EXTRAVERTED CHILDREN SWIM FASTER COMPARED TO INTROVERTED COUNTERPARTS REGARDLESS OF LIGHT AND SOUND NOISE LEVELS

CRIANÇAS EXTROVERTIDAS NADAM MAIS DEPRESSA QUE CRIANÇAS INTROVERTIDAS INDEPENDENTEMENTE DOS NÍVEIS DE LUMINOSIDADE E RUÍDO SONORO

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Abstract: Individual differences of personality are thought to influence motor performance. In terms of cortical arousal levels, because extraverts are infra-activated and introverts are hyper-activated, environment stimuli might enhance the impact of the extraversion trait on task performance. This study investigated the effect of light and sound noise on the swimming performance of extraverted and introverted children. 19 extraverts (12 boys, 7 girls) and 22 introverts (12 boys, 10 girls), ages 8.2 ± 0.9 years, adapted to water and swimming at intermediate levels. Participants performed two trials of the task (swimming 15 meters as fast as possible in crawl style) under two environment conditions: bright light/loud noise (A) and dim light/slight noise (B). Movements were filmed to allow calculation of time to complete the task and the stroke cycle. There was a significant effect for the group factor, with extraverts swimming faster than introverts. No effect was detected for the environment factor or the interaction group/environment. Regarding stroke cycle, no differences were found for group, environment or interaction. Although extraversion has not affected mechanical aspects of crawl style, compared to introverts, extraverts swan faster, showing a more effective process of reacting and executing movements in time-constraints tasks.
Keywords: Swimming, Sensorimotor performance. Personality. Extraversion. Individuality.

Resumo: Diferenças individuais de personalidade podem influenciar o desempenho motor. Em termos de ativação cortical, porque extrovertidos são infra-ativados e introvertidos hiperativados, os estímulos ambientais podem aumentar o efeito do traço de extroversão ao desempenhar tarefas. O presente estudo investigou o efeito da luminosidade e do ruído sonoro no desempenho natatório de crianças extrovertidas (19; 12 meninos, 7 meninas) e introvertidos (22; 12 meninos, 10 meninas), com idade de 8.2 ± 0.9 anos, adaptadas à água e com nível intermediário de natação. As crianças executaram duas tentativas da tarefa (nadar 15 metros o mais depressa possível em estilo crawl) sob duas condições ambientais: luz forte/ruído alto (A) e luz fraca/ruído baixo (B). Os movimentos foram filmados para cálculo de tempo para completar a tarefa e de ciclo de braçada. Houve efeito significativo para o fator grupo, com extrovertidos nadando mais rapidamente que introvertidos. Não houve efeito para o fator ambiente ou interação grupo/ambiente. Quanto ao ciclo de braçada, não houve diferenças para qualquer fator ou interação. Embora a extroversão não tenha afetado aspectos mecânicos do nado crawl, comparados aos introvertidos, os extrovertidos nadaram mais rapidamente, o que demonstra um processo mais efetivo para reagir e executar movimentos com restrições de tempo.
Palavras-chave: Natação. Desempenho sensório-motor. Personalidade. Extroversão. Individualidade.

INTRODUCTION

Performance differences between extraverts (friendly, talkative, outgoing) and introverts (introspective, quiet, reserved) have been explained within the Eysenck theory by distinct basal levels of cortical activation (arousal), which is the energy needed for basic cortical processes to take place, such as perception, memory and reasoning[1]. Because extraverts bear high arousal levels and introverts have low levels of cortical activation[2], the former tend to seek stimuli and the latter prefer constant, mild, and low intensity stimuli. The choice of stimuli (e.g. coffee, tobacco, audible noise and light) is a key topic in research programs that investigate individual differences associated with personality[3]. Theoretically, under the influence of these stimuli, the hyper-aroused introverts are more affected compared with extraverts because their arousal levels are even more raised, and, consequently, they may exceed the point of transmarginal inhibition, which functions as a protective tool of the body[1].

