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Original Article

Influence of Daily Physical Activity on Fine Motor Skills of Adults around a Fitts Task

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Abstract

Introduction: Achieving our daily tasks depends on the speed-accuracy conflict. Physical activity plays a role in the development of our motor skills. However, the relationship between physical activity level (PAL) and fine motor skills remains largely unexplored.

Aim: Our aim was to examine the relationship between the amount of daily physical activity and the performance of healthy adults in a reciprocal aiming task.

Materials and methods: Eighty-seven healthy adults completed a reciprocal aiming task using a digital tablet. Four difficulty levels (3-6, determined by target width) and 50 scores for each level were performed using both hands. Movement time, error rate, and performance index were analyzed. PAL was measured using the Global Physical Activity Questionnaire. Spearman correlations and nparLD analysis were used in R Studio to explore the influence of physical activity level, difficulty index on individuals' performances.

Results: Apart from a correlation between PAL and motor performance at the easiest level (r=0.23, p=0.002), there was no correlation between PAL and fine motor performance.

Conclusions: The results of our study did not indicate any significant major correlations between daily PAL and fine motor performance except when the constraints of a reciprocal aiming task are the lowest. Further work is needed to consider the use of the reciprocal Fitts task in a clinical setting.

Keywords

adult, daily living, exercise, Fitts' law, motor skills, upper extremity

INTRODUCTION

The level of physical activity (PAL) varies from individual to individual and from lifestyle to lifestyle these days. It is recognized as a good indicator of individuals' participation in their daily activities.[1] The term "physical activity" (PA) is used as a generic term that includes leisure, travel, domestic and occupational activities.[2] The compendium of PA has been widely accepted as a resource for estimating and classifying the energy cost of human activity in metabolic equivalent tasks (METs). One MET is considered to be the resting metabolic rate or energy cost of a person at rest. MET values from the compendium range from 0.9 METs for sleep to 23 METs for a 14.0 mph run.[3] Stodden et al.

suggest that the development of motor skills has an impact on the PAL of young adults.[4] This relationship between motor skills and PAL emerges in childhood and continues to strengthen during adulthood.[5] At the same time, regular PA improves individuals' motor performance.[6]

Motor performance is defined as a temporary state of motor behavior.[7] Its measurement is specific to the task type and differs according to task difficulty, environment, and the physiological characteristics of the individuals. It makes it possible to account for the motor skills of individuals.[8] Clinicians can assess motor performance when performing gross motor tasks or fine manual activities using several tests, specific to the examined functions (e.g., the 6-minute walk test and the "Purdue Pegboard" dexterity test).[9,10] However, due to the variability and complexity of fine motor tasks, it is difficult to define standard activities for the arm. Nevertheless, among the daily life tasks, "reaching" has the highest priority: it is considered as the most important movement performed by the upper limb.[11] Grasping a glass, for example, requires a reaching movement. The success and completion of reaching tasks require movement adjustments to deal with the prevailing accuracy.

The trade-off between movement speed and accuracy is described in Fitts' law, which states that movement time relates linearly to the index of difficulty (ID), which quantifies task difficulty, in aiming tasks.[12,13] Relying on Shannon and Weaver's (1949) information theory, according to which a signal is transmitted through a processing channel that is disturbed by noise[14], Fitts (1954) postulates that the difficulty of an aiming movement can be measured using the same metric as in an artificial information system. The author describes the relationship between the ratio of the distance of a target to the width of the target and movement time (MT): $MT = \boldsymbol{a}+\boldsymbol{b} \times log_2(2\mathbf{A}/\mathbf{W})$ where $\boldsymbol{a}$ and $\boldsymbol{b}$ are empirical constants, **A** is the amplitude of the motion and **W** is the width of the target. In this expression, $log_2(2\mathbf{A}/\mathbf{W})$ corresponds to the index of difficulty of the task (ID). Furthermore, in analogy with Shannon and Weaver's information theory, Fitts predicts that the information processing capacity of the human motor system illustrates the performance index (PI). The measurement of the PI is a relevant parameter as it gives a glimpse into how the subject behaves facing two opposite constraints, namely speed and accuracy of movement. Thus, when the accuracy of a movement needs to be preserved, movement time increases based on the task's constraints and, thus, its level of difficulty, the individuals' task PI is reduced.[12,15] This law applies to most human movements, including the fine movements necessary to perform daily activities such as tying one's shoelaces or using a computer mouse.[16]

