Neurobiological Factors of Trait Anxiety and Their Effects on Individual Cognitive Performance

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Abstract: Trait anxiety refers to the general and stable personality traits that individuals become anxious, or a tendency and susceptibility to anxiety. Because there are many comorbidities in patients with anxiety disorder, it is not easy to carry out strict experimental research directly. Therefore, from the perspective of the continuity of anxiety development, a systematic study on the key cognitive components of anxiety for the special group of trait anxiety individuals is not only conducive to deepen our understanding and understanding of the key cognitive symptoms of anxiety disorder, but also provide experimental evidence for the early identification, intervention and later treatment of anxiety disorder with noninvasive brain stimulation.

1. Introduction

When people face the same stress situation, they often show different anxiety levels and coping strategies. This difference in behavior is largely affected by trait anxiety. Trait anxiety is an anxiety tendency and personality trait with individual differences and relative stability. At the same time, trait anxiety, as the main factor of neuroticism in the big five personality, is closely related to mental diseases such as anxiety and depression, and shows 40% ~ 60% inheritance. When facing the same coping environment, individuals with different trait anxiety levels have differences in physiological response and cognitive performance. With the same growth experience, individuals with high trait anxiety (HTA) will show a higher level of anxiety for the same specific situation. Moreover, when facing the same stress situation, such as an upcoming speech task, cognitive reappraisal strategy can alleviate the anxiety of individuals with low trait anxiety (10 W trait anxiety, LTA), but can not alleviate the anxiety HJ of individuals with HTA. At the same time, after acute stress, LTA individuals showed impaired inhibition in flanking tasks, while HTA individuals performed worse in alternative use tests (fluency, flexibility and originality). Different trait anxiety levels are one of the main risk factors leading to the difference of stress susceptibility among individuals. Compared with LTA individuals, HTA individuals tend to show more abnormal behavior, cognitive defects and physiological stress response during stress, which makes HTA individuals more prone to mental disorders such as anxiety and depression. Deeply analyze the neurobiological factors of trait anxiety and its impact on individual cognitive performance, in order to provide reference for future related research or clinical treatment [1].

2. Neurobiological Factors of Trait Anxiety

2.1 Trait Anxiety and Gene Polymorphism

Gene polymorphism can affect the level of individual trait anxiety. The current research mainly includes serotonin transporter gene (5-HTT) and brain-derived neurotrophic factor gene (BDNF). The 5-HTT promoter sequence includes two alleles: short (s) and long (10NG, l). Compared with the L allele, the S allele can reduce the transcriptional efficiency of the gene, resulting in the decrease of the expression of serotonin transporter (5-h) in neurons, which may be related to the higher level of trait anxiety. Zhang et al. Found that the S / s homozygous of 5-HTT promoter had higher trait anxiety level than the L allele carriers, and the polymorphism of serotonin transporter gene linked polymorphism, 5-HTTLPR) can affect men's trait anxiety level through the functional connection between amygdala and insula at rest. At the same time, in the elderly population, the S allele carriers of 5-HTT promoter have a higher level of trait anxiety than L / L homozygotes. This may explain that the therapeutic effect of L / L homozygous of 5-HTT promoter is better than that of S / s homozygous and LS gene carriers in the treatment of patients with generalized anxiety.

The polymorphism of BDNF [methionine (MET) substitution for valine (VAL) at codon 66, Val66Met] is also related to trait anxiety. The polymorphisms of Y-aminobutyric acid type A alpha 6 receptor subunit gene (GABAA only 6 receptor subunit gene, gabra6) and catechol-O-methyltransferase gene (COMT) are related to trait anxiety.