Whereas introverts show better performance in reaction time, extraverts exhibit shorter movement time[4-10]. In addition, introverts tend to keep attention for long periods, while extraverts are thought to pay attention only for short periods[11]. While speed-accuracy trade-off remains unclear in children, adults and elderly[12], children's high scores of extraversion appear to predict better accuracy at dart-throwing[13] and manual dexterity performance[14]. However, there were extremely low correlations between extraversion and gross motor performance scores in children[15] as well as no differences between extraverted and introverted children in the learning of the handstand under physical practice followed by mental imagery[16].

In the cognitive domain, while studying in the university library, extraverts self-reported the preference for places with opportunities for socialization, high noise, and frequent pauses[17]. Extraverts and introverts seem to differ in the use of attentional resources when responding to auditory stimuli in a hearing discrimination task with randomly presented targets: introverts maintained a higher electrophysiological responsiveness and extraverts tend to react more strongly only initially, decreasing the level of responsiveness over trials[18]. Also, extraverts are more positive to gamification[19], are prone to performing creative assignments[20], and, in language learning, adopt affective strategies in interpersonal communication and are visual-learners, whereas introverts are concerned with the meaning of activities, having shown delayed responses to chats[21].

In the learning of a pair-associates task, the choice of low-intensity noise levels was beneficial to introverts and harmful to extraverts but when sound stimuli were imposed, high intensity noise harmed the performance of both extraverts and introverts[22]. Introverts and extraverts differ on choosing light and sound levels during a reading task[23]; in a quiet room with dim light there was a button which, if pressed, caused noise and bright light during a period of three seconds, with the possibility of maintaining these stronger stimuli if the button was pressed again; the extraverts tended to change the environment by making it noisier and luminous most of the time, whereas introverts hardly intervened to change the environment. In addition, extraverts are less effective compared to introverts in a reading task[19].

Accordingly, the conception of the present study was built upon the assumptions that luminosity and noise affect performance and that extraverts and introverts react in a different fashion to stimuli of the surrounding environment according to preferences and needs. Moreover, little has the literature on individual differences produced about stimuli preferences and needs of extraverts and introverts during the execution of the motor tasks. Moreover, this milieu is even more equivocal as regards to children. As swimming classes are a particularly popular and enjoyable motor activity with children and young people, we feel that it is appropriate to choose a swimming skill to investigate the influence of environment stimuli on extraverted and introverted children. Swimming is a racing sport that requires the utilization of the body to move through water. It is linked to survival and joy and has basic skills which are important to the full development of a person. Swimming strokes (butterfly, backstroke, breaststroke, freestyle) require a set of specific techniques. The freestyle stroke is most effectively performed by crawl style, a fastest way to swim and the first taught in swimming classes. To swim the crawl technique, the swimmer circles the arms forward in alternation on the water's surface, kicking the feet up and down to enable turning the body to breath[24,25].

Our purpose then was to examine the effect of light and sound noise levels on the aquatic motor performance of extraverted and introverted children. We chose a swimming skill, crawl style, as experimental task because it is the most used style in the learning of swimming, the fastest among the styles, and comprises the coordinated action of several degrees of freedom such as, arms, legs, trunk, and head[25,26]. We believe that broadening knowledge about the performance of extraverted and introverted children during the performance of crawl swimming under different levels of noise and light might help as a pedagogical tool to adapt activities to children with different personality profiles during the teaching-learning process. Our hypotheses are twofold: 1) extraverts would swim faster as compared with introverts under the environment emitting bright light and loud sound noise; 2) introverts would swim faster compared to extraverts under the environment emitting dim light and slight noise.

MATERIAL AND METHODS

Participants

The purposive sample comprised 41 children, from seven to nine years (mean age = 8.2 ± 0.9 years), who responded to a validated version of the Eysenck Personality Questionnaire – Junior, EPQ-J[27]. The score range of extraversion varies from one to ten. Participants were classified upon average values[8,28] and designated to one of two groups: introverts (ETPC score < 7; 12 boys and 10 girls) and extraverts (ETPC score > 7; 12 boys and 7 girls). Children who scored "7" were not considered for analysis.