The results measured around a Fitts task can be generalized to pointing and manual movements, as well as those involving the use of tools in daily life.[17] For these reasons, the execution and evaluation of the Fitts task allows us to assess the impact of many variables on an individual's fine motor skills, motor performance, accuracy, and time of movement.[18] Fitts' law has been widely used in clinical research to assess the impact of different treatments or symptoms on the fine motor performance of individuals.[19] A recent study suggests that, in young adults, intensive acute aerobic exercise reduces MT, an important component of motor performance, when performing a discrete aiming task.[20] These results as well as the popularity of the Fitts' law paradigm in other disciplines argue for its continued investigation in order to analyze the effect of exercise on human motor behavior.[20]

AIM

To our knowledge, no study has examined the effect of PAL on individuals' fine motor performance performed using a reciprocal aiming task. The objective of this study was to examine the relationship between the amount of daily PA and the PI of healthy adults while performing a fine motor task.

MATERIALS AND METHODS

Population

Volunteers were recruited from the Institut Limousin de Formation aux Metiers de la Réadaptation and the campus of Medicine and Pharmacy, University of Limoges. Participants had to be 18 years old or younger, working or studying at the University of Limoges, able to read and understand French, and willing to participate in the study. They were excluded if any impairments could interfere with the motor task. They were informed of the different steps of the study and gave their informed consent in writing, in accordance with the Declaration of Helsinki.[21] This study was divided into two parts: the first part aimed to assess the participants' PAL and the second part consisted in performing the reciprocal Fitts task.

Measurement of PAL

Physical activity levels are determined using the Global Physical Activity Questionnaire (GPAQ).[22] This questionnaire, developed by the World Health Organization, is composed of 16 items to assess the duration and the frequency of PA in three dimensions: leisure activities, work activities, and travel.[23] The GPAQ distinguishes PA duration by min/day and min/week for each PA domain, which allows for calculating the energy expenditure scored in metabolic equivalent tasks (METs). Based on duration and energy expenditure, PAL was classified as low, moderate, and high. Prior to the completion of the motor task, participants were invited to answer the GPAQ self-questionnaire using the Google form platform, under the supervision of a researcher to clarify any misunderstanding. Answers were assigned to anonymous identification numbers (e.g., S01, S02, (...), S90) and then recorded on a computer.

The analysis of this questionnaire, using different formulas by the user manual of the questionnaire, allowed to calculate a continuous index of individual PAL and distinguish three groups[23]: Group 1: people with a high level of physical activity (individuals who participate in intense PA at least 3 days per week, resulting in an energy expenditure of at least 1500 MET-min per week, or at least 7 days of moderate or intense walking and PA until a minimum of 3000 MET-min per week is reached); Group 2: people practicing regular PA in a moderate way (individuals who do not qualify for the criteria in the previous category, but who participate at least 20 minutes of intense PA per day for 3 or more days per week or 30 minutes of moderate PA or walking per day for 5 or more days per week, or at least 5 days of walking and moderate or intense PA, until achieving a minimum of 600 MET-min-week), and Group 3: people with a low level of PA (individuals who do not meet any of the above criteria).

Motor task

Apparatus and task

Participants sat at a table facing a laptop screen aligned at eye level. A graphics tablet (Wacom Cintiq Pro 13") was placed horizontally on the table directly in front of them and connected to the computer. Participants had to move a red cursor (represented by a vertical line) as quickly and accurately as possible back and forth between two vertical white bars displayed on either side of the computer screen. The left-right sliding movements of a pen on the surface of the graphics tablet resulted in the left-right movement of a cursor on the screen, controlled by a dedicated software developed at Aix-Marseille University, running on the laptop computer connected to the graphics tablet **(Fig. 1)**. The position of the pen on the graphics tablet was sampled at a frequency of 150 Hz. The cursor position on the screen was reconstructed from the pen position data.

