because none of the V SPAT test results were normally distributed, uncontrolled analyses were conducted using Spearman correlation analyses. Thereafter, in light of the literature indicating that age, weight and height may affect perceptions (12-14), the same correlation analyses were conducted using a partial correlation test controlling for these variables. Finally, we conducted the same procedure for both sexes. The significance level was set at 0.05 (two-tailed) and results with a p-value between 0.05 and 0.10 were described as "showing a trend toward correlation" due to the small sample size.

RESULTS

The sample consisted of 49 males (66.2%) and 25 females (33.8%) aged 20-24 years (mean age: 22.21±0.72 years); males and females did not differ significantly regarding age (Z = −.98, p = 0.32).

Table 1. Correlations between the BAI, ASI-3, and V-SPAT subtests before and after controlling for age, height and weight.

			BAI	AS Total	AS Physical	AS Cognitive	AS Social
TOTAL	Tall/Short	Uncontrolled	.04	-.09	-.14	.01	-.05
		Controlled	.05	-.08	-.19t	-.01	.02
	Wide/Narrow	Uncontrolled	-.06	-.06	-.03	.00	-.10
		Controlled	-.05	-.11	-.04	-.06	-.16
	Large/Small	Uncontrolled	-.20t	-.10	-.03	-.10	-.10
		Controlled	-.13	-.10	-.11	-.10	-.02
	Crowded/Deserted	Uncontrolled	.19t	-.03	.04	-.03	-.08
		Controlled	.21t	-.02	.00	.00	-.09

AS: Anxiety sensitivity, BAI: Back Anxiety Inventory, V-SPAT: Visual Size Perception Assessment Test

Controlled: Controlled for age, height, and weight ^{t}: $0.05 < p < 0.10$, *: $p < 0.05$, **: $p < 0.001$

According to the Spearman correlation analysis of the entire sample, there was a trend toward a correlation between BAI scores and responses to the crowded/deserted subscale; there was also a trend toward a negative correlation between BAI scores and the large/small subscale of the V SPAT. After controlling for age, weight and height, there was a trend toward a correlation between BAI scores and responses to the crowded/deserted subscale; there was also a trend toward a negative correlation between ASI-3 physical subscales and the tall/short subscale responses (Table 1). According to the Spearman correlation tests conducted on both sexes, crowded/deserted subscale scores were significantly correlated with BAI scores and the ASI-3 cognitive subscale scores, and crowded/deserted subscale scores showed a trend toward a correlation with ASI-3 total scores in females. However, in males, there was a trend toward for a negative correlation between the ASI-3 physical subscale scores and the tall/short subscale scores; furthermore, males also a trend toward a negative correlation between ASI-3 cognitive subscale scores and crowded/deserted subscale scores. According to the partial correlation tests conducted for both sexes, the BAI scores and the scores on the ASI-3 cognitive subscale for females were significantly correlated with their responses to the crowded/deserted subscale of the V-SPAT after controlling for weight and height. Additionally, there was a trend toward a correlation between the total ASI-3 scores and crowded/deserted, and also between the ASI 3 social subscale and tall/short subscales of the V-SPAT in females. Among males, scores on the ASI-3 physical subscale were significantly negatively correlated with responses to the

tall/short subscale of the V-SPAT; also, the scores on the ASI-3 cognitive subscale showed a trend toward a negative correlation with responses to the V-SPAT crowded/deserted subscale. The partial correlation analyses results are presented in Table 2.

DISCUSSION

The main hypothesis of the present study was that higher levels of anxiety and AS would be associated with a tendency for healthy individuals to describe neutral visual images as "larger", "wider", "taller", or "more crowded". As predicted, higher levels of AS physical and AS cognitive concerns were correlated with the description of images as "taller" and "more crowded", respectively, among males. However, contrary to the hypothesis, higher levels of anxiety and of AS total and AS cognitive concerns were more strongly correlated with descriptions of images as "less crowded" among females than among males. Additionally, AS social concerns were positively related to a description of neutral visual images as "shorter" among females.

Higher levels of anxiety have been related to the perception and recall of anxiety-related objects as larger or higher (5, 7, 15). Nevertheless, some studies have found that children's drawings depict frightening or bad figures as smaller than neutral ones (16, 17) and that children with a fear of witches draw smaller witch figures than do children without witch-related fears (18). In the present study, the severity of anxiety symptoms was related to the description of images as "deserted" by females,

Table 2. Correlations between the BAI, ASI-3, and V-SPAT subtests before and after controlling for age, height and weight in both sexes.