The children had systematic swimming practice of 1.41 ± 0.89 years (introverts) and 1.32 ± 0.92 years (extraverts). None of the children had less than six months or more than three years of practice of systematic swimming practice. All participants showed intermediate levels in crawl swimming according to a validated checklist[29]. Three children were overweighed: one extraverted (two years of practice) and two introverted (the first with one year of practice and the second with three years of practice). No obese child took part in the experiment. Height and weight values were 125.3 ± 5.92 cm (introverts) and 126.01 ± 5.29 cm (extraverts); 25.21 ± 4.98 cm (introverts) and 25.87 ± 3.69 cm (extraverts). T-tests indicated no significant differences between the groups: $t(39)=-0.531$; $p=0.60$ (height); $t(39)=-0.471$; $p=0.64$ (weight).

The University's Ethics Committee approved the study, which has been complied with all the relevant national regulations, institutional policies and in accordance with the tenets of the Helsinki Declaration. Parents and children read and signed an informed consent form prior to participate.

Procedures

We carried the data collection in a 15 meters-long swimming pool, 1.55 meters-deep. The water temperature was held between 31.5°C and 32°C, measured by a floating AX Sports thermometer. All windows of the environment were covered with black fabric.

Each child was instructed to swim 15 meters in crawl style as quickly as possible under two environment conditions: (A) bright light/loud sound noise, (B) dim light/low sound noise. To avoid the effect of order, the ABBA procedure[29] was adopted to randomize children in a counterbalanced way within each group. Thus, in the introverted group 11 children performed A-B order, while 11 children performed B-A; in the extraverted group 10 children performed A-B order, while 9 children performed B-A.

We induced light and sound in the environment with three 1000W luminous spotlights and a 12-inch Speedvoice stereo (250W driver and twitter). The average luminosity was 1650 lux in the bright environment and 27 lux in the dim environment. The sound noise during the attempts was produced with a 103 bpm song. The decibel meter recorded average values of 119 decibels with the stereo turned on. The environment with no music reached 50 decibels in average. We determined these parameters by using a digital portable lux meter (Tecman TM830M, version A0, accuracy of <3%rgd, 5%fs, 4%rgd/dgts) and a digital portable decibel meter (NAGANO GM1351, model NDD 30130, which measures from 30 to 130 decibels - accuracy of ± 1.5).

Each participant started the trial inside the pool next to the border but he/she was not allowed to push the wall to start swimming. The researcher announced the words "on your mark, go" and triggered the chronometer at the exact moment the child started moving the arm. While the children were swimming, the researcher walked along the edge of the swimming pool and pressed the button of the chronometer at the exact moment the child hit the opposite border.

At the end of the trial, the researcher provided to the child knowledge of results on the time to complete the task. Next, the child swam slowly to the starting position where he/she rested for one minute prior to performing the second trial. At the end of the second trial, the researcher provided to the child knowledge of results on the time to complete the task and the child left the pool, walked to the locker room, waited for 30 minutes and returned to perform two more trials under the other environment condition.

The researcher provided prior oral instruction in a standardized manner about the way to perform the task and terminal feedback (knowledge of results) on the time taken to swim. In order to record movement images for analysis, a researcher walked along the edge of the pool handling a digital video camera (Sony HDR-PJ340, 30Hz) at the same pace of the child who was swimming.

Analysis

Despite using the time displayed on the chronometer to provide feedback to the child, we registered the time to perform the task based upon the video images (frames). The time considered for analysis was the period between the moment the researcher lowered the arm and the moment the child hit the hand on the wall. We also analyzed the arm stroke cycle, defined as the number of arm strokes per minute; one cycle was determined as the period between two successive touches of the right hand on the water. To acquire arm stroke cycle data, a skilled evaluator watched and analyzed the videos, frame by frame, of the 10 intermediate meters of the course, following a procedure that has been used elsewhere[31,32] proposed by Chollet et al.[33].