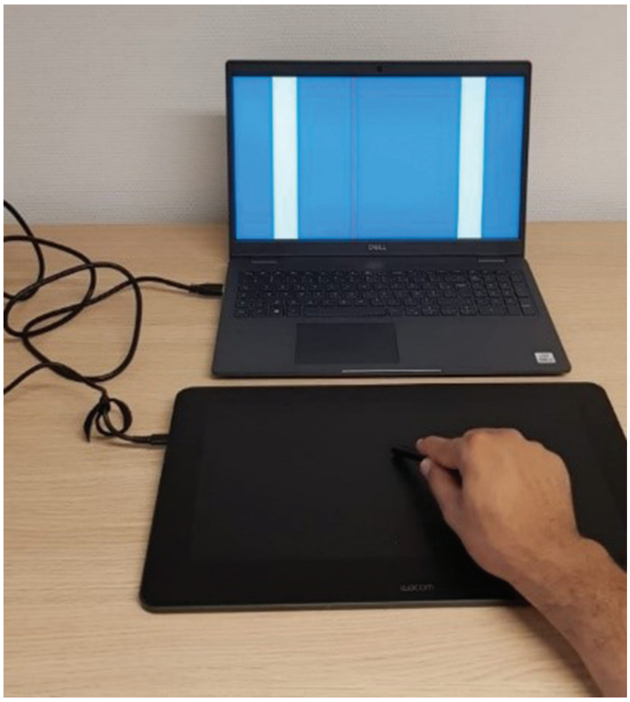

Figure 1. Motor task.

Procedure

The reciprocal aiming task was performed under four levels of difficulty. Following Fitts' law[12], task difficulty was defined through an Index of Difficulty [ID = $log_2(2\mathbf{D}/\mathbf{W})$], where **D** is the distance between target centers and **W** is the target width, or tolerance size. **D** was constant for all experimental conditions (25 cm). ID was thus manipulated by varying targets size (**W**). Sizes were 6.25 cm, 3.125 cm, 1.562 cm, and 0.781 cm for ID3, ID4, ID5 and ID6, respectively.

Participants first performed a familiarization trial (at level 3, the easiest) to ensure the understanding of the instructions. The four experimental conditions (ID3 to ID6) with both hands were performed in a randomized order. Each trial consisted of 25 cycles, for a total of 50 aiming movements per level per hand (200 movements per side).

Data analysis

The position time series were filtered with a dual-pass, second-order Butterworth filter, with a cut-off frequency of 8 Hz. Analysis focused on global measures such as MT, the PI, and the error rate (Err). MT was defined as the average half cycle time, from one spatial movement extremum (i.e., reversal point) to the next. The Err was defined as the number of movement reversal outside targets limits. In order to compute the PI, the effective width of the target (We) was defined as 1.96 times the standard deviation of the actual end-point distribution at movement reversal.[24] The PI was computed from MT and the effective Index of Difficulty (IDe) according to the International Organization for Standardization[25] as the following: PI = IDe/MT where IDe is the effective index of difficulty adjusted by using effective width of the target and computed as: IDe = $log_2(2D/We)$. All measurements were carried out for the two-handed conditions (DH and NDH) and for each level of Index of Difficulty.

Statistical analysis

Statistical analyses were carried out using R Studio (version 4.04, Integrated Development Environment for R, PBC, Boston). Gaussian distribution was verified using the Shapiro-Wilk test: due to an absence of normal distribution, non-parametric statistical analyses were prioritized. Spearman correlations were performed between our variables of interests: Performance Index (PI), movement time (MT) and error rates (Err), and the continuous index of individual PAL. These correlations were performed for the four levels of difficulty of the task (ID). To verify the application of Fitts' law to our motor task, a linear regression was conducted for MT, as a function of the difficulty index. NparLD tests were performed using the nparLD package.[26] The between-groups variable (subject group of PAL) and the within-groups variable (task difficulty index) were analyzed to determine the main effects as well as the interactions on the outcome variables listed above. Relative treatment effect (RTE) was used as a measure of effect with the following interpretations and a RTE value lies between 0 and 1. An RTE of 0.5 means no effect (a randomly selected participant from the whole sample has a 50/50 chance of achieving a lower score on an outcome measure than a randomly selected participant from either subgroup). An RTE<0.5 indicates a tendency for participants in a subgroup to score lower than a randomly selected participant in the full sample, conversely when a RTE>0.5. Differences were considered small, medium or large when RTE ≥0.56, 0.64 or 0.71, or ≤0.44, 0.36, and 0.29, respectively.[27] Post-hoc tests were carried out using the same nparLD method, to make matched comparisons between our groups.