Sex			BAI	AS Total	AS Physical	AS Cognitive	AS Social
Female	Tall/Short	Uncontrolled	-.09	-.00	-.03	-.05	.09
		Controlled	-.01	.11	.04	-.02	.36^t
	Wide/Narrow	Uncontrolled	-.07	-.05	.02	-.01	-.09
		Controlled	-.01	-.08	.05	-.11	-.15
	Large/Small	Uncontrolled	-.21	-.15	-.06	-.13	-.11
		Controlled	-.03	-.14	-.26	-.09	-.01
	Crowded/Deserted	Uncontrolled	.67**	.36^t	.20	.45*	.16
		Controlled	.70**	.36^t	.22	.46*	.12
Male	Tall/Short	Uncontrolled	.13	-.18	-.25^t	.03	-.20
		Controlled	.10	-.24	-.32*	-.05	-.19
	Wide/Narrow	Uncontrolled	.03	-.04	-.11	.08	-.06
		Controlled	-.02	-.09	-.07	-.01	-.12
	Large/Small	Uncontrolled	-.13	-.07	-.05	-.05	-.06
		Controlled	-.19	-.05	-.07	-.03	.00
	Crowded/Deserted	Uncontrolled	.05	-.22	-.08	-.25^t	-.14
		Controlled	.03	-.21	-.12	-.24^t	-.15

AS: Anxiety sensitivity, BAI: Back Anxiety Inventory, V-SPAT: Visual Size Perception Assessment Test
Controlled: Controlled for age, height, and weight , ^{t}: $0.05 < p < 0.10$, *: $p < 0.05$, **: $p < 0.001$,

which seems to be congruent with the drawing studies in children. However, no correlation was found between anxiety symptoms and visual perception in males. This difference between males and females may suggest that the anxiety–perception relationship acts via different mechanisms in males and females.

Similar to the relationship between the severity of anxiety symptoms and the perception of object characteristics found in the present study, the data also revealed positive relationships between the AS levels of female participants and their perception of objects as "shorter" and "less crowded". In contrast, higher levels of AS concerns were related to the perception of neutral images as "taller" and "more crowded" among males. To our knowledge, no data regarding the relationship between AS and object perception exist. However, these findings may be considered incongruent with a previous view that suggested that the perceptual distortions of anxious individuals can be interpreted as a bias that originates in emotions (7). Given that AS is regarded as a relatively stable constitutional variable, it is suggested that AS may affect the visual perception of both males and females.

However, AS seems to have differential effects on the object perception of males and females. Studies regarding the contrasting effects of anxiety and AS on the pain sensations experienced by males and females also seem to support the role of these constructs during perception. Females rate pain higher than do men following the application of topical capsaicin but, despite their lower pain ratings, males have more anxiety related to the pain (19). There is also evidence for a relationship between AS and negative pain responses in women but not in men (20). It is possible that the differing effects of AS on perception in males and females is explained by sex-related structural and functional differences in the amygdala involving the neurocircuitry of fear (21, 22).

Previous studies have reported that perception of the different dimensions (i.e., vertical and horizontal distance, slant and size perceptions) may not be correlated. For instance, slant is typically overestimated and distance is usually underestimated. Additionally, the size of an object is estimated correctly, however, the vertical distance of a balcony is overestimated (7). Similar to previous reports, the results of the present study indicate that several subscales of the V-SPAT were correlated to BAI or AS scores, however, the others were not. The V-SPAT wide/narrow and large/small perception subscales did not re-

veal any correlations when age, height and weight were controlled in the whole group or the analysis was conducted in both sexes. These differences may be attributed to the effect of anxiety or AS on various dimensions of visual size perception.

The small sample size and unbalanced gender distribution are significant weaknesses of the present study. Additionally, standardised diagnostic interviews were not used to determine the presence of psychiatric disorders. In summary, the present study provides preliminary evidence regarding the relationships among anxiety, AS, and the visual perception of neutral objects, including that this relationship differs in males and females. Future studies on this subject will further contribute to knowledge concerning the relationships of perception, anxiety, and AS in both males and females.

