# 92 - INTERLATERAL TRANSFERENCE OF LEARNING IN DART THROWING

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## INTRODUCTION

One of the main characteristics of motor learning is its capacity of adaptation. So, when a task is practiced with a limb in a determined body side, it may have an adaptation from the homologue limb even without performing any practice (TEIXEIRA, 2001). This adaptation by the homologue limb that did not perform the practice is known as inter-lateral learning transference (MAGILL, 2000). Two explanations have been provided by this capacity to transfer learning of one task for the contra-lateral homologue limb. The firs explanation takes into account the perceptual aspects (movement time, visual cues, movement global idea, etc.) that are learned and that may be shared with the limb that did not perform a practice period (KOHL; ROENKER, 1980). The second explanation considers a share of neural networks that would allow a improvement provided by the homologue contra-lateral limb, independently of having no practice (HICKS; GUALTIERI; SCHROEDER, 1983).

Support for the inter-lateral transfer has been reported in some studies. For example, Lazarus e Haynes (1997) showed that interlateral transfer of learning occurred in a task of isometric strength reproduction of prehension using the tomb and indicator fingers. These authors verified that interlateral transfer occurred in a symmetrical manner, that is, both groups the one who practice with the non-preferred hand and the one who practice with the preferred hand improved performance of the contra-lateral homologue limb. Parlow and Kinsbourne (1989) showed in the task of inverted writing that lateral transfer of learning occurred, but, only when practice was performed by the preferred side, being transmitted to the non-preferred side. Edwards and Elliott (1987) also found interlateral transfer of learning in an asymmetrical manner; however, there was only transfer of learning when the task of a finger sequence of movements was practiced with the non-preferred hand to improve the performance of the preferred hand. Therefore, in spite of the knowledge that interlateral transfer occurs on learning, it is not known yet the effect of the direction of transfer. In other words, if there is a symmetrical or an asymmetrical interlateral transfer when task is practiced with the preferred or non-preferred body side.

Within this scope, it was analyzed direction effect over interlateral transference of learning in the task of dart throwing. The present study has the potential to help in the understanding of the existence of symmetry or asymmetry in interlateral transference of learning. In function of the two explanations provided previously for the occurrence of the learning transference (sharing of the perceptual aspects and of neural networks), it was hypothesized that there will be a symmetry in the weight of the transference.

## METHODS

Twenty boys and twenty girls, between 10 and 12 years old (M=11 years old and DP=0,55), with right-handed manual preference (4,5 points in the Edimburgo Iventory; cf. OLDFIELD, 1971), participated in the study. The children tutors assigned a free term of consentient and participation. Subjects were pseudo-randomly divided into two groups with the gender factor counter-balanced. One of the groups performed the tests with the non-preferred hand and practiced with the preferred hand (GP-Np). The other group performed the tests with the preferred hand and practiced with the non-preferred hand (GNp-P).

Task consisted of throwing darts (weight: 20 g) in a circular target (45 cm of diameter), as precisely as possible, aiming to hit the center of the target. It was used a target (Dunlop) with 10 areas of score (10 points for the center and 1 point to the more peripheral area of the target). Subjects were verbally instructed about the task procedures to perform the task and received a demonstration of the throwing movement pattern performed by the experimenter. Both groups performed the Pre-test with 10 trials, the Acquisition with 100 trials of practice, and the Pos-test with 10 trials.

Performance analysis was done considering the absolute error (AE) calculated in function of the position of the darts in relation to the target center. The comparison between the groups with different interlateral transfer directions was performed by an ANOVA with two factors, 2 (Groups: GP-Np x GNp-P) x 2 (Tests: pre-test x post-test), with the significant level established at $P \leq 0,05$. The comparison between acquisition phases with the hand of practice was performed by an ANOVA with two factors, 2 (Groups: GP-Np x GNp-P) x 10 (Phases: 10 blocks of 10 trials grouped), followed by the post hoc of Tukey. The statistical analysis were performed with a significance level established at $P \leq 0,05$.

