The Strength of Preference in Girls' Lower Limb Tasks
女孩對不同下肢體動作任務的偏向之間的一致性與否

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Abstract

This study forms part of a larger study that investigated preference in girls' lower limb tasks. This paper reports the expression of girls' (N = 51) strength of preference over time. Strength of preference was analysed using two two-way ANOVA repeated measures designs. The first analysis had Age (4 levels) as the between subjects factor and Session (4 Sessions) as the within subjects factor while the second analysis used Task (6 tasks) as the within subjects factor. The results showed that the stability of girls' lower limb preference varied according to the task that they performed.

Key Words: Strength, Preference, Lower Limbs

摘 要

本篇研究是一個以探討女孩在不同動作任務上其下肢動作偏向的研究之其中一部份。此篇報告探悉五十一位女孩們在為期一對時間，對不同動作的任務，其下肢体的表現方法是否有一致性，或不一致性的現象。此研究使用雙向ANOVA 二因子重複量數變異數分析設計。第一次分析的兩個因子，分別為以“年齡”為因子(把受試者分為四個不同階段的年齡群)，和以“時段”為因子 (單一受試者在四個不同動作測試的時段內) 的兩因子重複量數變異數分析。第二次分析使用“任務”為因子 (六種不同任務) 和“每一受試者其個別下肢動作偏向”為因子，進行分析。研究結果顯示，女孩們對下肢動作的偏向，會依不同的動作任務，而有持續的不同表現方法。

Introduction

The strength of preference measures how consistent or stable an individual's preference is for a particular task over a number of trials or across time. Strength of preference can be measured as consistently right, left or mixed preferent for a given task. The methodology used to classify preference varies and continues to pose problems when comparing with other research in laterality (Coren, 1993; Gabbard, 1993).

Children show a right foot preference for kicking (Armitage & Larkin, 1993; Nonis, 1996). While this is the case for kicking tasks, research has also indicated that when different tasks are used no clear developmental trend is shown implying that lower limb preference may be task specific (Nonis, Larkin & Parker, 2006a). Further, mixed footedness is more common than mixed handedness (Gabbard, 1992, 1993; Gentry & Gabbard, 1995) and the former preference appears to increase with repeated sessions or trials (Peters & Petrie, 1979, Provins, 1992). This

change in lower limb preference for repeated sessions in comparison to single session designs suggests that the consistency of preference may be different from the direction of preference (Gabbard & Hart, 1995; Provins, 1992).

The Strength of Preference in the Lower Limbs

The stability or consistency of a preference response appears to be related to the success in motor performance tasks. Although research has indicated that children who show inconsistent preference tend to also perform poorly in motor performance tasks (Gabbard, 1989; Kaufman, Zalma & Kaufman, 1978; Tan, 1985), this suggestion is inconclusive. In longitudinal testing of the stability of lower limb preference response, Dodrill and Thoreson (1993) tested both adult males (n = 91) and females (n = 71) in a kicking task over five years. Right footedness was consistently shown by males (98%) and females (97%) at the beginning of the study and again after five years. There was a slight difference in percentage for stamping on a bug with females showing greater consistency (Females = 92%; Males = 85%).

Coren's (1993) study reported a higher percentage of females who were more stable in preference for lower limb tasks. For example, the percentages for the footedness index in Coren's (1993) Lateral Preference Inventory (LPI, handedness, footedness, eyedness and earedness) indicated that 38.8% of adult males (n = 1,375) and a larger 50.4% of females were consistently right footed. However, more males (7.9%) than females (4.9%) were mixed footed. The tasks used for the footedness test were kicking a ball to a target, picking a pebble with toes, stepping on a bug and stepping up onto a chair. Since the method used to calculate the LPI for each index combined scores for each of the tasks, the preference for each foot task could not be obtained from the percentages.