RESULTS

Ninety volunteers participated in the experiment proposed in this study. However, due to incomplete registrations, three participants were not included. Thus, 87 healthy adults (28.5±10.5 years old, 63 women) were included. Participants characteristics are summarized in **Table 1**.

Motor task

Performance index

No correlation between index of individual PAL and PI was observed (r=0.07, p=0.052). However, the analysis revealed a low positive correlation **(Fig. 2a)** between the PAL index and PI at level 3 (r=0.23, p=0.002).

The non-parametric longitudinal analyses revealed a non-significant group effect on PI ($F_{(2;\infty)}$=1.13; p=0.57; RTE=0.53 for group 1, RTE=0.48 for group 2, RTE=0.50 for group 3) **(Table 2)**. A main effect of index of difficulty (ID) was also found ($F_{(3;\infty)}$=570.9; p<0.000; RTE=0.76 for the ID3, RTE=0.56 for ID4, RTE=0.39 for the ID5, RTE=0.27 for ID6) **(Table 2)**.

Table 1. Participants' characteristics

	Participant (n=87)
Sex (men/women)	24/63
Age (years): mean ± SD	28.5±10.5
Hand dominance (left/right)	9/78
PA level (Kcal): mean ± SD	2079±2360
PA level: frequency (proportion)	
PA High (Group 1)	26 (29.89)
PA Moderate (Group 2)	29 (33.33)
PA Low (Group 3)	32 (36.78)

PA: Physical activity; SD: Standard deviation

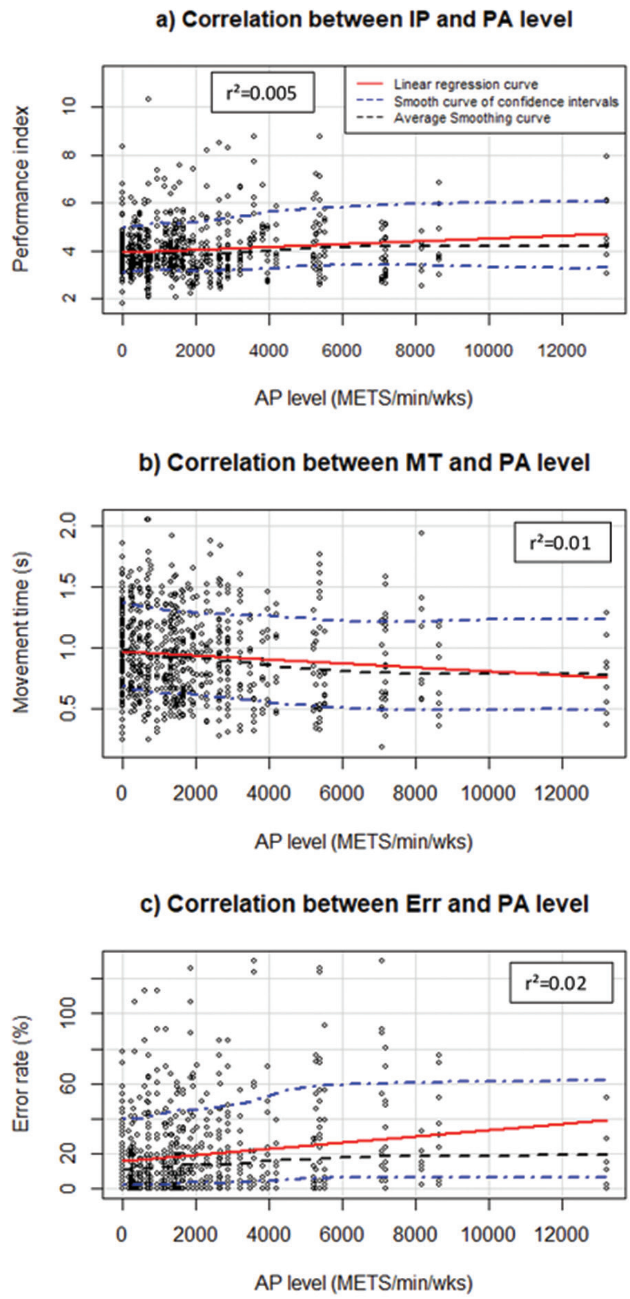

Figure 2. Correlations between the continuous index of individual PAL and variables of interest: Performance Index (**a**), Movement time (**b**), and Error rate (**c**).

