別紙様式３（課程博士申請者用）

（西暦）２０２２　年度 博士後期課程学位論文要旨

学位論文題名（注：学位論文題名が英語の場合は和訳をつけること）

A rule for anticipatory action planning for stepping onto two potential targets
2 つの潜在ターゲットへのステップ動作における予測的行動計画のルール

学位の種類：　博士（　学術　）
東京都立大学大学院
人間健康科学研究科　博士後期課程　人間健康科学専攻
ヘルスプロモーションサイエンス学域
学修番号 19999706
氏　名：渡邉　諒
（指導教員名：　樋口　貴広　　）

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The brain plans an anticipatory action for performing tasks successfully and effortlessly, even if there are multiple possible options. There is increasing evidence that, when multiple actions are possible, the brain considers two factors when planning an anticipatory action: the value of the competing options and the cost of each potential action. Previous studies in which an arm-reaching task was performed while sitting suggested that the initial reaching trajectory was biased toward the option with the higher probability of occurrence or higher expected gains.

When the action involves maintaining upright balance, such as standing, stepping, or walking, the cost of maintaining postural stability could be considered predominantly. I addressed this issue by using a “go-before-you-know” task of stepping onto a target on the floor. In this task, two potential targets were located on the medial or lateral side of the stepping foot, and the true target was presented only after participants shifted their loads to leave that foot. Participants initiated their stepping actions without knowing which of the potential targets would be the true one.

I conducted four experiments (Experiments 1, 2-1, 2-2, and 3) to test the hypothesis that, when the action to be performed involves maintaining upright balance, the cost of maintaining postural stability was considered more predominantly than desirability based on the value of options. In Experiment 1, I tested this hypothesis in a situation in which the occurrence probability of each option was the same, and no gains were explicitly assigned to either option. The results showed that, for the majority of

participants, lateral displacements of the center of pressure (COP) with two potential targets were similar to those when the single target existed on the medial side. Given that mediolateral postural stability became more destabilized when landing on the medial target than when landing on the lateral target, participants were likely to plan their mediolateral components of the postural adjustments to avoid postural destabilization.

In experiments 2-1, 2-2, and 3, I addressed whether the cost of maintaining postural stability continued to be considered more predominantly even when the occurrence probability of competing options (Experiments 2-1 and 2-2) or the gains from competing options (Experiment 3) were manipulated. In Experiments 2-2 and 3, both the COP displacements and the mediolateral velocity of the pelvis were measured as main outcomes to address whether the kinematic state of the body was regulated based on the same rule as with COP displacements. The results of Experiment 2-1 and 2-2 showed that, even when the lateral target was presented more frequently on the stepping side, the mediolateral COP was shifted for easy stepping onto the medial target. These results were consistent with the findings in Experiment 1. With regard to Experiment 3, the findings obtained from the velocity of the pelvis, but not from COP displacements, showed that the body states at the lifting of the swing foot were regulated for easy stepping toward the medial target.

In summary, evidence in the current study suggests that the cost of maintaining postural stability is an important factor, in addition to the value and energetic effort, especially for planning an action that involves maintaining upright balance. In planning the preparatory posture prior to stepping movements, the cost of maintaining postural stability is a more dominant factor than relative desirability based on the value of competing options. The rule found in these experiments provides a basic framework for understanding the neural computations that occur when planning an action involving dynamic movements (i.e., walking, running, or playing sports).