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Original Article

Children over "-enty, -rty, -fty": gamification and autonomy as an environmental education leitmotif for "children of all ages" using a new workplace narrative

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Abstract:
The "Pocket Trainer" research project is part of a more comprehensive project, the "Ufficio Proattivo 150" project, which aims to assess a new workplace concept as an opportunity for individual development and health promotion, which differs from frequent beliefs that consider the workplace itself the cause of sedentarism or stress. By this rationale, new workstations plan to substitute the natural environment. Owing to innovative architectural solutions and specific equipment designs, the employees can exercise without interrupting the usual workflow. Individualized and adapted training programs support this user–place interaction in the spirit of gamification and distinguishing factories oriented at promoting the awareness of proper health practices of their employees. We designed a new portable and straightforward equipment, the cube fitness test (CFT), which is based on exercising at submaximal intensity. It can be used in several environments: at home, in the office, indoors, and outdoors. A preliminary investigation assessed the validity and reliability of CFT. A total of 54 individuals (21 females and 33 males, 20.0 ± 4.2 years old, 65.0 ± 11.4-kg body weight, 1.74 ± 0.09-m stature, 22.0 ± 2.4-kg·m^{-2} body mass index) participated in this study. They were tested on cardio-respiratory and muscular endurance, flexibility, core muscular efficiency, shoulder mobility, and upper body strength; the obtained results were related to measurements performed using CFT. Overall, acceptable and good reliability were obtained in single tests ($r > 0.66$; $p < 0.001$), and moderate to good validity was observed ($r > 0.50$; $p < 0.001$). Low validity was found in the core muscular efficiency ($r = 0.44$; $p < 0.001$). CFT is a reliable instrument that contributes to developing consciousness, culture, and motivation toward physical activity. It provides knowledge of the advantages of good behaviour on the health status and quality of working life. This study confirmed that even mild and minimal exercise contributes to improving physical and mental health. Hence, the use of CFT in the Pocket Trainer intends to promote health at usual workplaces and in particular: i) higher wellbeing levels (actual and perceived), ii) new awareness on properties of physical activity on health prevention and healthy lifestyle promotion.
Key Words: physical activity, perception, exercise, wellbeing, active lifestyle

Introduction

It is a common belief that workplace (specifically office-like rooms) is a main cause of sedentarism or stress. A broad project called *Ufficio Proattivo 150* (inspired by the weekly minutes of moderate physical activity suggested by the World Health Organization, WHO) has been recently designed with the aim to define new arrangements of the workplace concept as an alternative opportunity for individual development and health promotion (Altavilla, 2016; D'Isanto, Manna, & Altavilla, 2017). A pivotal component of this main project is represented by the sub-project *Pocket Trainer* (PT), which is based on the rationale of lifelong and life-wide learning and education related to different situational and environmental contexts. PT allows the complete planning, evaluation, and promotion of physical activity at the workplace. It can further challenge recent new habits in sports and exercise after changes owing to pandemic restrictions (Gaetano Raiola et al., 2020). Briefly, PT consists of preliminary overall assessment, which provides an individual weekly score that need to be achieved by performing different types of physical exercises and activities (at the workplace, at home, indoors, and outdoors). After several weeks of exercising, a further assessment to check improvements (and to set an updated individual weekly score to achieve) is performed.

PT is also part of the so-called "third mission" action that Italian Universities promote to connect academics to society. The local Ethical Committee approved PT, and the Open Innovation and Technology Transfer Office at the University of Milan supports its development. PT develops the paradigm of a "workplace that educates" the workers to be more physically active and self-confident in their level of physical exercise. It ultimately aims to improve the individual physical and mental health and wellbeing that can also lead to the subsequent increase in the efficiency and productivity of the workers. Several players work in synergy in PT: a university research group, an architecture and design studio, and a computer technology company.