Table 2. NparLD analysis results

	PI	MT	Errors rate
Group effect, DF = 2			
F (*p*-value)	1.13 (0.57)	3.18(0.20)	**9.40 (0.009)**
RTE:			
Group 1	0.53	0.46	0.57
Group 2	0.48	0.52	0.47
Group 3	0.50	0.51	0.47
ID effect, DF = 3			
F (*p*-value)	**570.9 (<0.00)**	**1699.73 (<0.00)**	**239.88 (<0.000)**
RTE			
ID3	0.76	0.18	0.19
ID4	0.56	0.38	0.40
ID5	0.39	0.62	0.62
ID6	0.28	0.82	0.79
Interaction Group*ID, DF = 6			
F (*p*-value)	6.50 (0.37)	5.70 (0.46)	**16.73 (0.01)**
RTE (group*ID)			
1*3; 1*4	0.81; 0.61	0.15; 0.33	0.22; 0.49
1*5; 1*6	0.41; 0.27	0.57; 0.78	0.71; 0.86
2*3; 2*4	0.74; 0.51	0.19; 0.42	0.15; 0.36
2*5; 2*6	0.39; 0.27	0.64; 0.85	0.59; 0.78
3*3; 3*4	0.72; 0.57	0.20; 0.40	0.20; 0.36
3*5; 3*6	0.39; 0.30	0.63; 0.82	0.56; 0.75

PI: index of performance; MT: movement time; ID: index of difficulty; Group: group of PA level; F: statistic, significant p-value at $p<0.05$; RTE: relative treatment effect; DF: degree of freedom.

Movement time

A negative correlation between the continuous index of individual PAL and movement time (MT) was observed ($r=-0.12$, $p<0.002$) **(Fig. 2b)**, regardless of the difficulty level of the task ($r=-0.28$, $p<0.001$; $r=-0.25$, $p<0.001$; $r=-0.16$, $p=0.004$; $r=-0.21$, $p=0.03$; for the ID3, ID4, ID5, and ID6, respectively). The ID also correlated positively with movement time ($r^2=0.69$; $p<0.000$). No effect of the group of PAL was found on the MT ($F_{(2;\infty)}=3.18$; $p=0.20$).

The nparLD analysis revealed a main effect of the index of difficulty on MT ($F_{(3;\infty)}=1699$; $p<0.000$; RTE=0.18 for the ID3, RTE=0.38 for ID4, RTE=0.62 for the ID5, RTE=0.82 for ID6) **(Table 2)**.

Error rate

A positive correlation between the PAL index of participants and their Error rates (Err) was observed ($r=0.15$, $p<0.000$) **(Fig. 2c)**. Correlations were observed at ID 4, 5 and 6 (respectively $r=0.27$, $p<0.001$; $r=0.32$, $p<0.000$ and $r=0.32$, $p<0.000$).

The NparLD analysis revealed a small significant effect of the group of PAL index on Err ($F_{(2;\infty)}=9.4$; $p=0.009$; RTE=0.57 for group 1, RTE=0.47 for group 2, RTE=0.47 for group 3). Participants with a high level of PA made, on average, more errors (25.8±2.5%) than those with moderate (16.1±2.3%) and low levels of PA (17.011%±2.213%). No differences were shown between moderately and low active subjects **(Table 2)**. A main effect of index of difficulty (ID) was also found ($F_{(3;\infty)}=23.88$; $p<0.000$; RTE=0.19 for the ID3, RTE=0.40 for ID4; RTE=0.61 for the ID5, RTE=0.79 for ID6). The correlation between Err and ID indicated that when difficulty increases, so do the individuals' error rates **(Table 2)**.

An interaction exists between PAL and difficulty index ($F_{(6;\infty)}=16.73$; $p=0.01$; RTE=0.22, 0.48, 0.70, 0.85 for group 1 and the ID 3, 4, 5, and 6, respectively; RTE=0.15, 0.36, 0.59, 0.78 for group 2 and the 4 ID, respectively; RTE=0.20, 0.37, 0.56, 0.75 and for group 3 and the ID 3, 4, 5 and 6, respectively) **(Table 2)**.

