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The oblique effect in the human somatic sensory system

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Short communication

Abstract. Blindfolded, sitting subjects were asked to feel whether two bars were parallel or not. In 50 % of the presentations the bars were parallel to each other. In all presentations either one or two bars were oriented vertically, horizontally, 45^{o} or 135^{o}. In this situation the best accuracy was found when the bars were vertically and horizontally oriented in space. The experiments were repeated with the subjects tilted laterally by 45^{o}. Now the best accuracy was found when the bars were at an angle of 45^{o} or 135^{o} to the length-axis of the body. This means that the oblique effect in the somatic sensory system is of vestibular origin.

Key words: haptic oblique effect, somatic sensory system, body tilt

The term "oblique effect" was introduced by S. Appelle in a review article on : "Perception and discrimination as a function of stimulus orientation: The "oblique effect" in man and animals" (Appelle 1972). In this article the oblique effect was defined as "a small but consistent superiority in performance when visual stimuli are horizontal or vertical, as opposed to oblique".

In some of the reports the oblique effect was found to be related to the orientation of the stimuli on the retina, in others to the orientation of the stimuli in space.

Examples of an oblique effect, related to retinal coordinates, are found in studies by Lennie (1974), Banks and Stolarz (1975) and Jouen (1985). These authors described that when the body was tilted sideways, optimal acuity, measured with sinusoidal gratings, remained unchanged with respect to retinal coordinates, but changed with respect to gravity.

A different type of oblique effect was found in a study on reaction times by Attneave and Olson (1967). Subjects were found to respond faster to horizontal and vertical stimuli (lines or rectangles) than to stimuli tilted 45° right or left. The experiments were repeated with the head tilted sideways by 45°, i.e. with physical and retinal orientation in opposition. Performance was superior on the physical rather than on the retinal horizontals and verticals.

When the term "oblique effect" came into use it was considered to be a purely visual phenomenon. Lechelt et al. (1976) found that also in the haptic modality discrimination of vertical and horizontal was significantly more accurate than discrimination of oblique orientations.

In the present report on haptic tilt perception, experiments will be described which are analogous to the ones by Attneave and Olson (1967) in the visual modality. The purpose of these experiments was to determine whether this haptic oblique effect is exclusively related to the degree of pronation and supination of the forearms. The possible influence of the position of the body in space on the haptic oblique effect was studied.

Blindfolded, sitting subjects were asked to feel whether two round bars were parallel or not. The bars were 15 cm long and 2 cm wide. Simultaneously each hand grasped one of the bars. Behind each

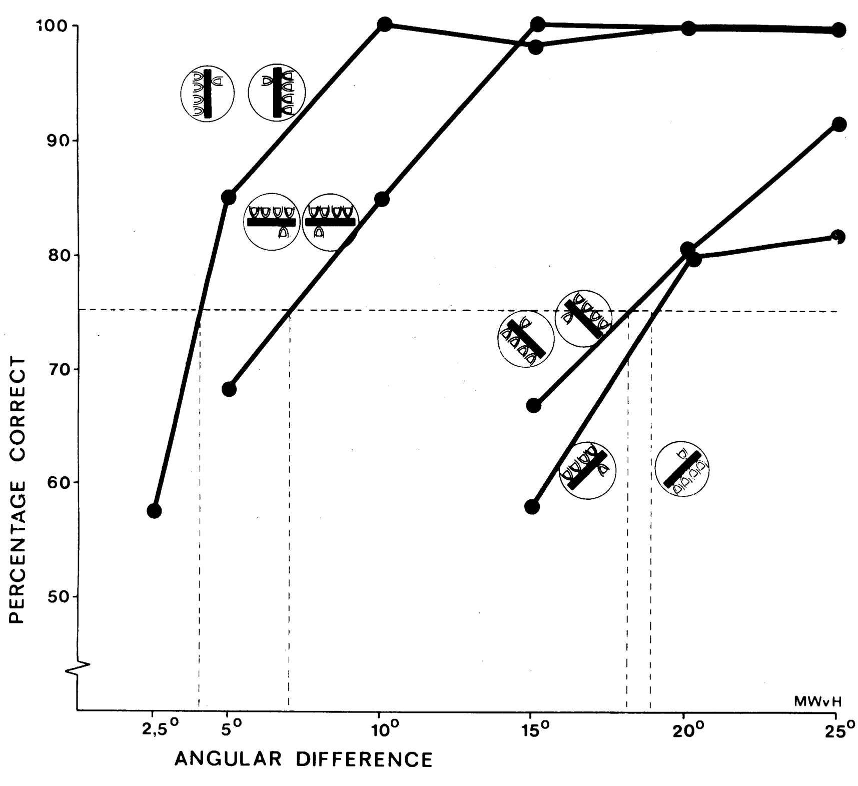

Fig.1. Sets of 60 trials each were given in which the two bars were either parallel or non-parallel. In the first set presented, either both bars were vertical or one bar was vertical and the other one clockwise or counter-clockwise rotated by 25°. The blindfolded subjects were asked whether the two bars were parallel or non-parallel. In the next sets of trials the angular difference was stepwise reduced. The 75% correct level was determined by means of linear interpolation. The same procedure was repeated with the bars oriented around 180°, 45° and 135°.

