ORIGINAL ARTICLE

Neuroimaging in cockroach phobia: An experimental study

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Abstract
Background/Objective: In this study we explored the neuroimaging characteristics of persons with specific small animal (cockroach) phobia to determine whether there are differences in cerebral activity between persons with and without cockroach phobia under conditions of phobic and non-phobic stimulation. Method: 24 adult persons (12 with phobia) were studied. The diagnosis of phobia was obtained with a structured interview and questionnaires. All participants were exposed to a 3D video presentation during an fMRI session. Results: The phobic group showed significant differential activations that were congruent with a dual route model of fear processing through the thalamus-amygdala (route I) and the thalamus-sensory and association cortex-entorhinal cortex-hippocampus-subiculum-amygdala (route II). Apart from this dual route, we also found differential activations in the globus pallidum, parahippocampal gyrus, insula, pars orbitalis, triangularis and opercularis of the frontal cortex, and cerebellum. Respect to non-phobic group, no activations were found in the insula or the anterior cingulate cortex. Conclusions: There seems to be a dual route depending on how persons with phobia to cockroaches process phobic stimuli. This double processing can have implications for the psychological treatment of specific phobias.

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Neuroimaging studies of patients with mental disorders have been conducted with the main aim of providing evidence of the neurological bases of such diseases. Such knowledge is expected to contribute to a better understanding of the neuropsychological mechanisms of psychopathology and consequently to the improvement of psychological and biological treatments (Anderson, Mizgalewicz, & Illes, 2013; Wright et al., 2013). Phobias are a type of anxiety disorder and refer to a high persistent anxiety response that people usually (but not always) consider excessive or irrational to the presence or anticipation of a threatening object or situation (American Psychiatric Association, APA, 2013). According to the APA, three groups of phobias (i.e., agoraphobia, social phobia, and specific phobias) are the most prevalent mental disorders overall. Of these, specific phobias have the highest prevalence rates, which range from 7% to 12.1% (APA, 2013; Kessler, Petukhova, Sampson, Zaslavsky, & Wittchen, 2012). Clemente et al. (2014) pointed out that small animal phobia is one of the most disabling phobias because there is a possibility of encountering the animal in everyday life. According to these authors, 40% of specific phobias are phobias of small animals.

As shown by systematic reviews (Del Casale et al., 2012; Linares et al., 2012) and meta-analyses (Fullana et al., 2016; Ipser, Singh, & Stein, 2013), neuroimaging studies of phobias have found a group of similar brain areas and circuits to be related to brain responses to phobic stimuli. The areas most often found are those associated with limbic and paralimbic structures. The amygdala (especially the left amygdala) is the brain structure that has been found to be most closely associated with specific phobia in several studies (Britton, Gold, Deckersbach, & Rauch, 2009; Caseras, Mataix-Cols et al., 2010; Dilger et al., 2003; Goossens, Schruers, Peeters, Griez, & Sunaert, 2007; Li et al., 2013; Lipka, Miltner, & Straube, 2011; Straube, Glaeur, Dilger, Miltzel, & Miltner, 2006; Straube, Mentzel, & Miltner, 2006). However, other brain areas have also been found to be activated by phobic stimuli. Such is the case of the left insula, cingulate gyrus, medial prefrontal cortex, hippocampus, and orbitofrontal cortex (Goossens et al., 2007; Schienle, Schäfer, Stark, & Vaitl, 2009; Wendt, Lotze, Weike, Hosten, & Hamm, 2008; Wright, Martis, McMullin, Shin, & Rauch, 2003).

The differences between those studies illustrate the complexity of neurological processes in phobias. However, the differences found may also be due to the methodological characteristics of those studies. In fact, studies differ from one another in many ways. A few examples are the use of clinical or subclinical samples, the type of phobia, age, gender, the presence or absence of a control comparative group, and procedural differences. In this regard, not all studies used the same type of fMRI machine. Machines with higher spatial resolution such as the one used in this study—3 T—allow a better delimitation of the brain structures detected and may explain some slight differences found between studies. There may also be specific effects depending on whether participants are shown pictures or a video presentation.

Considering the above, a more refined meta-analysis was performed of studies including an fMRI procedure whose participants included persons with small animal phobia and a healthy control group. The left amygdala and insular cortex were the brain areas found to be associated with the presence of phobic stimuli. Other structures involved in phobic responses were the fusiform gyrus, the left dorsolateral prefrontal cortex, and the left cingulate cortex. Overall, this review found that the role of frontal areas seemed to be less stable than that of limbic areas (Peñate et al., 2017). Considering the findings of the above-mentioned review, the aim of the present study was to provide data about brain activation...
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