We organized data on Microsoft Excel and statistically analyzed them through IBM SPSS, version 24. First, we explored the data to identify missing data, outliers, and normality of distribution (Shapiro-Wilk). Next, the data of each variable were submitted to a descriptive analysis and a two-way analysis of variance (ANOVA), 2 (Group) x 2 (Environment): group (introverts x extraverts) as between-subjects; environment as within-subjects. We reported partial square eta values (ω) to indicate the magnitude of the effect for significant results. The level of significance was set at 5%.

RESULTS

The exploration of the data, 164 observations for analysis (n=41 x 4 variables), indicated only one cell with no value, normal distribution for three variables, and six moderate outliers, which were maintained in the analysis. Time and stroke cycle means and standard deviations are shown in Table 1. As ANOVA is robust to non-normality[34], we adhere to this parametric statistical technique.

Table 1. Time and arm stroke cycle values of introverted and extraverted on the environment conditions (swimming 15 meters).

	Introverts (M±SD)		Extraverts (M±SD)
Time			
BL/LN	22.37 ± 7.95		18.13 ± 3.97
DL/SN	22.04 ± 5.25		19.07 ± 3.07
Total	22.21 ± 6.6	*	18.6 ± 3.52
Arm stroke cycle			
BL/LN	33.53 ± 11.42		37.34 ± 12.79
DL/SN	33.87 ± 13		38.59 ± 16.36
Total	33.7 ± 12.21		37.96 ± 14.57

Note: mean (M) ± standard deviation (SD).
* significant differences (p<0.05).
BL-bright light; DL-dim light;
LN-loud noise; SN; slight noise.
Source: Authors

The ANOVA of the variable "time" detected significant effect for the Group factor [F(1,39)=4.92; p=0.032; ω=0.112], with extraverts having swum faster than introverts. There were no significant effects for the Environment factor [F(1,39)=0.29; p=0.59; ω=0.007] or the Group x Environment interaction [F(1.39)=1.23; p=0.27; ω=0.031].

No differences in the "stroke cycle" variable were identified by the ANOVA for Group [F(1,39)=1,07; p=0,31; ω=0,027], Environment [F(1,39)=1,12; p=0,30; ω=0,028], or Group x Environment interaction [F(1,39)=0,36; p=0,55; ω=0,009].

DISCUSSION

The present study aimed at investigating the effect of light and sound noise levels on the performance of a swimming skill (crawl style) in extraverted and introverted children. Since the analysis indicated a group effect on the time to swim in favor of extraverts and no group differences on the stroke cycle, there was partial support for the hypothesis that extraverts would swim faster in comparison with introverts under the environment emitting bright light and loud sound noise. Therefore, extreme levels of light and sound noise levels did not affect aquatic motor performance whatsoever as indicated by the absence of significant differences on the interaction group x environment on both variables (time and stroke cycle).

Regardless of light and sound noise levels, the bottom line is that the extraverted children swam significantly faster, 3.7s on average, compared to their introverted counterparts. This advantage of extraverts over introverts regarding time to perform tasks (motor processing) has received support from prior research[4-10]. These studies showed that introverts only outweigh extraverts in the time to react to the stimulus (reaction time), that is, on pre-motor processing, which has been associated with cognitive aspects of performance. This advantage in sensorimotor processing by extraverted children when compared to their introverted counterparts was corroborated in other studies in the motor domain, specifically on movement times and correct answers during the performing of difficult tasks that involved manual dexterity[14] and target accuracy while performing a dart-throwing task[13]. Likewise, our findings showed superior performance by the extraverted children in the crawl-swimming task, so typical a skill that requires complex motor processing[24,25].