2.2 Trait Anxiety and Oxidative Stress

More and more studies have found that there is oxidative stress in the brain of HTA individuals, accompanied by abnormal mitochondrial function. Hovatta et al N81 used six inbred mice to reveal the relationship between oxidative stress and HTA for the first time. The results showed that the protein expression levels of glyoxalase-1 and glutathione Reductase-1 in the brain of HTA mice were significantly higher, and inhibiting the expression of glyoxalase-1 could reduce the anxiety like behavior of HTA mice. At the same time, the levels of more than 300 protein products and metabolites in the synaptic part of cingulate cortex of HTA mice changed, the protein expression level related to electron transport chain complex (etc) increased, and the glycolytic enzyme level decreased, resulting in the increase of reactive oxygen species (ROS) level and oxidative stress response. In addition, neurons and glial cells in the hippocampus and cerebellum of HTA mice had higher ROS levels h 9i. The expression level of mitochondrial complex I and II protein and respiratory ability decreased, and the levels of adenosine triphosphate (ATP) and ROS increased in the nucleus accumbens of high anxiety rats. Although studies have proved that oxidative stress is related to anxiety related behavior, it has not fully revealed the causal relationship between them[2].

2.3 Trait Anxiety and Brain Area Size and Brain Chemicals

In addition to gene polymorphism and oxidative stress, brain area size and brain chemical level are also closely related to individual trait anxiety. Functional magnetic resonance imaging (fMRI) evidence M2O shows that the gray matter volume of hippocampus, medial prefrontal cortex (mPFC) and bilateral hypothalamus in HTA individuals is smaller, and the cerebral cortex fold area of left upper parietal lobe and precuneus cortex fold area in HTA individuals are smaller. Proton magnetic resonance spectroscopy (1H-MRS) was used to further analyze the chemicals in the anterior cingulate cortex (ACC) of people with high and low trait anxiety. It was found that the levels of inositol, glutamate and glutamine in ACC of HTA individuals were significantly increased; In LTA individuals, the release of dopamine in ACC beak and amygdala increased, accompanied by the

weakening of their connectivity. Individuals with HTA had smaller dorsal ACC volume and lower content of 5-hydroxytryptamine (5-HT) in amygdala. At the same time, the expression level of mineralocorticoid receptor and RNA in hippocampus of HTA mice were higher.

3. The Influence of Trait Anxiety on Individual Cognitive Performance

3.1 Trait Anxiety Will Affect the Acquisition and Regression of Individual Fear Memory

Compared with LTA individuals, HTA individuals have a higher fear response to fear related cues, with obvious over activation in the amygdala and decreased activity in the ventral prefrontal cortex (vPFC). HTA children have a higher sense of fear of fuzzy information, and HTA adolescents show a greater sense of fear of conditioned fear stimuli. Accordingly, in the regression stage of fear memory, HTA individuals' inhibition of unrelated cues of fear decreased and showed a relatively large fear response. With the continuous activation of amygdala and the decrease of dorsal ACC activity. Anxiety level did not affect the acquisition of fear memory. Individuals with high and low trait anxiety level had no significant difference in fear enhancement shock response, skin electrical response and online risk assessment. The level of trait anxiety will affect the acquisition and regression of individual fear memory. In the process of acquiring fear memory, HTA rats showed more rigid behavior. In the regression stage of fear memory, HTA rats also had rigid behavior to a certain extent to sound fear cues, accompanied by the weakening of immediate early gene expression in the lower marginal cortex and lateral amygdala (LA), and the enhancement of c-fos response in the medial part of central amygdala (CEA). This shows that the ability of fear memory regression in HTA rats is impaired, and relevant studies show that it is accompanied by abnormal neuronal activity. In conclusion, relevant studies in humans and animals have shown that trait anxiety is related to different stages of fear memory development and the activity of different brain regions. The level of trait anxiety may not affect whether individuals form fear conditioning, but in the process of acquiring fear memory, individuals with high and low levels of trait anxiety may produce different behavior and brain activity. At the same time, HTA level may have an adverse effect on the regression of fear memory.

