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THE EFFECTS OF STATE ANXIETY ON OLFACTORY FUNCTION IN HEALTHY YOUNG ADULTS

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BACKGROUND

• Anxiety is a universal and natural multisystem response to a perceived threat in an individual’s internal or external stimuli (Davidson, 2002).
• State anxiety refers to a transitory negative emotional response to specific stressful or threatening conditions or stimuli (Spielberger, 1972).
• Levels of state anxiety may fluctuate over time and across situations.
• State anxiety has the potential to elicit various emotional, behavioral, and cognitive changes, which can have short-term or long-term effects on an individual’s functioning.

• There is significant overlap between the limbic and olfactory systems that translates to a high level of functional connectivity in the amygdala, the hippocampus, and the frontal lobe responsible for the anxiety-olfaction interaction (Soudry et al., 2011; Zaid & Pardo, 1997).
• Research on the effect of changing levels of state anxiety on olfaction is limited to the following findings:
  • Individuals reporting higher levels of state and trait anxiety yield higher olfactory threshold scores and lower odor identification accuracy scores (Takahashi et al., 2015).
  • Increase in levels of state anxiety precipitate a deficit in odor threshold, an increase in odor identification accuracy, and a tendency to rate normatively neutral odors as intensely pleasant (Kruze et al., 2020).

• The purpose of this study was to expand the literature on the relationship between levels of state anxiety and olfaction by investigating the effects of anxiety induction on odor detection sensitivity, odor identification accuracy, and odor hedonic ratings in a healthy young adult population.
• Sex differences were also explored.

HYPOTHESES

Hypothesis 1. Participants in the anxiety induction group will exhibit a significant decrease in post-induction odor threshold scores, compared to baseline scores, while odor threshold scores will remain stable in the control group.

Hypothesis 2. Participants in the anxiety induction group will exhibit a significant increase in their post-induction odor identification accuracy scores, compared to baseline scores, while odor identification accuracy will remain stable in the control group.

Hypothesis 3. Participants in the anxiety induction group will rate odors that are normatively neutral as more unpleasant post-induction.

METHODS

Sample
• 46 undergraduate students at a Midwestern university participated in the study for course required research credit
  • 56.5% female (20 males, 26 females)
  • Mean age = 18.94 (SD = 1.01)

Experimental Groups
• Participants were randomly assigned to either the experimental anxiety induction group or the control non-induction group.

Measures
• State-Trait Anxiety Inventory for Adults (STAI-A; Spielberger, Forusch, & Luscheine, 1983): 40-item self-report measure for state anxiety and trait anxiety, yielding two scores for each respective type of anxiety. State anxiety scores were included in our analysis, while also controlling for baseline trait anxiety scores.

• Sniffin’ Sticks Threshold Test (Burghart Instruments, Wedel, Germany) was used to assess odor detection acuity.

• Sniffin’ Sticks Extended Identification Test (Burghart Instruments, Wedel, Germany) was used to assess identification of 32 common odorants (e.g. orange, peppermint, rose) (Figure 1, left).

• Olfactory Hedonics: Ratings of odor pleasantness and unpleasantness were assessed following the administration of each Sniffin’ Sticks Identification odorant using two five-point unipolar scales (Figure 1, right).

RESULTS

Preliminary Analyses
• Data were examined for kurtosis and skewness, as well as for the presence of outliers.
  • Found that none of the variables exceeded the acceptable ranges for skewness and kurtosis and thus were determined to be normally distributed
  • Identified the presence of one outlier, which was subsequently removed from the data set analysis.

Manipulation Check
• Mean baseline and post-test state anxiety scores are displayed in Figure 2 and are the average score for all items in the state-axiety scale.
  • ANCOVA results, controlling for baseline trait anxiety, indicated a significant group by state anxiety effect, Wilks’ Lambda = 0.879, F(1, 42) = 5.805, p = 0.0185, partial η2= 0.119.
  • Control group state anxiety scores significantly decreased from baseline to post-induction, Wilks’ Lambda = .881, F(1, 42) = 5.664, p = .022, partial η2= .119.
  • Significant changes were not observed in the experimental group (p = .271).
  • Hypotheses could not be tested as planned due to ineffectiveness of anxiety induction paradigm
  • Instead, exploratory analyses were conducted to see if the reduction in state anxiety in the control group would have the opposite effect of what was predicted for the experimental group.

Odor Threshold [Sensitivity]
• Mean odor threshold scores are presented in Figure 3.
  • ANCOVA results, controlling for trait anxiety, indicated that there was not a significant group by threshold effect, Wilks’ Lambda = .970, F(1, 42) = 1.307, p = .259, partial η2= .030.

Odor Identification Accuracy
• Mean odor identification accuracy scores are presented in Figure 4.
  • ANCOVA results, controlling for trait anxiety, indicated that there was a significant group by odor identification accuracy effect, Wilks’ Lambda = .710, F(1, 42) = 11.446, p = .002, partial η2= .119.
  • Control group odor identification accuracy scores significantly increased from baseline to post-induction, Wilks’ Lambda = .786, F(1, 42) = 10.81, p = .005, partial η2= .144.
  • Experimental group odor identification accuracy scores significantly decreased from baseline to post-induction, Wilks’ Lambda = .875, F(1, 42) = 6.002, p = .018, partial η2= .125.

Odor Hedonics [Pleasantness/Unpleasantness]
• Mean odor hedonic ratings are presented in Figure 8.
  • There was no significant group by odor hedonic ratings effect, Wilk’s Lambda = .992, F(1, 42) = 1.677, p = .685, partial η2= .004.

CONCLUSIONS

• Anxiety induction did not work as predicted, as state anxiety scores did not significantly change post-induction.
  • However, results suggest that the free-line coloring task utilized appears to lower an individual’s experience of state anxiety.
  • This may be due to the potentially stress-relieving effects of coloring.

• Furthermore, lowered state anxiety was associated with an increase in an individual’s odor identification accuracy, which are a measure of central olfactory processing function.
  • This finding is consistent with experimental findings that demonstrate anxiety-induction is associated with a decreased in an individual’s odor identification accuracy (Krusemark et al., 2013), but is inconsistent with other findings that appear to show higher levels of state anxiety are associated with lower odor identification accuracy scores (Takahashi et al., 2015).
  • Must note that consistency and inconsistency cannot be definitively established since the studies aforementioned were not specifically looking at the effects of anxiety reduction, but rather anxiety induction.

• Further research should be conducted specifically aimed at examining the effects of lowering an individual’s experience of state anxiety and at the effects of varying levels of state anxiety on odor threshold and odor hedonics.

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