DISCUSSION

To our knowledge, this study is the first to determine the influence of PAL on individuals' fine motor performance using a reciprocal aiming task. Apart from a correlation between PAL and individuals' motor performance when the constraints of a reciprocal aiming task were lowest (i.e., ID3), this study did not show an influence of participants' daily PAL on their PI.

Level of physical activity

Motor performance

Our results indicated that the continuous index of level of PA was positively correlated with the PI achieved when performing a Fitts task on a tablet when the ID was 3. On a reciprocal aiming task, when the constraints imposed by the task are minimal (i.e., low ID), the movement is cyclic and continuous, and the deceleration and acceleration phases are fully merged. If the ID of the task increases, the motion becomes a concatenation of discrete movements, and the movement tends towards a more accurately constraining goal.[28] The kinetic energy created by the initial acceleration of the motion is dissipated during the final braking phase.[29] Thus, at ID3, the individual has a greater variability allowed by relatively low constraints (a greater width of targets). It is possible that these results reflect differences in behavior and performance between subjects that are not identifiable at ID4, 5, and 6. However, the correlation is weak and other parameters should be considered in the analysis.

Many activities of daily living, such as walking, do not require great precision. Conversely, many sedentary activities require the production of fine and accurate movements. Computer games, for example, have a positive influence on the motor skills of young adults, particularly about the precision and speed of arm and hand movements.[30] Professional musicians, on the other hand, can learn motor sequences faster and more accurately than non-musicians.[31] It is possible that participants with music-related activity can adapt more easily to fluctuating levels of difficulty, providing an adapted motor response more quickly and accurately than other subjects. Thus, it would also be important to consider the sedentary activities performed by the participants.

Error rate

Concerning the accuracy of movements produced, we observed that physically active participants are less accurate when the task becomes more difficult. Fitts' law suggests that the less accurate a subject is, the faster they are. Also, we can suggest that if they are less accurate, very physically active people should move faster than low or moderately active person. Nevertheless, our results do not indicate any significant effect of PAL on MT. In addition to the influence of PAL on individuals' performance on fine motor skills, these results may illustrate the impulsivity of some subjects compared to others who are more cautious. Kekäläinen et al.[32] support this hypothesis. Using NEO-Personality Inventory-33, the authors showed that the impulsivity facet had one of the strongest associations with physical activity.[32]

Index of difficulty

The task difficulty index had a significant effect on the participants' PI, MT, and Err. The MT of the three groups (i.e., the high, moderate, and low physical activity groups) increased linearly according to Fitts' law.[12] The PI, which is the product of the ratio between the MT and the ID, and accuracy were altered. These results are consistent with those found in the literature.[13,33] The task performed by the participants thus complied with Fitts' law.

Strengths and limitations

Despite the number of participants, the sample size for each PAL was approximately 30 individuals. In addition, the study sample was primarily female and students under the age of 25. It would be interesting to replicate this study with a more heterogeneous population. Furthermore, due to temporal limitations, only the GPAQ questionnaire could be used to measure participants' daily PAL. Nevertheless, the combination of measurement instruments, which is widely recommended today, and should be sought[34], would have made it possible to evaluate physical and sedentary activities in all their complexity, with qualitative and quantitative information.[35]

The overall strength of this work is to identify the benefits of using an aiming task and a digital tablet in a clinical setting. According to the literature, it seems that the results measured around a Fitts task can be generalized for pointing and manual movements as well as those involving the use of tools in daily living: pen, cutlery, needle, screwdriver, which are of interest to occupational therapists.[17] Thus, it could be interesting to perform Fitts' tasks in a clinical setting. The use of a digital tablet could also be interesting to evaluate the quality of movements. While several measures of movement quality have been developed, these quality measures depend mainly on the clinician's experience.[36] The use of this tablet allows us to reflect the motor functioning of individuals and to objectively assess the quality of fine movements of individuals with different movement disorders, such as Parkinson's disease or developmental coordination disorders, an assessment that until now has been difficult for clinicians.

CONCLUSIONS

To our knowledge, this study is the first to determine the influence of daily physical activity on individuals' fine motor performance using a reciprocal aiming task. The results of our study didn't indicate any significant major correlation between daily PAL and PI or an effect of the group of PAL on the performance index achieved by the participants. The next step will be to consider the use of Fitts' reciprocal task and a digital tablet in a clinical setting.