Peters and Servo's (1989) study involved 53 left-handed (Males = 18; Females = 35); 65 inconsistent left-handed (Males = 24; Females = 41) and 57 right-handed (Males = 28; Females = 29) undergraduate students who performed both foot and hand preference tasks. Subjects who signed up as right handers were classified in the right-handed group (RH) and consistently left-handers (CLH) were those subjects who used their left hand to perform the first eight hand preference items (write, hammer, throw, unscrew lid of jar, use a knife for cutting bread, use toothbrush, hold a match while striking and hold a racket) of a total of fourteen items. Inconsistent left-handers (ILH) were subjects who preferred their right hand for two to six of the first eight hand preference items. The first half of Peters and Servos' (1989) preference test included the first eight hand preference items collapsed across gender. In the second test, excluding holding a bat and a hockey stick items, all the foot and hand preference items were used. The foot preference questionnaire items were kick a ball, step up on a chair, the leg used in single-legged hopping, the leg used to swing up on a bike, roll a golf ball around a centre target in circle, the leg used to jump off in the high jump, write in the sand with toes, arrange five marbles in a straight line while sitting, tap rhythm to "Yankee Doodle" and kick one foot as high up a wall as possible. Subjects qualified the degree of preference on a scale of 1 to 5 (1 = always left, 2 = usually left, 3 = left or right, 4 = usually right, 5 = always right). The results showed that the RH group who were quite strongly right footed (Males = 70%; Females = 82%) were also strongly right handed (> 90%) but the CLH group were less strongly left-footed (Males = 62%; Females = 60%) than they were strongly left-handed (> 80%). In contrast to these two groups (RH and CLH), the inconsistent left-handers (ILH) showed varied preference choice for both foot and hand tasks indicating no consistent pattern. The authors suggested that the CLH and the RH group were similar in their preference but merely opposite in direction and that the preference of the CLH and ILH group can be expected to differ from one another.

The hypothesis for this study was that girls would become right preferent across sessions. This study forms part of a larger study which investigated the development of lower limb preference in girls, however, the strength of preference is discussed in this paper while the direction of preference is reported elsewhere (Nonis, Larkin & Parker, 2006a).

Method

Participants

Fifty-one girls aged 3 (n = 7, M Age = 40 months), 4 (n = 14, M Age = 50 months), 5 (n = 15, M Age = 62 months) and 6 (n = 15, M Age = 74 months) years volunteered in this study (Nonis, 1996; Nonis & Parker, 2005; Nonis et al., 2006a).

Data Collection and Statistical Analysis

Using a Lower Limb Preference Test Battery, girls performed two trials for each of six tasks. The tasks were kick a stationary and moving ball, step-up, pick-up, single leg static balance and repetitive in-place hopping (Nonis, 1996; Nonis et al., 2006a).

From the two trial scores for each task, the strength and direction of lower limb preference were calculated. The direction of preference was quantified by the trichotomous method which identified right, left and mixed preference in which the Laterality Quotient (LQ) was used (Nonis, 1996; Nonis et al., 2006a). A detailed description for the direction of preference is provided in Nonis (1996) and Nonis et al., (2006a).

The strength of preference for each of the six tasks was derived, irrespective of the direction of preference (Armitage & Larkin, 1993). This score was the absolute magnitude of the LQ ranging from 0 to +1. A score of +1, for example, indicates strongest or most consistent preference (whether right or left). The absolute derived scores for the strength of lower limb preference ranged between 0 and 1. The three-way ANOVA used to analyse the direction of preference in girls' lower limb preference was not appropriate for the strength of lower limb preference using the 0 to 1 range (Nonis, 1996; Nonis et al., 2006a). This was because girls were relatively consistent in their preference response within a single session but changed preference across both the four sessions and the six lower limb preference tasks (Nonis, 1996).

Consequently, two two-way ANOVA repeated measures design were used to analyse the absolute strength of lower limb preference. In the first analysis, Age (4 levels) was the between subjects factor and Session (4 sessions) was the within subjects factors and the second used Task (6 tasks) as the within subjects factor. Post hoc contrasts and Student Newman-Keul's post hoc tests were used to identify which means were significantly different. This paper reports the significant ANOVA results for the strength of preference. All statistical tests were considered significant at a probability of .05.

Results

The Strength of Lower Limb Preference

The second two-factor ANOVA analyses which used age (4 levels) as the between subjects factor and task (6 tasks) as the within subjects factor showed a significant main effect for task only [$F(5,235) = 12.66$, $p < .01$].

A mean strength of preference of 1 indicates the most consistent lower limb preference response across the four sessions for that task. Girl's mean strength of preference showed that the consistency of preference changed according to the task performed. The ANOVA results indicated that lower limb preference response was most consistent for kicking a stationary ball (M = .91) compared with balance where girls were least consistent (M = 0.50). In order, the consistency of preference response for each task was stationary kick, moving kick, pick-up, step-up, hop and balance (see Table 1).