3.2 The Impact of Trait Anxiety on Threat Related Information Processing

Trait anxiety will affect individuals' processing of threat related information. HTA individuals show excessive processing of threat related information, resulting in attention bias. HTA individuals are difficult to distinguish the three situational stimuli of security, unpredictable threat and predictable threat, and show over estimation and higher aversion to the possibility of unpredictable threat stimulus. At the same time, HTA individuals' inhibition of threat related cues is impaired. When conditional threat cues and security cues appear at the same time, HTA individuals show more fear responses, indicating that they pay more attention to threat related cues. When threat related stimuli were presented alone, the connectivity between dorsal stria terminalis bed nucleus and amygdala of HTA individuals was closer. Relevant studies showed that HTA individuals had attention bias only in the short time of threat related stimuli. When the time of threat related stimuli was prolonged, this attention bias disappeared. In addition to attention bias, HTA individuals show an earlier escape response to slowly approaching attackers. At the same time, with the increased activation of ventral hippocampus, medial prefrontal cortex, amygdala and insula, HTA individuals will show the tendency of over processing, over estimation and premature response in the face of threat related information.

3.3 Effects of Trait Anxiety on Other Cognitive Performance

Trait anxiety has different effects on people's information processing, emotion and sleep. HTA individuals often need to mobilize more cognitive resources to cope with the adverse effects of external behavioral events. Using structural magnetic resonance imaging and G0 / no-g0 task research, it is found that healthy adults with HTA have significantly longer reaction time in go / no-g0 task, The volume of the inferior prefrontal cortex is larger. At the same time, when HTA individuals show longer response than LTA individuals, there is also a positive correlation between glutamate level in PFC of LTA individuals and the activation degree of dorsolateral PFC, but HTA individuals do not show this correlation. HTA individuals have poor emotion recognition ability and are more difficult to distinguish negative emotions. H5-hta individuals also perform worse on tasks requiring high mental rotation ability. At the same time, HTA individuals are more likely to indulge in social software such as Facebook and video games. The research on trait anxiety and sleep shows that trait anxiety may affect the quality of deep sleep, mainly state anxiety and trait anxiety will affect non REM sleep, while REM sleep is mainly related to trait anxiety. HTA individuals have shorter REM sleep time and longer REM sleep latency.

4. The Cognitive Neural Mechanism of the Interaction between Uncertain Processing and Speech Flow in Individuals with Trait Anxiety

At the behavioral level, there is no significant difference in the accuracy and response time between the definite relationship inference and the uncertain relationship inference, indicating that the difficulty of the uncertain relationship inference presented in the form of graphics is basically the same as that of the definite relationship inference. Then, we found that there was a significant positive correlation between trait anxiety score and subjects' reaction time in the inference of graphical uncertain relationship, that is, the higher the level of trait anxiety, the longer the subjects needed to complete the inference of graphical uncertain relationship. The reason for this related result may be that individuals with high trait anxiety have low tolerance for uncertain relationships, and the processing of uncertain relationships leads to the generation of anxiety, and then the interaction between anxiety and cognitive processing of relationship inference leads to the increase of time to complete homework. In terms of brain imaging results, our results showed that the information integration processing stage of the left putamen and left wedge under uncertain conditions was more activated than that under certain conditions. Individuals generally produce anxiety in the processing of uncertain relationships. This anxiety spontaneously activates the verbal stream of the subjects. The higher the degree of anxiety, the higher the degree of verbal stream activation, which is mainly reflected in the positive correlation between the level of trait anxiety and temporal lobe brain signals. In terms of the matching between the activation of verbal stream and the presentation form of stimulation, Thus, it promotes the logical reasoning of the subjects for the uncertain relationship, mainly manifested in the stronger activation of the occipital lobe and frontal lobe, which better promotes the completion of the inference of the uncertain relationship, that is, the accuracy is higher under the uncertain condition.

5. Conclusion

Future research should focus on the impact of trait anxiety on information processing and emotion recognition, so as to help HTA individuals more effectively avoid or prevent the adverse effects of daily life events. In addition, HTA, as a stress susceptibility phenotype, is a specific risk factor for evaluating and predicting mental disorders such as anxiety and depression. However, in terms of etiology, the current research can not provide enough effective information. A more

comprehensive understanding of the neurobiological factors of trait anxiety and their impact on individual cognitive performance will help us better deal with daily life events and more effectively prevent or treat mental diseases such as anxiety and depression [3-7].

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