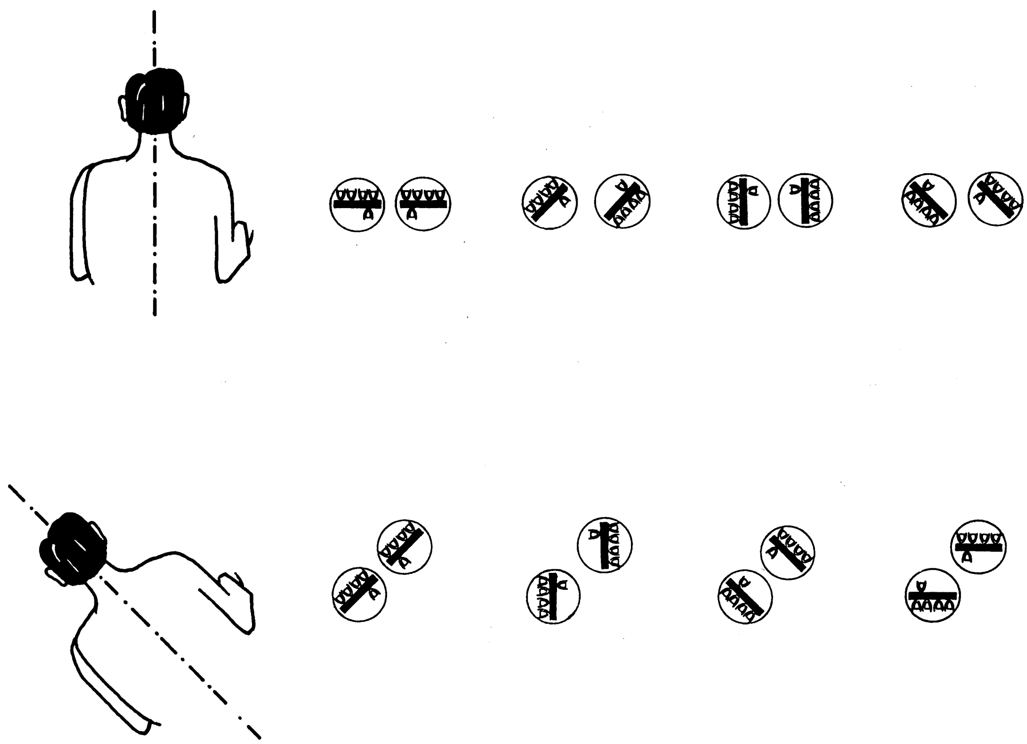

Fig.2. Schematic representation of the subject seen from behind, before and after the tilting procedure. The round plexiglass bars were 15 cm long and 2 cm wide. A plexiglass circular plate was attached behind the bars in such a way that the subject touched the bars with the fingertips during the whole experiment. A protractor was attached to the plates. At first the threshold of tilt discrimination was determined with the subject sitting in the vertical position. The threshold was determined around the horizontal, 45°, vertical and 135° orientation. After that the procedure was repeated with the subject tilted 45° to the left. The set-up was designed in such a way that the position of the bars did not change with respect to the body.

bar, a perspex plate was attached in such a way that the fingertips were in contact with the bar. A protractor was mounted behind each bar. Sets of 60 trials each were given in which the two bars were randomly parallel or non-parallel. In the first set presented, the orientation of the non-parallel presentations differed by 25° (clockwise or counterclockwise). The angular difference between the bars was stepwise reduced. The 75% correct level was determined by means of linear interpolation.

The same procedure was repeated around 180°, 45° and 135° (Fig.1)

After this the same experiment was carried out with the subjects tilted by 45° (Fig.2).

In Figure 2 the experiment is illustrated. At first the subject was sitting upright and asked to indicate whether the bars were parallel or not. This experiment was carried out around 90°, 45°, 180° and 135° as described in the method section. The 75% correct values were determined by means of linear interpolation.

The white bars in Fig.3 indicate the results obtained with the subjects sitting in upright position. In all three subjects studied performance was best with the bars in vertical and horizontal orientation. After that the experiments were repeated with the subject tilted by 45°. This means that the position of the forearms with respect to the body remained unchanged. However, the position of the bars did change with respect to gravity.