Post hoc task comparisons showed that the strength of preference was highest for both kicking tasks and similar to pick-up task. The consistency of girl's preference response for pick-up task was similar to the step-up and hopping tasks but clearly different from the balance tasks. Balance, however, was also grouped with step-up and hopping tasks (see Table 1). This result supports the hypothesis that the strength of lower limb preference varies with the task performed.

Table 1. Means and Standard Deviations and Task Groupings* for the Strength of Preference Collapsed for Tasks (N = 51).**

Tasks	*M* (*SD*)	Groupings*
Kick Stationary Ball	0.91 (.19)	A
Kick Moving Ball	0.87 (.23)	A
Pick-up	0.75 (.33)	B, A
Step-up	0.63 (.33)	B, C
Hop	0.62 (.37)	B, C
Balance	0.50 (.38)	C

Note. * Post hoc comparisons using Student Newman-Keuls test, $p < .05$
** Score range = 1 indicates the most consistent preference response and 0 as the least consistent preference response.

Discussion

The Strength of Girls' Preference in Lower Limb Tasks

Three task groupings were shown for the ANOVA result of the strength of lower limb preference. Kicking tasks were grouped with the pick-up task which also formed a subgroup with the step-up and hopping tasks. The balance task was grouped with step-up and hopping only. Task groupings were also revealed for the direction of preference (Nonis et al., 2006a). However, the strength of preference which measured the consistency of preference over the four sessions indicated slightly different task groupings. Although kicking tasks were still grouped with the pick-up task, this latter task was also grouped with the step-up and hopping tasks. The balance task grouped with step-up and hopping tasks. The methodology of assessing and administering the Laterality Test Battery could be explained for the differences in the stability of lower limb preference shown in this study compared with other studies. For example, Armitage and Larkin (1993) administered the laterality test battery (hand, foot, eye and ear) for each child in the first trial and then repeated this battery for the second trial. In contrast, this study administered the second trial for each task immediately after the first trial. Secondly, since the research on preference has shown varying responses based on gender (Coren, 1993; Didia & Nyenwe, 1988; Dodrill & Thoreson, 1993; Larkin & Revie, 1995; Peters & Petrie, 1979; Whittington & Richards, 1987) and Armitage and Larkin's (1993) study combined the preference responses of boys and girls for each task, it is suggested that this procedure may have affected the results. In contrast, this study focused on girls only.

Further, as suggested for the direction of preference (Nonis et al., 2006a), variation in the task could also affect the expression of lower limb preference. For example, for the step-up task, Armitage and Larkin (1993) used a chair while this study used a bench. It is suggested that different equipment would immediately alter the task in question and would therefore require a reorganisation of the underlying coordinative structures to provide a different performance set for the task (Nonis et al., 2006a).

Contrary to research that reported a frequent occurrence of left preference in single leg static balance (Armitage & Larkin, 1993; Follett, 1930; Monson, 1990), this study reported increasing mixed preference (M = .50) which was also supported in the direction of preference (Nonis et al., 2006a).

The result of inconsistent preference across the four sessions poses problems for clinical tests that use these tasks as indicators of the integrity of the underlying neuromuscular system. In particular, hopping and balance tasks have often been used in clinical test batteries to identify the status of the neurological delay or subclinical pathology. Denckla (1974) and Gubbay (1975) have suggested that mixed preference or poor consistency in preference is indicative of neurological deficit and that with age these inconsistencies in preference are usually reduced. The literature suggesting that there may be a relationship between poor consistency in preference and pathology is not supported for hopping and balance tasks in this study. Girls were consistently right preferent for kicking tasks both within session (Nonis, 1996) and across sessions implying that this task can be used as a test for subclinical pathology.

The change in preference for the unipedal tasks of hopping and balance were different from the dual limb tasks of kicking, pick-up and step-up. Preference for the kicking task was stable. Given that girls were either right or left preferent for the balance and hopping tasks within a session (Nonis, 1996) but switched preference over the four sessions, it is suggested that for unipedal tasks preference shows stability in a single session but instability over time. Although pick-up and step-up tasks involve both limbs, a few girls' preference were unstable both within a session (Nonis, 1996) and between the four sessions implying preference may be more adaptable for these tasks.

Conclusion

This study showed that the stability of girls' lower limb preference changed according to the task performed which is consistent with the direction of preference for the same study (Nonis et al., 2006a). Girls were more consistent in their preference for the kicking tasks but less consistent for pick-up, step-up and hopping tasks. In addition, girls were least consistent for the balance task.

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