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Outdoor movement education and gyms (Prolegomena: gym as a surrogate of the natural environment)

Modern humans do not require the same body functionality of primitive men, whose motor abilities were essential to survival in the natural environment, searching for food, and keeping safe in the natural selective process (Ferrara, 1992). However, currently, modern humans are still claimed to acquire several motor skills as our ancestors did. Human body, which is designed to overcome natural constraints, has not change over the centuries. However, it is necessary to practice motor actions to maintain health and operability (Nicolosi et al., 2010).

In the outdoor environment, motor experiences are practiced by necessity and without protection, which increases risks associated with physical activity. By confining outdoor experiences to an indoor environment, gyms allow to exercise under more controlled conditions (and therefore under safety rules) to gradually acquire movements that modern humans are still not used to performing. Physical education teachers have designed gym equipment in which classic gymnastics served to maintain physical efficiency to reproduce in a safe setting the practice that the natural environment would have required, assuming it was the actual habitat again. Therefore, practitioners are gradually and adequately taught the movement, and risks of injuries are reduced. In addition, because skill requirements and demands evolve smoothly under indoor conditions than while exercising in the natural environment, less able practitioners more adequately tolerate exercise and benefit from the inclusive approach assured by this controlled activity. In the past, the lack of this progressive and structured opportunity to learn motor skills would likely have meant a natural negative selective process for weaker individuals.

Pedagogy, instruction, and training methods further evolved and completed the educational chance of modern humans for recovering, developing, and achieving the otherwise missing motor abilities.

While knowledge and circumstances to perform indoor or outdoor physical activities are available, the self-awareness of values to learn and keep moving is currently lacking. Actions, such as PT, intend to promote it starting from the workplace, where employees spend a large portion of their daily life.

Workplace as a school: a dissemination site for the culture of movement (Prolegomena: new frontiers of architecture) According to Michel de Montaigne, *"the consciousness laws that are said to be born from nature come from habits,"* and *"common ideas that credit around us seem as general and natural laws."* (de Montaigne, 2014)

Based on these assumptions, workplace can serve adults as a dissemination site of education on movement (Ajibuia, Olorunsola, & Alla, 2013), which is similar to how school is for children, gym is for practitioners, and nature was for our ancestors. New architecture concepts and modern approaches create and reinvent the worksite environment, which promotes the employees' physical literacy and education on "motor normality" (intended as adequate human motricity) assured initially by the natural environment and then by the gyms. Owing to the pandemic, the worksite environment has extended to home during smart working.

Therefore, employees are encouraged, motivated, and supported in exercising and, in particular, in experiencing physical activities during the usual daily workflow, which makes the worksite proactive and enhances workers' self-awareness approximately their level of physical efficiency (Gao, Nguyen, Dunstan, & Moodie, 2019; Jindo et al., 2019; Tsai, 2016). In addition to the advantages for the workers, companies also benefit from the augmented physical exercise by the employees. Productivity, work performance, workability, and workers' mood improve (Brown, Gilson, Burton, Brown, 2011; Grimani, Aboagye, & Kwak, 2019). Medical costs decrease by approximately $3.27 for every dollar spent on wellness programs, and companies' absenteeism costs decrease by approximately $2.73 for every dollar spent (Baicker, Cutler, & Song, 2010).

Workplace that takes care of workers, a new narrative

What makes the workplace proactive? What encourages employees to exercise while working? How to make workers enjoy a new workplace narrative? PT embraces two concepts to answer these questions.

First, the principles of intrinsic motivation and the self-determination theory served to plan PT and assure workers' autonomy in choosing the motor activity to perform (Deci & Ryan, 1985). In a bold vision, employees can choose a more appropriate physical activity, a favourite place (e.g., office, home, outdoors, or indoors), or even not engage in the activity if the moment is not appropriate (e.g., not enough time, too much work/stress, or too tired). Moreover, the continuous practice and educational information on the sports activity create new physical competencies. Cooperating during the activity or only doing the activity collectively further enhance the method. Second, positive psychology (Crum, Salovey, & Achor, 2013) and gamification (Robson, Plangger, Kietzmann, McCarthy, & Pitt, 2016; Sgro, Quinto, Platania, & Lipoma, 2019) promote exercising and make the activity exciting and enjoyable. When used in the daily workflow, gamification can encourage employees to engage in more physical activity. Game novelty, competitive and/or cooperative approaches generate appreciation and sociality, which further stimulates acceptable and durable motor practices for health and wellness.