## RESULTS

The absolute error (AE) did not show effect for the Tests factor ($F_{1,38}=1,79$; $P=0,189$), indicating that practice was insufficient to demonstrate an improvement from pretest to posttest on both groups. There was effect of Groups ($F_{1,38}=9,03$; $P=0,0046$) for AE, showing a greater performance for Np-P group, compared to P-Np. There was no effect for interaction Tests x Groups ($F_{1,38}=3,49$; $P=0,069$), indicating that there was no direction that favored learning transfer (Figure 1).

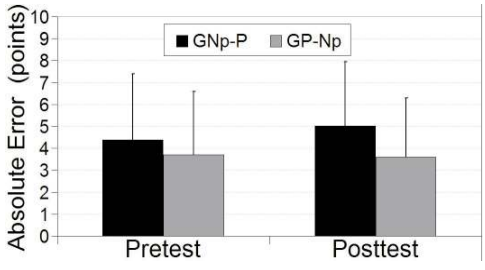


FIGURE 1. Absolute error (mean and standard deviation) on transfer for the preferred side (GNp-P) and for the non-preferred side (GP-Np) in pretest and posttest.

Figure 2 showed the mean of the absolute error (grouped in ten blocks of trials) in the acquisition period for the performance of practice with the preferred and non-preferred limb, respectively for the GP-Np and GNp-P groups. It was verified effect for Groups (F1,38=63,40; P<0,0001), indicating a superiority in the performance of the preferred hand (GP-Np) in comparison to the non-preferred hand (GNp-P). It was not found effect for Phase (F19,38=1,24; P=0,268) neither for interaction Groups x Phase (F9,38=0,88; P=0,543). Thus, the amount of practice was not sufficient to improve performance achieved with the hand that practiced the task.

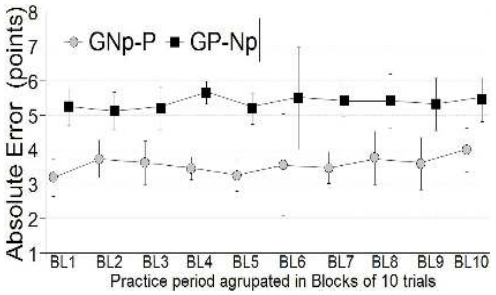


FIGURE 2. Absolute error (mean and standard deviation) on the acquisition phase performing the practice with the preferred and non-preferred hand, respectively for the GP-Np and GNp-P groups.

**DISCUSSION**

It was analyzed the effect of direction over the interlateral transfer of learning on darts throwing task. The results showed that both groups (GNp-P and GP-Np) did not have practice effect. Thus, it was not verified the learning transfer in both directions analyzed, from preferred hand to non-preferred (GP-Np), and from preferred hand for the non-preferred (GNp-P). The main explanation for these results was that neither the hand that practiced during the acquisition phase (non-preferred hand for GNp-P and the preferred hand for GP-Np) showed to improve its performance. In other words, the amount of practice performed with the hand that should transfer its acquired specific experience with practice seemed to be insufficient. Therefore, it was suggested that, interlateral transfer demands that practice performed with one side must show a significant improvement, on the other hand interlateral transfer will not occur.

The studies that showed interlateral transfer of learning, even in a asymmetrical manner only in a certain direction (PARLOW; KINSBOURNE, 1989; EDWARDS; ELLIOTT, 1987; TAYLOR; HEILMAN, 1980), also corroborate with the above hypothesis. Because, practice with a particular side is only able to transfer some elements of the performed movement. In other words, even though the side that practice gets better in a considerable manner, learning transfer is able to improve the opposite side with an inferior magnitude in comparison to the specific practice on this side. This is plausible understanding the principles that explain how interalteral transfer of learning occurs.

Within the two possible explanations of learning transfer, apparently, it has been attributed more importance for the sharing of the perceptual-motor aspects of movement, in comparison to the explanation of transfer in function of the neural networks. This, mainly, in motor tasks that demand higher accuracy control than movement power. Support for the major importance of the perceptual-motor elements may be found in the study performed by Kohl and Roenker (1980). These authors analyzed a task of tracking a moving target, showing an inferior performance for the control group in comparison to the mental practice and physical practice groups, that presented the same performances. Within this scope, as higher the perceptual-motor demands for the task, as higher will be the number of elements that may be transferred to improve learning with the side that did not perform the task.

