DIMORPHIC TURNING BIAS IN SPONTANEOUS ROTATIONAL MOVEMENT

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Introduction

Keeping track of position and orientation during travel relies on two main mechanisms: 1/ landmark-based navigation that provides direct sensory information about current position and orientation allowing the updating of a spatial representation; 2/ path integration where self-motion is used to update current position and orientation relative to some starting point. This last basic mechanism provides also a homing vector allowing subjects to directly return to the origin even in the absence of vision.

Understanding the evolution of an effective navigation system depends on the development of basic researches concerning spatial perception and spatial cognition. Among them, quite complex experiments are often designed to assess path integration abilities through distance and direction errors encoding. It is less common to evaluate how variations in cognitive profile related to biological characteristics, such as sex, could modulate this ability.

This experiment was designed to estimate sex differences in spontaneous body-turn following a most simple linear displacement in the absence of vision. This idea was based on several data provided by both animal and human researches showing that 1/ turning biases could be associated with unbalanced hemispheric dopaminergic activity; 2/ sexual differentiation in hippocampal dopaminergic receptors could be observed following spatial learning; 3/ dopaminergic activity could be correlated with cue-directed behaviors; 4/ sex-related differences may have more to do with disparities in preferred strategy than with differences in hemispheric asymmetry.

Materials and method

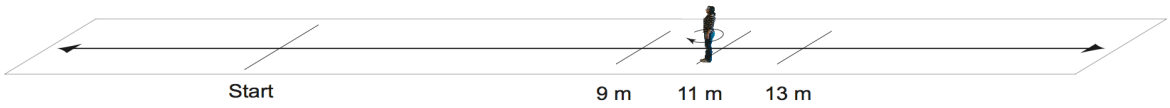
Participants

91 young volunteers (44 males, 22.9±1.4, 46 females 26.4±2.8) recruited from the University of Lausanne campus served as subjects.

41 females showed right-sided preference for handedness and 5 for left-sided. The same preference was observed in males (40 right-sided, 4 left-sided).

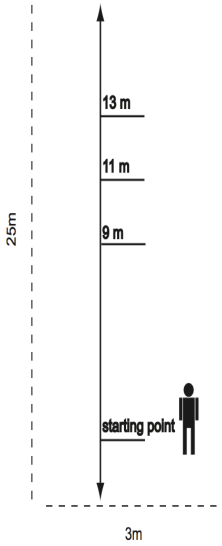
Apparatus

Our experiment was conducted in a large corridor of a University of Lausanne building. On the floor in the middle of the section, a 25-m line of white adhesive tape ran parallel to the walls. The starting point was marked by a 50-cm line of white adhesive tape perpendicular to the 25-m line. Actual traveling distances were limited to 9, 11 and 13 m.



Procedure of testing

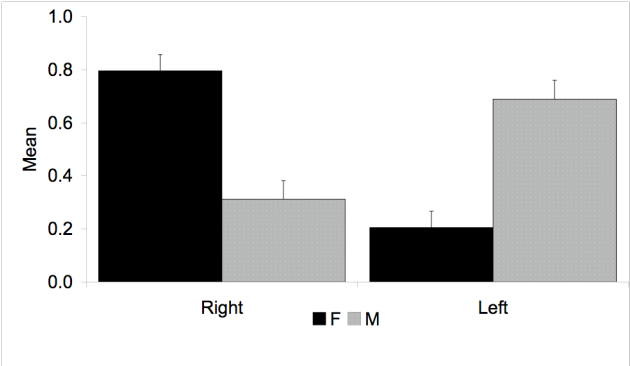
Blindfolded subjects were led on foot by the experimenter over one of the three fixed distances. The traveling distance was chosen randomly at the beginning of the experiment. The experimenter led the subjects by the arm. Once the pair stopped, the experimenter let go of the subject's arm and asked him/her to turn so as to face the starting point.



Results

Males and females differed in their spontaneous body turn preference (F[1,88]=27.58; p=0.000).

Females showed a right turn preference (t[45]=-4.1; p=.0002), while males showed a left turn preference (t[43]=-3.35; p=.0017).



Comments

The result of this single experiment is quite astonishing since it was never observed before. With no doubt, females turn spontaneously to the right, while males turn left. By contrast, turn biases studies in humans typically show a left turn bias for right-handed normal subjects, when a moderated bias toward the hemisphere with decreased DA is observed in subjects with dopaminergic abnormalities. In view of the task, this obvious behavioral asymmetry cannot be explained differently than by sex-related differences. The discrepancy with previous results might be associated with the design of the exercise. Indeed, blindfolded subjects are just linearly led by their arm to a point, and asked to turn alone towards the origin. There are no challenges like problem solving or complex devices that might bias spontaneous behavior through changes in brain activation. Thus, this observation gives a cue concerning a possible sex-related difference in dopaminergic activity in human brain. This difference might be associated with disparities in preferred strategies used for solving navigation tasks. Moreover, it emphasizes the fact that behavior is particularly sensitive to situation. Thus, it cannot be assessed without careful consideration of the effects of experimental design.