The Effect of the Nature of Precued Parameters on Reaction Time of a Force Production Task

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Results of previous studies on Parameter Precuing Technique suggested a relationship between reaction time (RT) and number and nature of precued parameters. Most of these studies only examined aiming movements as the experimental tasks. The present study was designed in order to test the effect of the nature of precued parameters on RT in a force production task. A mixed 3 factorial design was performed on non-athlete right-handed volunteer students (n=16; age=20 to 25). Having applied "Parameter Precuing Apparatus", subjects performed 2400 trials over 5 sessions on successive days (4 blocks of 120 trials per session) under different precued conditions of precuing. The task required production of defined isometric force (3 or 6 kg) toward inside or outside, with the right or left upper limb as quickly and accurately as possible after displaying the stimulus preceded by the precue. The subjects’ RT in different levels of independent variable were analyzed by using 3 factor experiments (nature of precued parameter*gender*session) with repeated measures on two of the factors (type of precued parameter & session). It was found that the main effects of nature of precued parameter and session were significant (p<0.05); but the main effect of gender, interaction of nature of precued parameter and gender, and gender and session were not significant (p>0.05). The results are discussed in relation to their significance in the context of current theories and hypotheses on movement programming.

key words: force production task, motor preparation, parameter precuing technique, reaction time

Introduction

The concept that rapid movements are controlled as wholes and that control is vested in an abstract representation, a motor program, is well established (Keele, 1968; Woodworth, 1899). However, the defining of parameters that might be programmed and the way(s) in which these parameters might be dealt with in the
programming process are less clear. To study these processes, Rosenbaum (1980, 1983) developed a procedure called "Parameter Precuing Technique". In Parameter Precuing Technique, a signal (the precue) providing partial or complete information about the required response is presented in advance of an imperative stimulus to begin the movement. Other necessary information for the required response is delivered by the stimulus. According to Rosenbaum (1980, 1983) if specific parameters could be identified prior to movement, then parts of the motor program would be prepared in advance; therefore reaction time (RT), representing the duration required to prepare an unknown parameter, evidently is shorter than in a non precued condition.

Most studies using Parameter Precuing Technique indicate a relationship between normal subjects RT and the number (Anson, Hyland, Kotter, & Wickens, 2000; Bonnet, Requin, & Stelmach, 1982; Goodman & Kelso, 1980; Jentzsch & Leuthold, 2002; Larish & Frekany, 1985; Rosenbaum, 1980, 1983) or, more importantly, the nature of precued parameters (Bock & Eversheim, 2000; Dornier & Reeve, 1990; Goodman & Kelso, 1980; Nicoletti & Umilta, 1984, 1985; Proctor & Reeve, 1986; Proteau & Girouard, 1984; Reeve & Proctor, 1984; Rosenbaum, 1980; Spijkers, 1990; Zelaznik & Hahn, 1985). For example, Rosenbaum (1980) reported that precuing direction produced a greater reduction in RT than precuing extent. Goodman & Kelso (1980) replicated the different effect of direction versus extent precues. Larish & Frekany (1985) found if subjects knew direction in advance of stimulus onset, the process of selecting the appropriate extent (near/distant) when the stimulus occurred did not result in an increase in RT. Various clarifications have been put forward to justify the differential effects of diverse precued parameters and dispute over the reason behind it still continues. It is stated that RT not only is affected by motor programming processes, but also is somehow affected by non motoric processes related to stimulus identification and response selection (Bock & Eversheim, 2000; Goodman & Kelso, 1980; Larish & Frekany, 1985; Larish, 1986; Nicoletti & Umilta, 1984, 1985; Proctor & Reeve, 1986; Proteau & Girouard, 1984; Reeve & Proctor, 1984; Spijkers, 1990; Nik, Shapiro, & Carter, 1982). These non motoric processes may be in turn affected by stimulus response (S R) compatibility and also by number of responses to be selected. Therefore, several authors have stated that deficiency in controlling experimental conditions and inconsistency in the number of responses to be selected could be responsible for these empirical effects (Zelaznik et al., 1982). Some others believed that this might be a function of S R incompatibility (Goodman & Kelso, 1980; Larish, 1986).