Considering the transfer of the perceptual-motor elements, in the task of darts throwing, subjects had the possibility to transfer aspects related to movement parametrization (specification of strength, velocity, movement amplitude, etc.) in function, mainly, of the trajectory of the dart toward the target. However, even as the specific practice was not able to enjoy the knowledge of these elements, it was not verified an improvement on the side that did not performed a period of practice with the task. The absence of interalteral transfer of learning is in consonance with other studies. For example, Karni and colleagues (1995) found complete absence of the interlateral transfer effects after a period of practice in the manual speeded repeated movements. Teixeira (1993) also did not verify the effect of interlateral transfer of learning in the task of throwing small discs with forefinger toward the horizontal spatial target. This author pointed out that the fundamental aspect for movement performance was the adequate generation of strength in the forefinger extensor to propel the small disc. Such studies also suggest that the interlateral transfer of learning must take into account the specific control parameters that are related to the effectors system. Because, apparently, the movement parameterization would occur in function of the particular characteristics of each used side.

Other important question, when is analyzed the interlateral transfer of learning, is that, generally, one of the sides has greater experience/performance. That is, a right-handed person tends to perform a greater number of activities with the right side in comparison with the left side. Thus, if it was compared the capacity of this person on transferring the practice from the right side to the left, and from the left side to the right, it should be taking into account also this previous experience (and the level of performance). Because, the higher is the experience of a person to perform a particular task, the higher will be the amount of practice needed to improve significantly the performance. In the other hand, as lower the experience, as lower will be the amount of practice needed to improve the performance. Thus, interlateral transfer of learning in the direction preferred side to non-preferred side should present certain advantage in relation to the direction non-preferred side to preferred side. Therefore, it was suggested studies that analyzed the interlateral transfer of learning considering new tasks, in which there is initial performance symmetry between the sides, and tasks with asymmetry in the performance to test such supposition.

**CONCLUSION**

It was not verified the interlateral transfer of learning. This absent on the interlateral transfer of learning was explained by the small amount of practice provided during the acquisition period. Thus, interlateral transfer of learning will occurred just when a significant amount of practice is provided improving the performance of the side that practices. Because, only part of the elements acquired as a result of the specific practice from one of the sides is transferred for the other side. Also, it is suggested that the greater the number of the perceptual-motor elements in the task, the greater will be the chances of the interlateral transfer of learning to happen. It was suggested the analysis of the interlateral transfer of learning considering the specific experience of the preferred side to perform the task, because this may be a bias factor on the magnitude of the interlateral transfer of learning.

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**INTERLATERAL TRANSFER OF LEARNING IN DART THROWING**

It was analyzed the effect of the direction of interlateral transfer of learning in dart throwing task. Forty children (10 to 12 years old), divided into two groups GP-Np and GNp-P, performed the task of throwing darts aimed to a spatial target. GP-Np group performed the tests with the preferred hand and the acquisition phase with the non-preferred hand and the GNp-P group performed the tests with the non-preferred hand and the acquisition phase with the preferred hand. Groups performed a pretest (10 trials), acquisition phase (100 trials) and posttest (10 trials). The absolute error was calculated considering the center of the target. Interlateral transfer of learning was not found. This absence of interlateral transfer of learning was explained by the small amount of practice provided during the acquisition phase. Thus, interlateral transfer of learning will occurred just when a significant amount of practice is provided improving the performance of the side that practices. Because, only part of the elements acquired as a result of the specific practice from one of the sides is transferred for the other side. Also, it is suggested that the greater the number of the perceptual-motor elements in the task, the greater will be the chances of the interlateral transfer of learning to happen.