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Declaration of conflicting interests

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REFERENCES

1. Roelker SA, Bowden MG, Kautz SA, et al. Paretic propulsion as a measure of walking performance and functional motor recovery post-stroke: A review. Gait Posture 2019; 68:6–14.
2. Bangsbo J, Blackwell J, Boraxbekk CJ, et al. Copenhagen Consensus statement 2019: physical activity and ageing. Br J Sports Med 2019; 53(14):856–8.
3. Ainsworth BE, Haskell WL, Herrmann SD, et al. 2011 Compendium of Physical Activities: a second update of codes and MET values. Med Sci Sports Exerc 2011; 43(8):1575–81.
4. Stodden D, Langendorfer S, Roberton MA. The association between motor skill competence and physical fitness in young adults. Res Q Exerc Sport 2009; 80(2):223–9.
5. Stodden D, Goodway JD, Langendorfer SJ, et al. A developmental perspective on the role of motor skill competence in physical activity: an emergent relationship. Quest 2008; 60(2):290–306.
6. Hübner L, Voelcker-Rehage C. Does physical activity benefit motor performance and learning of upper extremity tasks in older adults? - A systematic review. Eur Rev Aging Phys Act 2017; 14:15.
7. Shumway-Cook A, Woollacott MH. Motor control: translating research into clinical practice. 4th ed. Baltimore: Lippincott Williams & Wilkins; 2012.
8. Shishov N, Melzer I, Bar-Haim S. Parameters and measures in assessment of motor learning in neurorehabilitation; a systematic review of the literature. Front Hum Neurosci 2017; 11:82.
9. Papathanasiou J, Dionyssiotis Y, Kasnakova P, et al. Six-minute walk test: A tool for assessing mobility in frail subjects. J Frailty Sarcopenia Falls 2016; 1(4):73–6.
10. Proud EL, Bilney B, Miller KJ, et al. Measuring hand dexterity in people with Parkinson's disease: reliability of pegboard tests. Am J Occup Ther 2019; 73(4):7304205050p1–8.
11. Romilly DP, Anglin C, Gosine RG, et al. A functional task analysis and motion simulation for the development of a powered upper-limb orthosis. IEEE Trans Rehab Eng 1994; 2(3):119–29.
12. Fitts PM. The information capacity of the human motor system in controlling the amplitude of movement. J Exp Psychol 1954; 47(6):381–91.
13. Fernandez L, Huys R, Issartel J, et al. Movement speed-accuracy trade-off in Parkinson's disease. Front Neurol 2018; 9:897.
14. Shannon CE, Weaver W. The mathematical theory of communication. Urbana, IL: The University of Illinois Press; 1949:1-117.
15. Plamondon R, Alimi AM. Speed/accuracy trade-offs in target-directed movements. Behav Brain Sci 1997; 20(2):279–303; discussion 303-349.
16. Casiez G, Vogel D, Balakrishnan R, et al. The impact of control-display gain on user performance in pointing tasks. Human-Computer Interact 2008; 23(3):215–50.
17. Thumser ZC, Slifkin AB, Beckler DT, et al. Fitts' law in the control of isometric grip force with naturalistic targets. Front Psychol 2018; 9:560.
18. De Vries S, Huys R, Zanone PG. Keeping your eye on the target: eye-hand coordination in a repetitive Fitts' task. Exp Brain Res 2018; 236(12):3181–90.
19. Gorniak SL. The relationship between task difficulty and motor performance complexity. Atten Percept Psychophys 2019; 81(1):12–9.
20. Smith DL, Claytor RP. An acute bout of aerobic exercise reduces movement time in a Fitts' task. PLOS One 2018; 13(12):e0210195.
21. Mavrov M. The law institute of patient's informed consent. Stovi Group Publishers, 2018:243.
22. Rivière F, Widad FZ, Speyer E, et al. Reliability and validity of the French version of the global physical activity questionnaire. J Sport Health Sci 2018; 7(3):339–45.
23. World Health Organization. Global physical activity: analysis guide. [Internet]. 2008 [cited 2020 Nov 29]. Available from: https://www.who.int/ncds/surveillance/steps/resources/GPAQ_Analysis_Guide.pdf
24. Welford AT. Fundamentals of skill. London: Methuen; 1969.
25. International Organization for Standardization. ISO 9241-9 [Internet]. ISO. 2002. Available from: https://www.iso.org/cms/render/live/en/sites/isoorg/contents/data/standard/03/00/30030.html
26. Noguchi K, Gel YR, Brunner E, et al. NparLD: An R software package for the nonparametric analysis of longitudinal data in factorial experiments. J Stat Softw 2012; 50(1):1–23.
27. Vargha A, Delaney HD. A critique and improvement of the CL common language effect size statistics of McGraw and Wong. [Internet]. 2000 [cited 2021 Mar 8]. Available from: https://journals-sagepub-com.ezproxy.unilim.fr/doi/10.3102/10769986025002101
28. McGrath RL, Kantak SS. Reduced asymmetry in motor skill learning in left-handed compared to right-handed individuals. Hum Mov Sci 2016; 45:130–41.
29. Guiard Y. On Fitts's and Hooke's laws: simple harmonic movement in upper-limb cyclical aiming. Acta Psychol (Amst) 1993; 82(1-3):139–59.
30. Borecki L, Tolstych K, Pokorski M. Computer games and fine motor skills. Adv Exp Med Biol 2013; 755:343–8.
31. Sobierajewicz J, Naskręcki R, Jaśkowski W, et al. Do musicians learn a fine sequential hand motor skill differently than non-musicians? PloS One 2018; 13(11):e0207449.
32. Kekäläinen T, Terracciano A, Sipilä S, et al. Personality traits and physical functioning: a cross-sectional multimethod facet-level analysis. Eur Rev Aging Phys Act [Internet]. 2020 Nov 24 [cited 2021 Jan 14];17. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7685629/
33. Hoffmann ER, Chan AHS, Tsang SNH. Bimanual and unimanual convergent goal-directed movement times. J Mot Behav 2015; 47(3):232–45.
34. Bard-Pondarré R, Castan C. Intérêts et limites de l'utilisation des tests quantitatifs d'évaluation fonctionnelle du membre supérieur de la personne paralysée cérébrale. [Interests and limits of the use of quantitative functional assessment tests of the upper limb of the cerebral palsy person.] Mot Cérébrale Réadapt Neurol Dév 2017; 38(2):59–70 [French].
35. Anadón M. Les méthodes mixtes: implications pour la recherche «dite» qualitative. [Mixed methods: implications for "so-called" qualitative research] Rech Qual. 2019;38(1):105–23 [French].
36. Yang N, Zhang M, Huang C, et al. Motion quality evaluation of upper limb target-reaching movements. Med Eng Phys 2002; 24(2):115–20.

