ORIGINAL RESEARCH—ANATOMY/PHYSIOLOGY

At the Second Glance: Stability of Neural Responses Toward Visual Sexual Stimuli

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ABSTRACT

Introduction. Studies investigating the neural responses toward sexual stimuli can provide an important basis for further understanding disorders of sexual functioning. Although our knowledge of the neural correlates of sexual stimulus processing has increased considerably in the last decade, the stability of the observed effects in studies on neural sexual responses has been rather neglected.

Aims. The current study aimed to test the stability of behavioral and neural responses to visual sexual stimuli in men and women over a time span of 1 to 1.5 years. To disentangle valence and arousal-related aspects of sexual stimulus processing, we employed not only sexual and neutral, but also positive and negative emotional stimuli.

Methods. A sample of 56 subjects (24 women) was assessed twice, with an interval of 1 to 1.5 years between assessments. During a functional magnetic resonance imaging (fMRI) session, participants passively viewed sexual, neutral, positive, and negative emotional pictures. Pictures were presented in 24 blocks of five pictures each. Every block was rated immediately after its presentation with respect to valence, arousal, and sexual arousal.

Main Outcome Measures. Blood oxygen level dependent (BOLD) responses measured by fMRI and stimulus ratings.

Results. fMRI analyses revealed a distributed network involved in the processing of sexual stimuli, with large parts of this network being consistently activated at both assessment points. Nucleus accumbens, anterior cingulate, occipital and parietal cortex showed the most robust results with respect to group stability. Responses of anterior cingulate, orbitofrontal, parietal and occipital cortex showed interindividual stability. Gender differences were restricted to a few regions of interest.

Conclusions. Our data indicate stability of neural responses toward sexual stimuli not only on the group but also on the individual level. Activation of parietal and occipital cortex might reflect a trait like character of attention related responses toward sexual stimuli. **Wehrum-Osinsky S, Klucken T, Kagerer S, Walter B, Hermann A, and Stark R. At the second glance: Stability of neural responses toward visual sexual stimuli. J Sex Med 2014;11:2720–2737.**

Key Words. Sexual Response; Sexual Arousal; Stability; Nucleus Accumbens; fMRI

Introduction

Our understanding of the neural responses toward sexual stimuli is constantly increasing. In this context, a very important question refers to the stability of the observed effects over time. Assessing the effects of interest only once (single assessment) can have certain disadvantages: The observed results might be influenced, for example, by the novelty of the employed stimuli, experimental settings, or procedures (for a discussion, see e.g., [1]). In addition to novelty effects, many variables varying over time might influence the results: Neural responses to sexual stimuli might be affected by factors that have been suggested to influence sexual desire and behavior, e.g.,

mood, stress, hormonal variations, relationship problems, and health factors (e.g., [2–6]). In order to identify aspects of sexual stimulus processing that are relatively independent of short-term influences, responses to sexual stimuli should be assessed at least twice with a reasonable time span in between (e.g., several weeks or months). Exploring the stability of these responses can provide an important basis for further investigation and a better understanding of disorders related to dysfunctional responses to sexual stimuli (e.g., hypersexuality, hyposexual desire disorder). For example, identifying stable responses in certain brain structures in healthy controls but instable responses in patients (or vice versa) might indicate a disorder-related neural correlate. Depending on the assumed function of these structures, indications for therapeutic interventions might be drawn.

To date, several studies have investigated the stability of hemodynamic responses using functional magnetic resonance imaging (fMRI) (e.g., [1,7,8]; for an overview, see [9]). However, to our knowledge, no study so far has investigated the stability of neural responses to sexual stimuli in women and men. Instead, most studies investigating the processing of sexual stimuli focused on men using sexual film clips or pictures (for meta-analyses, see [10,11]) at only one assessment point. In men, the most commonly identified structures associated with the processing of sexual stimuli comprise the hypothalamus, the thalamus, the amygdala, the insula, the occipital cortex (OCC), the anterior cingulate cortex (ACC), inferior and superior parietal regions, as well as the orbitofrontal cortex (OFC) and the nucleus accumbens/ventral striatum (NAcc/VS) (e.g., [10,12–16]). Fewer studies have investigated women, reporting overall more heterogeneous results (for an overview, see e.g., [17]). Accordingly, some studies directly comparing women and men observed gender differences in sexual responsivity with stronger responses in men than in women ([13,18–20]), while others did not find such differences ([21,22]). The heterogeneity of these results might at least partly be explained by employing different stimulus materials (e.g., comparing sexual vs. neutral or sexual vs. other positive stimuli) and by different sample sizes. In a recent study, we investigated a large sample of 100 participants (50 women) to explore gender commonalities and differences in the processing of sexual stimuli ([23]). Our results showed very similar neural response patterns toward sexual stimuli in men and women, engaging a network comprising hypothalamus, NAcc, as well as orbitofrontal, occipital, and parietal areas. Gender differences were restricted to few regions, e.g., OCC and thalamus.

Aims

The aim of the present study was to assess the stability of sexual stimulus processing in a large sample of women and men. Neural responses toward sexual stimuli were investigated twice with at least 12 months between assessments (for results of the first assessment, see [23]). Stability was assessed for specific regions of interest (ROI) at the group as well as at the interindividual level. Group stability was assessed using intraclass correlation coefficients (ICC) indicating the similarity of spatial distributions of contrast values for all voxels within each ROI. Additionally, conjunction analyses were performed to identify regions significantly activated at both assessment points. Interindividual stability was also assessed using ICC. Here, ICC indicates the similarity of subject-specific responses at first and second assessment on a voxelwise basis. Since the comparison of sexual with neutral stimuli reflects a combination of valence and arousal effects associated with the sexual stimuli (and might represent emotional processing per se), we employed not only sexual and neutral, but also positive and negative emotional stimuli. These four stimulus categories (sex, neutral, positive, negative) were presented in an fMRI experiment using a block design.

Activations in response to sexual stimuli were expected in structures that have been linked to the processing of visual sexual stimuli in women and men: the hypothalamus, the NAcc, the thalamus, the amygdala, the insula, the OFC, the ACC, the OCC, as well as the superior and inferior parietal cortex [10–29]. According to the findings at the first assessment [23], stronger responses in men than in women were expected in OCC, thalamus, and parietal cortex.

Methods

Participants

Participants were assessed twice within 1 to 1.5 years. One hundred heterosexual participants (50 female) participated at the first assessment point (t1; see [23]). For the second assessment point (t2), we were able to complete the data set of 56 par-