**KEY-WORDS**: interlateral transfer of learning, laterality, dart throwing.

**INTERLATERAL TRANSFERT DE L'APPRENTISSAGE DANS DART LANCEMENT**

Il a été analysé l'effet de la direction du transfert interlateral de l'apprentissage dans dart lancement. Quarante enfants (10 à 12 ans), divisés en deux groupes GP-Np et PNp-P, de la tâche de lancer des dart sur une cible visant spatiale. GP-Np groupe a effectué les tests avec la main préférée et la phase d'acquisition avec la main non-préférée et le groupe PNp-P a effectué les tests avec la main non-préférée et la phase d'acquisition avec la main préférée. Groupes effectué une phase d'pré-test (10 répétitions), d'acquisition (100 répétitions) et d'post-test (10 répétitions). L'erreur absolue a été calculé en considérant le centre de la cible. Interlateral transfert de l'apprentissage n'a pas été trouvé. Cette absence de interlateral transfert de l'apprentissage a été expliqué par la faible quantité de pratique à condition pendant la phase d'acquisition. Ainsi, le transfert de la volonté interlateral apprentissage a eu lieu juste au moment où une quantité importante de la pratique est fourni amélioration de la performance de l'équipe qui les pratiques. Eh bien, seule une partie des informations acquises à la pratique spécifique d'un côté est transféré de l'autre côté. Il a également été suggéré que plus le nombre d'éléments dans la tâche sensori-motrice, plus le chance de transfert de l'apprentissage.

**MOTS-CLÉS**: interlateral transfert de l'apprentissage, latéralité, dart lancement.

**TRANSFERENCIA INTERLATERAL DE APRENDIZAJE EN EL LANZAMIENTO DEL DARDO**

Se investigó el efecto de la dirección en la transferencia interlateral del aprendizaje en la tarea de lanzar dardos. Cuarenta niños (10 a 12 años), dividido en dos grupos GP-Np y GNp-P, hicieron la tarea de lanzar dardos en un objetivo. El grupo GP-Np realizó las pruebas con la mano preferida y la fase de adquisición con la mano no-preferida y el grupo GP-Np grupo realizó las pruebas con la mano no-preferida y la fase de adquisición con la mano preferida. Los grupos hicieron un pre-test (10 repeticiones), la adquisición (100 repeticiones) y un post-test (10 repeticiones). Se consideró el error absoluto calculado a partir del centro del objetivo. No se ha verificado la transferencia interlateral de aprendizaje. Esta ausencia de la transferencia interlateral se explicó por la pequeña cantidad de la práctica ofrecida durante la fase de adquisición. Por lo tanto, para la transferencia del aprendizaje acontecer, debe haber una cantidad suficiente de la práctica para mejorar el rendimiento del lado que hace el proceso de adquisición de la tarea específica Bueno, sólo una parte de la información adquirida con la práctica específica a un lado se transfiere al otro lado. Se sugirió también que cuanto mayor es el número de elementos perceptivo-motores en la tarea, mayor es la posibilidad de transferencia del aprendizaje sucederse.

**PALABRAS-CLAVE:** transferencia interlateral de aprendizaje, lateralidad, lanzamiento del dardo.

**TRANSFERÊNCIA DE APRENDIZAGEM INTERLATERAL NO ARREMESSO DE DARDO**

Foi analisado o efeito da direção da transferência interlateral no aprendizado do arremesso de dardo. Quarenta crianças (10 a 12 anos), divididas em dois grupos GP-Np e GNp-P, realizaram a tarefa de arremessar dardos em direção à um alvo. O grupo GP-Np realizou os testes com a mão preferida e a fase de aquisição com a mão não-preferida e o grupo GNp-P realizou os testes com a mão não-preferida e a fase de aquisição com a mão preferida. Os grupos realizaram um pré-teste (10 tentativas), uma aquisição (100 tentativas) e um pós-teste (10 tentativas). Foi analisado o erro absoluto calculado a partir do centro do alvo. Não foi verificada transferência de aprendizado interlateral. Esta ausência na transferência interlateral foi explicada pela pequena quantidade de prática fornecida durante a fase de aquisição. Assim, para que a transferência de aprendizado ocorra, deve haver uma quantidade de prática suficiente para melhorar o desempenho do lado que realiza a fase de aquisição específica na tarefa. Pois, apenas parte dos elementos adquiridos com a prática específica de um dos lados é transferida para o outro lado. Também foi sugerido que quanto maior for o número de elementos perceptivo-motores na tarefa, maior será a chance de ocorrer transferência de aprendizado.

**PALAVRAS-CHAVE:** transferência interlateral de aprendizagem, lateralidade, arremesso de dardo.