Влияние ежедневной физической активности на мелкую моторику взрослых при выполнении задачи закона Fitts

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Резюме

Введение: Выполнение наших повседневных задач зависит от конфликта скорости и точности. Физическая активность играет важную роль в развитии наших двигательных навыков. Однако взаимосвязь между уровнем физической активности (PAL) и мелкой моторикой остается в значительной степени неизученной.

Цель: Нашей целью было изучить взаимосвязь между объёмом ежедневной физической активности и успеваемостью здоровых взрослых в моделировании акта двумерного наведения.

Материалы и методы: Восемьдесят семь здоровых взрослых выполнили задание на моделирование акта двумерного наведения с помощью цифрового планшета. Обеими руками выполнялись четыре уровня сложности (3-6, в зависимости от ширины мишени) и 50 баллов для каждого уровня. Были проанализированы время движения, частота ошибок и индекс производительности. PAL измерялся с помощью опросника глобальной физической активности. Корреляции Spearman и анализ nparLD использовались в R Studio для изучения влияния уровня физической активности и индекса сложности на успеваемость людей.

Результаты: За исключением корреляции между PAL и двигательной активностью на самом простом уровне (r=0.23, p=0.002), не было никакой корреляции между PAL и мелкой моторикой.

Заключение: Результаты нашего исследования не выявили каких-либо существенных корреляций между ежедневным PAL и мелкой моторикой, за исключением тех случаев, когда ограничения акта двумерного наведения являются самыми низкими. Необходима дальнейшая работа для рассмотрения возможности использования моделирования акта двумерного наведения Фиттса в клинических условиях.

Ключевые слова

взрослый, повседневная жизнь, упражнения, закон Фиттса, двигательные навыки, верхняя конечность