REFERENCES

1. *Stefanucci JK, Gagnon KT, Lessard DA. Follow your heart: Emotion adaptively influences perception. Soc Personal Psychol Compass 2011;5(6):296-308. PubMed PMID: 21731579. PMCID: 3124782.*

2. *Cisler JM, Koster EH. Mechanisms of attentional biases towards threat in anxiety disorders: An integrative review. Clin Psychol Rev 2010;30(2):203-16. PubMed PMID: 20005616. PMCID: Pmc2814889. Epub 2009/12/17.*

3. *Clerkin EM, Cody MW, Stefanucci JK, Proffitt DR, Teachman BA. Imagery and fear influence height perception. J Anxiety Disord 2009;23(3):381-6. PubMed PMID: 19162437. PMCID: 2650002.*

4. *Riskind J, Kelley K, Harman W, Moore R, Gaines H. The loomingness of danger: Does it discriminate focal phobia and general anxiety from depression? Cognit Ther Res 1992;16(6):603-22.*

5. *Vasey MW, Vilensky MR, Heath JH, Harbaugh CN, Buffington AG, Fazio RH. It was as big as my head, I swear! Biased spider size estimation in spider phobia. J Anxiety Disord 2012;26(1):20-4. PubMed PMID: 21906909. PMCID: 3244514.*

6. *Rachman S, Cuk M. Fearful distortions. Behav Res Ther 1992;30(6):583-9. PubMed PMID: 1358058. Epub 1992/11/01.*

7. *Stefanucci JK, Proffitt DR. The roles of altitude and fear in the perception of height. J Exp Psychol Hum Percept Perform 2009;35(2):424-38. PubMed PMID: 19331498. PMCID: 3398806.*

8. *Beck AT, Epstein N, Brown G, Steer RA. An inventory for measuring clinical anxiety: psychometric properties. J Consult Clin Psychol 1988;56(6):893. PubMed PMID: 3204199.*

9. *Ulusoy M, Sahin N, Erkmen H. Turkish version of the Beck Anxiety Inventory: psychometric properties. Journal of cognitive psychotherapy 1998;12:163-72.*

10. *Taylor S, Zvolensky MJ, Cox BJ, et al. Robust dimensions of anxiety sensitivity: development and initial validation of the Anxiety Sensitivity Index-3. Psychol Assess 2007;19(2):176-88. PubMed PMID: 17563199.*

11. *Mantar A, Yemez B, Alkin T. The validity and reliability of the Turkish version of the anxiety sensitivity index-3. Turk Psikiyatri Derg 2010;21(3):225-34. PubMed PMID: 20818510.*

12. *Linkenauger SA, Leyrer M, Bulthoff HH, Mohler BJ. Welcome to wonderland: the influence of the size and shape of a virtual hand on the perceived size and shape of virtual objects. PLoS One 2013;8(7):e68594. PubMed PMID: 23874681. PMCID: 3708948.*

13. *Piryankova IV, Wong HY, Linkenauger SA, et al. Owning an overweight or underweight body: distinguishing the physical, experienced and virtual body. PLoS One 2014;9(8):e103428. PubMed PMID: 25083784. PMCID: 4118886.*

14. *Nelson M, Atkinson M, Darbyshire S. Food photography. I: The perception of food portion size from photographs. Br J Nutr 1994;72(5):649-63. PubMed PMID: 7826990.*

15. *Teachman BA, Stefanucci JK, Clerkin EM, Cody MW, Proffitt DR. A new mode of fear expression: perceptual bias in height fear. Emotion 2008;8(2):296-301. PubMed PMID: 18410203. PMCID: 3182306.*

16. *Thomas GV, Chaigne E, Fox TJ. Children's drawings of topics differing in significance: Effects on size of drawing. Br J Dev Psychol 1989;7(4):321-31.*

17. *Golomb C. The child's creation of a pictorial world. Berkeley: University of California Press; 1992. 305 p.*

18. *Fox TJ, Thomas GV. Children's drawings of an anxiety-eliciting topic: effects on the size of the drawing. Br J Clin Psychol 1990;29 (Pt 1):71-81. PubMed PMID: 2310872.*

19. *Frot M, Feine JS, Bushnell MC. Sex differences in pain perception and anxiety. A psychophysical study with topical capsaicin. Pain 2004;108(3):230-6. PubMed PMID: 15030942.*

20. *Keogh E, Hamid R, Hamid S, Ellery D. Investigating the effect of anxiety sensitivity, gender and negative interpretative bias on the perception of chest pain. Pain 2004;111(1-2):209-17. PubMed PMID: 15327825.*

21. *Schwabe L, Hoffken O, Tegenthoff M, Wolf OT. Opposite effects of noradrenergic arousal on amygdala processing of fearful faces in men and women. Neuroimage 2013;73:1-7. PubMed PMID: 23380165.*

22. *Tang T, Jiao Y, Wang X, Lu Z. Gender versus brain size effects on subcortical gray matter volumes in the human brain. Neurosci Lett 2013;556:79-83. PubMed PMID: 24103376.*