行政院國家科學委員會專題研究計畫成果報告

側向性動作對右側腦血管疾病病患與正常成人視覺空間注意力之影響

Effect of Lateral Movement on Visuospatial Attention in Adults With and Without Right Cerebral Vascular Accident

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一、中文摘要

直線兩等分測驗常被用於診斷右側腦傷後之空間忽略症。這項空間注意力問題的可能成因包括對腦傷對側空間的視覺空間注意力分佈失調，以及朝腦傷對側空間做出側向性動作的啟動困難。一項值得探究的療法是透過側向性動作來誘導視覺空間注意力之轉移。本計畫旨在探討(1)運用側向性動作之提示法對直線兩等分表現的影響;以及(2)側向性動作之目標是否也影響測驗表現。

本計畫之研究對象包括二十名右側腦中風後出現視覺空間忽略症之國內病患，以及二十名無中樞神經系統病變之正常成人。施測情況有三(1)將直線兩等份中分;(2)以右手食指碰觸左邊的鈴再將直線切成兩等份;(3)以右手食指按左邊的鈴，使其發出聲響後再將直線中分。

研究結果顯示:(1)相較於傳統的視覺提示法，側向性動作提示法較有效的導引忽略症病患進行直線兩等分時視覺注意力的左移;(2)動作目標具較高功能意義之側向性動作比功能意義較低之伸臂動作擁有較好之提示效果。這兩重趨勢亦出現在正常成人組。本研究計畫之結果對空間忽略症之理論推進與新療法之開闢具深切意義。此外，本計畫之結果也有助於對國人視覺空間注意力功能之瞭解。

關鍵詞：視覺空間注意力，直線兩等分測驗，忽略症，提示法，腦血管疾病

Abstract

Right brain damaged patients showing left neglect typically transect a horizontal line to the right of true center. This study is designed to: (1) investigate the effect of laterally directed movement (i.e., visuomotor cueing), relative to visual cueing, on line bisection performance in adults with and without right CVA; and (2) investigate the effect of the goal of the laterally directed movement on bisection performance.

Twenty Chinese-speaking patients with right CVA with neglect and 20 normal control subjects matched with the patients on age and gender participated in this study. The three testing conditions were as follows: (1) the subject marked with a pencil the center of each line; (2) the subject directed the right index finger leftward to touch the ringing lever of the bell before bisection; and (3) the subject pressed the ringing lever of the bell before bisection.

Results showed that (1) laterally directed movements for reaching, as compared with visual cueing, were more effective in reducing neglect on line bisection; and (2) laterally directed movements were differentially effective in biasing attention toward the reach target depending on the goal of the movement. These trends in line bisection performance were also obtained in healthy controls.

Findings of this study have implications for theory and clinical practice in relation to visuospatial attention. Use of neurologically unimpaired Chinese adults in the study provides information on the modifiability of attentional functioning in this under-investigated population and sheds light on the mechanism underlying visuospatial attentional processing.

Keywords: visuospatial attention, line bisection, neglect, cueing, cerebral vascular accident

二、緣由與目的

Patients with visuospatial neglect due to right cerebral vascular accident (CVA) typically fail to attend to and explore visual stimuli presented to the space contralateral to the brain lesion (Heilman, Watson, & Valenstein, 1993). Various tests have been designed for diagnosis of visuospatial neglect (e.g., line bisection, clock drawing, target cancellation, etc.) (see Cermak & Lin, 1994). The line bisection test is regarded as an excellent indicant of visuospatial neglect (Black, Martin, & Szalai, 1990). Both perceptual and motor factors are implicated in this apparently simple task. Right brain damaged patients showing left neglect typically transect a horizontal line to the right of true center (Schenkenberg, Bradford, & Ajax, 1980). The errors in bisection in these patients has been interpreted as the consequence of an impairment in attending to visuospatial information presented to the contralesional space (Riddoch, & Humphreys, 1983) or as due to a deficit in initiating a contra-lesionally directed motor act (directional hypokinesia) (Heilman, Bowers, Coslett, Whelan, & Watson, 1985).

The line bisection task also provides a useful instrument for research on how attention may be modified through experimental manipulation of task demands or stimulus parameters. Previous research has investigated the effect of cueing neglect patients to attend to a visual cue placed to the left of a line to be bisected before bisecting the line. According to these authors (Halligan, Manning, & Marshall, 1991; Heilman & Valenstein, 1979; Riddoch & Humphreys, 1983), visual cueing has not satisfactorily eliminated left neglect on this task.

An alternative therapeutic possibility that warrants exploration involves the use of laterally directed movement. For example, the patient may be instructed to reach for an object placed to the left of a centrally placed horizontal line to be bisected prior to bisecting the line. Motivated by the recent findings of the close coupling of mechanisms involved in controlling spatial attention and those involved in the preparation and guidance of goal-directed actions (Allport, 1989; Neumann, 1990), this study attempted to study the visuomotor cueing effect induced by laterally directed movement on line bisection performance by neurologically unimpaired adults and post-stroke patients with visuospatial neglect.