The black bars indicate the 75% correct values obtained in this situation. Now performance was best with the bars which were oblique with respect to the body, but horizontal and vertical in space.

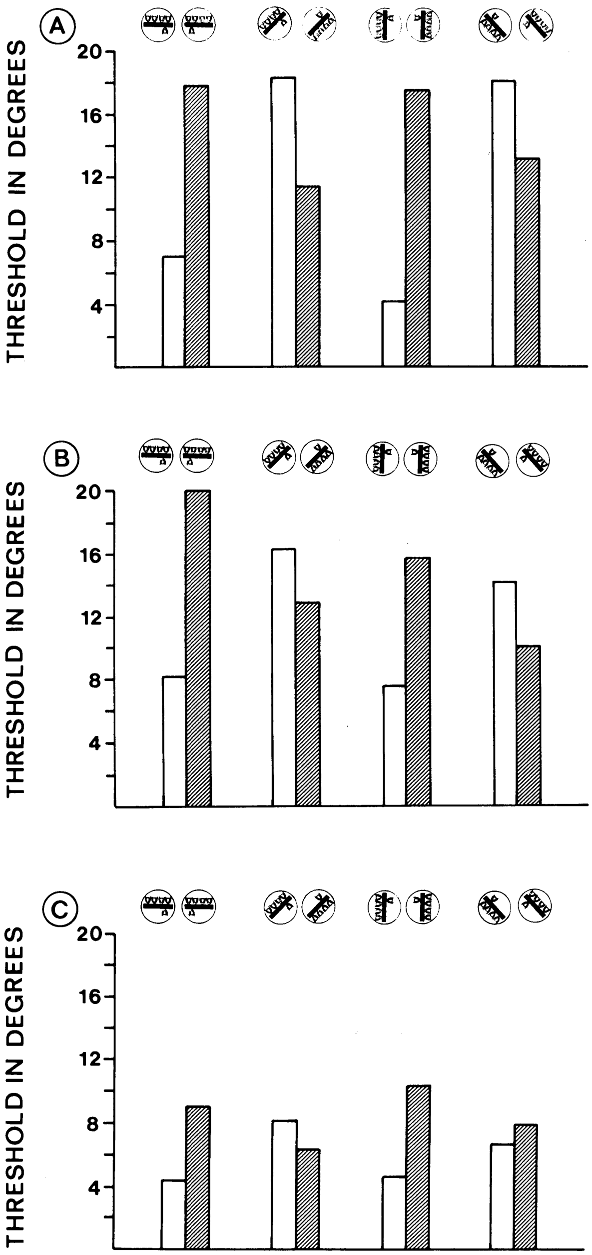

Fig.3. The white bars indicate the 75% percent correct values in three subjects sitting upright. The shaded bars give the 75% correct values in the tilted position.

Before the publications by Lechelt et al. (1976, 1980), the oblique effect was tacitly assumed to be an exclusively visual phenomenon.

Appelle and Gravetter (1985) in a study on modality-specific experience on visual and haptic judgment of orientation concluded that the haptic oblique effect is more strongly influenced by visual experience than by haptic experience.

They argued "that the obtained haptic oblique effect may not be an independent phenomenon but rather a reflection of the visual oblique effect with performance on obliques, both visually and haptically, limited by the veridicality of the visual image for oblique orientations".

The results obtained in the present report show that in blindfolded subjects the haptic oblique effect is determined by the position of the body in space. Therefore, the obvious explanation seems that the haptic oblique effect, like several visual oblique effects mentioned in the introduction, is primarily of vestibular origin.

Appelle S. (1972) Perception and discrimination as a function of stimulus orientation: the "oblique effect" in man and animals. Psychol. Bull. 78: 266-278.

Appelle S., Gravetter F. (1985) Effect of modality-specific experience on visual and haptic judgement of orientation. Perception 14: 763-773.

Attneave F., Olson R.K. (1967) Discriminability of stimuli varying in physical and retinal orientation. J. Exp. Pschychol. 74: 149-157.

Banks M.S., Stolarz S.J. (1975) The effect of head tilt on meridional differences in acuity: implications for orientation constancy. Percept. Psychophys. 17(1): 17-22.

Jouen F. (1985) The influence of body position on perception of orientation in infants. Behav. Brain Res. 15: 241-245.

Lechelt E.C., Eliuk J., Tanne G. (1976) Perceptual orientational asymmetries: A comparison of visual and haptic space. Percept. Psychophys. 20: 463-469.

Lechelt E.C., Verenka A. (1980) Spatial anisotropy in intramodal and cross-modal judgment of stimulus orientation: the stability of the oblique effect. Perception 9: 581-589.

Lennie P. (1974) Head orientation and meridional variations in acuity. Vision Res. 14: 107-111.

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