Very few studies recent studies controlled motor and performance factors in swimmers. Swimming training seems to have positive effects in promoting students' psychological health and personality traits. For example, a two months swimming training program showed significantly effects in extraversion, self-confidence and sociability but decreased neurotic tendency, dominancy and self-contained in 60 Iranian female volunteer university students; the authors applied a pre test and post test design, used the Bernreuter's personal inventory, and analysed data with a multivariate analysis of covariance to compare the control group to the experimental one, the latter took part in the swimming program[35]. On the other hand, a descriptive study reported that 67 skilled adult swimmers, men and women, answered the Brazilian version of the "Eysenck Personality Questionnaire" and extraversion did not differentiate short-, middle- and long-distance skilled swimmers[36]. These studies show that swimming lessons has the potential to increase extraversion levels in non-skilled participants and that extraversion has not a major effect upon on the type of event chosen by skilled swimmers.

In cognitive processing, another interesting feature of extraversion-related differences is the responsiveness when the task ought to be executed within time constraints. For example, in performing a hearing discrimination task with randomly presented targets under auditory stimulation, the first trials' responses of extraverts were shorter compared to introverts', but with the course of practice, the introverts overcame extraverts, arguably due to high levels of electrophysiological responsiveness of the former over the latter[18]. In addition, introverts exhibit delayed responses to chats in language learning conversations[21], whereas extraverts have predilection for competitive, vigorous and game activities[19]. These findings seem to be in line with the type of skill we employed in the present study the (crawl swimming), a vigorous short-duration task, in which extraverts verified their promptness to show superior performance when compared to introverts.

Alternatively, introverts have a preference for choosing slight noise in order to enhance performance in a pair-associates cognitive task[22], while extraverted students preferred noisy places in the library[17] and tended to change the environment in a reading task by making it noisier and brighter most of the time[23]. These studies of extraversion that offered the participants the choice of stimuli while performing cognitive tasks appear to give little support to our findings. Although we did not give the participants the opportunity to choose the stimuli under which they would perform the crawl-swimming task, extreme levels of light and sound noise in the environment produced no significant effect on motor performance of extraverted and introverted children.

We also addressed the movement pattern of crawl swimming by measuring the arm stroke cycle, an index of biomechanical aspects of the swimming technique[31,32]. There were no differences between introverts and extraverts; hence, no distinct movement patterns were displayed by any of the experimental groups, which is evidence of the absence of any relationship between quality and performance outcome of crawl swimming in children who have intermediate skill levels. It appears that the direct relationship between the quality of crawl swimming and its performance outcome is only present when the skill level of the swimmers is high[37].

A limitation of our study was that we did not take a baseline mean time of each group under the regular environment, with normal levels of light and noise. Thus, regarding a possible bias related to a better time that one of the groups could have started the experiment, the rationale for explaining this issue is that all the participants had intermediate levels of swimming (the systematic swimming practice of introverts was 1.4 years, whereas 1.3 years for the introverts).

We would like to make a final, conjectural but attractive, attempt of discussing our findings. Preserving due proportions, pursuant to attentional control theory certain stimuli induce anxiety, which can prompt compensatory strategies to uphold performance[38,39]. Although we can only speculate that the non-preferred environments built under light and sound noise might have brought anxiety to our introverts (bright light/loud noise) and extraverts (dim light/slight noise), it is arguable that the performance of anxious individuals would be offset by increased cortical activation, physical/mental exertion, tremors, sweating, flushing, and increased heart rate. We are aware that these psychophysiological characteristics were not systematically measured in the present study, but we hypothesize that the interaction group x environment could have been neutralized by compensatory strategies associated to anxiety. Future studies could examine this hypothesis with the use of psychophysiological measures.

CONCLUSION AND PRACTICAL IMPLICATIONS

In summary, extraverted children swam 15 meters in crawl style significantly faster as compared to their introverted counterparts, irrespective of light and sound noise levels in the environment.

Practical implications for swimming coaches and practitioners involve no major concern about levels of light and sound noise when coping with introverted and extraverted children, but careful attention to specific instruction and pedagogical procedures to boost introverts' performance in tasks in which speed is the primary demand (e.g. encouragement, feedback, reward). Finally, we would like to highlight some limitations of our work. We chose an adapted (15 meters) swimming distance to enable experimental control in detriment of ecological validity regarding official swimming distances. In addition, we selected a purposive sample composed of intermediate level learners whose age range varied from seven to nine years.

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