A further question that needed to be addressed is whether altering the goal of a leftward motor act (in terms of meaningfulness and functional relevance) before bisecting a horizontal line may affect line bisection performance. Recent research further showed that different goals of movement would elicit different movement organization in neurologically unimpaired (Marteniuk, MacKenzie, Jeannerod, Athenes, & Dugas, 1987) and neurologically impaired (Mathiowetz, 1992; van Vliet, Kerwin, Sheridan, & Fentem, 1995) populations. The possibility existed that goal of a reaching task may influence the extent to which visual attention is biased toward the object used for reaching. A recent study of healthy young adults showed that use of a naturalistic task with a higher functional goal resulted in more attentional carry-over toward the locus of the task than a less natural task with a lower level of functional relevance (Lin, Wu, & Trombly, 1998). This study tested the hypothesis that laterally directed movement would be differentially effective in biasing attention toward the reach target depending on the goal of the movement.

There was also a need to study of the visuomotor cueing effect on line bisection performance using normal controls because this information would afford insights into the mechanisms of neglect. The majority of previous research on normative performance on line bisection has involved Western people. This study investigated normative performance by Chinese adults on the line bisection test.

三、結果與討論

The study sample consisted of twenty Chinese-speaking patients with right CVA with neglect and 20 normal control subjects matched with the patients on age and gender. Left neglect in the patient group was diagnosed by means of the line bisection task and the cancellation task. Each study participant performed the line bisection test under three testing conditions: (1) line bisection administered in the standard manner (the no-cue condition); (2) the participant directed the right index finger leftward to touch the ringing lever of the bell before bisection (the lower functional goal condition); and (3) the participant pressed the ringing lever of the bell before bisection (the higher functional goal condition).

This study investigated the effects of visuomotor cueing that involved laterally directed movement on line bisection performance by neurologically unimpaired adults and post-stroke patients with visuospatial neglect. As predicted, line bisection performance was most accurate in the cueing condition that involved reaching to press the ringing lever, followed by the cueing condition that involved a lower functional goal. Least accuracy of line bisection was found in the no-cue condition. This pattern of bisection accuracy was found in the patient group and in the control group. In addition to the significant condition effect, the differences in bisection performance between the patient and the control groups were highly significant in all test conditions. The between-groups differences were more marked in the neutral and the lower functional goal conditions. The patient group improved in task performance with the higher functional goal to the extent that the difference between groups was largely minimized.

The findings indicated that leftward movements led to an improvement in line bisection performance. This effect may be attributed to a shift in attention concomitant with the motor act. It was further found that reaching for a higher functional goal produced a larger effect than the condition for a lower functional goal. The findings were interpreted as supporting the hypothesis that altering the goal of a leftward motor act (in terms of meaningfulness and functional relevance) before bisecting a horizontal line would affect line bisection performance. Previous research has shown that different goals of movement may elicit different movement organization in neurologically unimpaired (Marteniuk, MacKenzie, Jeannerod, Athenes, & Dugas, 1987) and neurologically impaired (Mathiowetz, 1992; van Vliet, Kerwin, Sheridan, & Fentem, 1995) populations. This study supported the notion that goal of a reaching task may influence the extent to which visual attention is biased toward the object used for reaching. Findings of this study were consistent with the findings of a previous study which showed that use of a naturalistic task with a higher functional goal resulted in more attentional carry-over toward the locus of the task than a less natural task with a lower level of functional relevance (Lin et al., 1998).

Implications of the study findings are enormous. First, providing visuomotor cueing may lead to an enhanced effect than traditional visual cueing. Secondly, the effect of visuomotor cueing is contingent upon the goal set for the reaching act. Reaching for a higher functional goal may be more effective in inducing a lateral shift of attention toward the locus of the task because of the increased motivation for action. Perceived functional relevance of accomplishing the task goal may have elicited a greater sense of task meaningfulness.

This study also revealed that neurologically intact adults were susceptible to the attention biasing effect of visuomotor cueing. Bisection performance in the neutral condition was characterized by a rightward bias. This pattern is in contrast with the commonly found leftward bias in line bisection in Western populations.

Future research may further study the effect of task goal that involves lateral reach for a target object by analyzing kinematic characteristics of reaching made for different goals. A further issue that warrants investigation is the role of the position of the cueing object. Will the cueing effects differ as a function of the object position? There is also a need for more research into the factors (e.g., chronicity and severity of neglect, pattern of eye dominance, etc.) that may mediate the degree to which a patient with left neglect may benefit from the visuomotor cue. It is also needed to conduct a systematic study of normative performance by normal persons differing in age, gender, handedness, and pattern of eye dominance.

四、計畫結果自評

This study contributed to increased understanding of the therapeutic possibility of action cues for reducing left neglect following right cerebrovascular accident. The results supported the benefit of engaging participants in tasks with a higher functional goal. Implications of the findings for neglect theory and therapy are enormous. The promise of action cues for reducing the directional motor disorder in left neglect is obvious. This study should stimulate continued inquiry into the motor aspect of the neglect syndrome.

Study of normal persons revealed that Chinese-speaking adults tended to err toward the right in line bisection. This pattern is unlike that reported for Western populations (i.e., pseudoneglect characterized by a predominantly leftward error). Ethnic cultural factors may affect performance on cognitive tasks such as the line bisection test and thus warrant systematic study.

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