PT requires to record all physical activity practiced, even daily routine activity (e.g., carrying shopping bags upstairs or taking a dog for a walk). Each activity provides a score that is based on duration and perceived intensity. At the end of the week, scores are summed, and the final value corresponds to the weekly physical activity amount. There are several ways to measure physical activity. A suitable method to measure it is to implement physical activity-based technological systems in the typical workplace workflow. The employee interacts with workplace tools in a modified way to improve physical activity by small exercise practice (Elia,

Domenico, Isanto, Altavilla, & Raiola, 2020; Jindo et al., 2019; Raiola, Domenico, Isanto, Altavilla, & Elia, 2020; Sgrò, Licari, Coppola, & Lipoma, 2015). As previously described, to make the workplace proactive, PT considers: i) pedagogic, ii) architectural, and iii) technological variables.

i) *Pedagogic variables:* The paradigm of a "workplace that educates" embodies pedagogic values. The primary intent is to set the "motor normality" for healthy adult individuals, which is human motricity that can be assumed as sufficient and necessary to avoid a debilitating status that increases risk of injuries and results in low quality of life. PT has been designed to properly lead physical exercise at the workplace by bringing an individual to and measuring such physical efficiency levels. PT is based on the cube fitness test; its procedure, validity, and reliability are reported later. The second aspect to consider is related to professionals who are appointed to supervise the evaluation and training processes; these individuals should be identified (specialists in exercise sciences), allocated, and possibly engaged by the employers to act as competent facilitators to guarantee effective and enjoyable motor practices.

Finally, methods and didactic strategies have to be defined to motivate and consolidate employees' participation; specifically, storytelling and cooperative learning best serve this purpose and are the primary approaches of PT.

ii) Architectural variables: Changes in the workplace environment are the second pillar of PT. Implementing physical activity-based technological systems in the typical workplace flow should help the employees easily engage in physical activity during working hours. Equipment, which is specifically built to induce exercise to accomplish the workflow, reproduces at the workplace facilities that are present at the gyms.

iii) Technological variables: The development of a dedicated app for mobile devices and a technological system for detecting and recording physical activity is the main focus of technological variables. The app has to communicate with the office's technological devices that generate a database of any employee's physical activity. In this way, employees obtain individual performance parameters for personal gaming or collective competitions under the gamification approach, with due regard to privacy policies.

Developing and maintaining education on the movement

The previously described structure of a proactive workplace to promote physical activity first requires tools and criteria to measure and monitor the exercise. Cube fitness test (CFT) is a testing procedure that is performed with portable and straightforward equipment (a cube) that is designed to be used in any environment: at home, in the office, indoors, and outdoors (Figure 1). It allows to exercise and test cardiovascular endurance, flexibility, core muscles, shoulder mobility, and the upper body's strength. The testing procedure lasts 10 min at maximum and requires efforts of moderate intensity. Anyone can easily tolerate submaximal engagement; it can be performed without specific apparel, and safety is guaranteed.

Figure 1: Cube fitness test. The equipment (in the middle) and examples of home and office applications for exercising and testing motor normality.

Materials and Methods

The first preliminary investigation aimed to assess the validity and reliability of CFT.

Participants: A total of 54 individuals (21 females and 33 males, 20.0 ± 4.2 years old, 65.0 ± 11.4 kg, 1.74 ± 0.09 m, BMI of 22.0 ± 2.4 $Kg \cdot m^{-2}$) participated in the preliminary investigation. After receiving explanations of the study's aims and procedures, they signed an informed consent to participate. The study was conducted by following the Declaration of Helsinki for the Humans Rights and was approved by the Milan University Ethics Committee.

