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Adaptation as a Sensorial Profile in Trait Anxiety: A Study With Virtual Reality

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Abstract—Twenty-four volunteers were recruited on the basis of their trait anxiety scores (low trait anxiety [LTA] and high trait anxiety [HTA]) as assessed by the State-Trait Anxiety Inventory. Adaptation to conflicting visual–vestibular stimulation (VVS) was used to study integration of space-related multi-sensory information in trait anxiety. First, vestibular perception was assessed by rotating the blindfolded subjects about the vertical axis (horizontal plane rotations) on a remote-controlled mobile robot. The

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subjects were asked to indicate the perceived rotation by use of an angular pointer. Subjects were then immersed into the center of a visual virtual square room by means of a head-mounted display. They were asked to control the robot with a joystick in order to perform 90° rotations in the virtual room. However, a gain of 0.5 was introduced between visual scene and robot rotation so that the subjects were submitted to a conflict situation in which the 90° rotational visual input was concurrent with a 180° vestibular input. After 45 min of training with the virtual reality display, subjects were tested again in total darkness in order to determine whether their vestibular system had been reset by the conflicting visual signals. We found significant differences in adaptation to VVS between HTA and LTA groups as well as between males and females. Subjects of the HTA group demonstrated larger adaptation than that of the LTA group. Males also showed a greater level of adaptation compared to females. Our results suggest greater visual dependence in HTA subjects. This might be important for understanding the mechanisms underlying pathological anxiety and particularly agoraphobia.

Keywords: Anxiety; Multisensory integration; Sensory conflict; Vestibular perception

The relationship between emotion and dizziness has been studied for centuries (de Sauvages, 1771; Benedikt, 1870). Schilder (1933) insisted on the importance of the vestibular system for understanding neuroses and psychoses because of its importance in the dynamics of the body image. Indeed, dizziness, which can result from a distorted vestibular input, is an associated symptom of several psychiatric disorders (Brandt, 1996). Dizziness is also a key symptom of panic (Kenardy, Evans, & Oie, 1992). In their study on panic attack symptomatology, Cox and colleagues found that dizziness was experienced by almost all their panic disorder patients ($N = 212$) (Cox, Swinson, Endler, & Norton, 1994). Thus, many studies have tried to find vestibular dysfunction in panic and agoraphobic patients, but so far a consistent pattern of vestibular dysfunction in panic disorder has not been demonstrated (see Asmundson, Larsen, & Stein, 1998 for a review). Several studies agreed, however, to suggest a possible problem with multisensorial integration in some of these patients: subjects with symptoms of panic and agoraphobia are destabilized under conflicting sensory conditions while maintaining upright posture (Yardley, Britton, Lear, Bird, & Luxon, 1995; Yardley, Luxon, Bird, Lear, & Britton, 1994; Jacob, Furman, Durrant, & Turner, 1996, 1997). An abnormal vulnerability to destabilization by visual or proprioceptive sway-referencing was demonstrated in these patients using dynamic posturography.[1] Dynamic posturography is the only vestibular test involving a sensory conflict situation.

The dizziness symptomatology is thought to be linked to a strategy for maintaining balance or orientation by relying on visual cues, although a recent

[1] Dynamic posturography uses moving platforms to study postural control. This system allows for the disturbance of visual and proprioceptive sensory inputs by a technique called sway-referencing. This test has been designed to assess the overall function of the balance control system by manipulating the available sensory information (see Nashner & Peters, 1990).