

Trajectory control in targeted force impulses

VII. Independent setting of amplitude and direction in response preparation

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Summary. We have previously shown that when aiming impulses of force to unpredictable flexion and extension targets, subjects prepare themselves to respond by preselecting a default amplitude and direction. In our preceding study, where flexion and extension target ranges were symmetrical, subjects prepared a single default amplitude near the center of each of the two ranges and selected a default direction arbitrarily (Favilla, Hening et al. 1989). Following target presentation, amplitude and direction were specified gradually and in parallel. By using an experimental paradigm in which target amplitudes had unequal probabilities in only one of the two directions, we now sought to determine to what extent the default amplitude prepared by subjects is dependent on the default direction that is selected for a given trial. Five normal subjects produced isometric elbow flexion and extension force impulses to match four targets requiring responses of two amplitudes in each direction. Flexion and extension targets were of the same size. In all biased probability conditions, targets were presented in unpredictable order and, in one direction, the probability of occurrence of the targets was biased (80% versus 20%). In the other direction, the two targets were equiprobable. To maximize the effect of the default settings on response parameters, we required subjects to initiate their response in synchrony with a predictable tone occurring less than a reaction time subsequent to the presentation of the visual target. Such a short interval was chosen to disclose the default parameters selected by limiting the influence of the target just presented on the amplitude and direction of

the subjects' responses. If the default amplitude were prepared independently of the response direction selected, subjects should show a bias in the default amplitude in both directions. In contrast, if default amplitudes were associated with direction, the bias would occur only in the direction whose target amplitudes had unequal probability. For controls, we presented the same four targets both in predictable series (simple condition) and in unpredictable series without any bias (choice condition). When presented with targets whose amplitudes were of unequal probability in only a single direction, all subjects showed a strong bias in the amplitudes of their responses in both directions. This result was true of all subjects and occurred independently of the response direction (flexion or extension) or whether the response was in the same direction as the current target or the opposite direction (i.e. wrong direction). This bias was strongest when responses were made in the same direction as the targets with unequal probability. We conclude that subjects prepare default amplitudes that are, in large measure, independent of the direction of responses made to unpredictable targets. The present results expand our demonstration that subjects may perform different component processes of sensorimotor processing, such as specification of response amplitude and direction, by parallel processing channels.

Key words: Sensorimotor processing – Response preparation – Isometric – Trajectory specification – Reaction time – Human subjects

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Introduction

In previous reports in this series, we examined the processes by which human subjects extract information from visual targets in order to accurately