Procedure: All participants arrived at the didactic laboratory on four different days (one week between testing) at the same time of the day; they observed rest or had a very light exercise in the days before the tests. The first session was used to familiarize the participants with the test procedure. The fourth session was finally carried out to administer tests at the maximal effort. Every participant performed in the same order five submaximal tests composing CFT. Tests and procedures were applied according to Crotti, Bosio, and Invernizzi (2018), and Invernizzi, Signorini, Bosio, Raiola, and Scurati (2020).

The Ruffier test (Sartor et al., 2016) assessed cardio-respiratory and muscular endurance. The participants were asked to perform 30 half squats paced by a metronome to be executed within 45 s. Heart rate at

rest, immediately after the end of the test, and after 1 min of recovery were the outcome measures. The half squat's deepness was standardized using a purpose-built device to perform CFT.

The sit and reach test assessed hip flexibility (Baltaci, Un, Tunay, Besler, & Gerceker, 2003). According to the protocol, the measures were positive or negative based on participants' forward flexion, i.e., sliding hands below or above the foot reference level, respectively. Right and left hip flexibility was assessed separately and successively averaged. Sit-up exercise measured the core muscular efficiency (Bianco et al., 2015). The number of sit-ups was counted. The shoulders' mobility was assessed through the upper limb rotation while holding a stick by measuring the distance of the hands' grip during the rotation (Harre, 1977).

The push-up test provided information about the upper body strength (Pescatello, 2014). The number of push-up repetitions was recorded. All tests were performed using the purpose-built equipment that was designed and explicitly realized for CFT. Apart from the Ruffier test, in which the experimenter set the pace, the participants had to perform all tests at submaximal intensity. They were asked to exercise up to the score of 5 AU on the Borg's CR-10 scale of perceived exertion during sit-ups and push-ups, and at the 100-AU score level on the stretch intensity scale during the sit and reach and shoulder mobility measurements (Invernizzi et al., 2020). After each test, participants recovered for two minutes before continuing the procedure.

During the fourth session, the same tests were repeated at the maximal intensity, apart from the cardiovascular endurance evaluation for which the YOYO IR1 intermittent running test was used (Bangsbo, Iaia, & Krustrup, 2008). *Statistical analysis*: Test–retest reliability (Intraclass correlation, ICC) was assessed from scores obtained during the second and third sessions. The correlation coefficient (r) between the best scores achieved in sessions 2 and 3, and the results of maximal tests were calculated to determine the validity of the construct of CFT. The correlations between heart rate immediately after the Ruffier test and maximal heart rate during the YOYO test were also examined.

Results

The overall CFT results are summarized using an arbitrary "normal motricity index." The index ranges from 0 to 100, and two cut-offs of 33 and 66 are arbitrarily used to determine low (0–33), medium (34–66), and high (67–100) levels. The percentage distribution of individual scores resulted in 2% at the low level, 87% at the medium level, and 11% at the high level. Overall, acceptable and good reliability was observed in single tests ($r > 0.66$; $p < 0.001$), and moderate to good validity was observed ($r > 0.50$; $p < 0.001$). Low validity was observed in the sit-up test ($r = 0.44$; $p < 0.001$).

Discussion

The concept of "motor normality."

As highlighted in the introduction section, human body could attain the necessary motor efficiency that provided survival functionality in the past. Currently, motricity represents the means to preserve health and wellbeing, provided that it is performed and that sedentary behaviour does not take over. When this occurs, our body decays and becomes prone to diseases and injuries, and even trivial accidents (e.g., falls) represent sources of risk. Having an acceptable physical efficiency that allows to overcome health deterioration and most common events that otherwise cause injuries (e.g., insufficient upper body's muscular strength to mitigate a fall; too low flexibility to widen the support base and counteract a loss of balance) represents the so-called "motor normality" (Figure 2). Motor normality also considers the awareness and perception of one's own body, skills, and abilities. From the previous example, it is easy to understand that individuals need to be correctly conscious about situational constraints and actions to perform, sustain, or undertake to address the requirements. Therefore, exceeding efforts can be avoided, safety preserved, and understanding of the actual functional status fully realized. Thus, PT and CFT meet the demand to help to set the motor normality level. They base the rationale on some deal-breakers: perception and functionality.

Using perceived exertion scales while exercising and performing testing procedures, ordinary decisional habits in acknowledging tasks' demands and responses arise and sustain perceptual abilities.

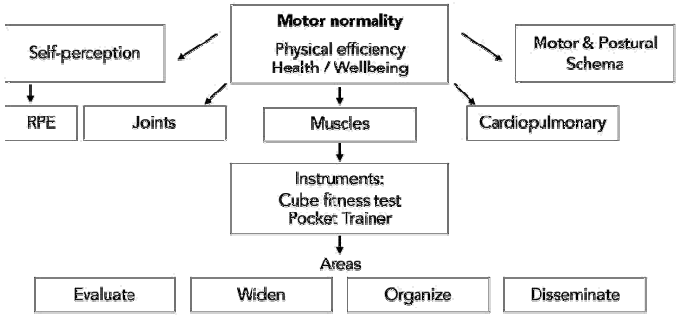

Figure 2: The "motor normality" meaning framework.

Using PT and CFT, the functional normality level can be arranged, and the most appropriate dosages can be determined for each feature. Concerning flexibility and shoulders' mobility, an acceptable condition of normality reasonably lies between rigidity and joint instability. In particular, everyday functional movements should be enabled, at all ages, to overcome limitations caused by growth (e.g., unsynchronized development of bones and muscular/ligament lengths in children's evolutionary stages) or by muscular rigidity occurring in the elderly. Unacceptable limitations occur when adults cannot raise the arms to reach an object placed overhead, when they cannot put on a jacket or cannot easily brush their back with a sponge, or when they cannot flex forward enough to put on socks. PT and CFT specifically test, train, and teach these skills at submaximal effort conditions, which preserves standard functionality. Similarly, muscular strength and endurance are normal when climbing up and down the stairs without fatigue, which corresponds to the half squatting CFT exercise. In addition, CFT sit-up and push-up procedures indicate motor normality levels corresponding to the core strength required when getting out of bed and when protect against a fall by absorbing the impact on the soil.

The objective of PT and CFT is to promote physical activity at the workplace and to reduce sedentarism. Some actions outline their articulation and application (Figure 3).

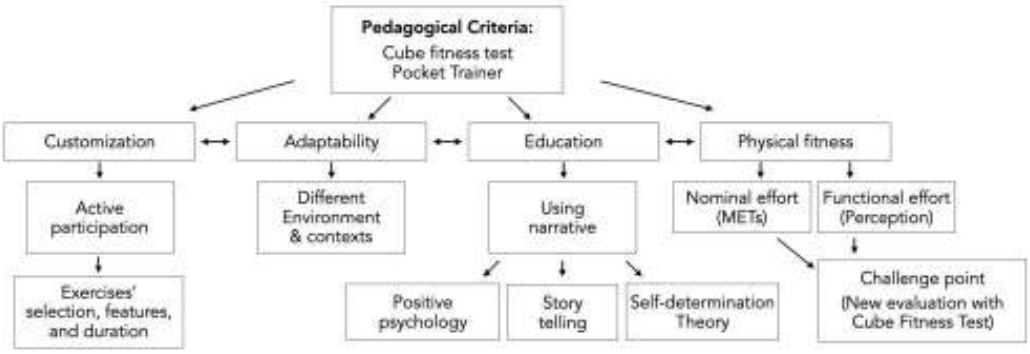

Figure 3: "Pedagogical criteria" framework.

Evaluate

Evaluation is the first and essential step. it determines the starting functional point, increases consciousness in self-ability, and promotes motivation (Black & Weiss, 1992). Using CFT and repeating evaluations regularly are crucial in providing adequate monitoring of employees and potentially enhancing the PT method and the awareness of good health and physical activity practices (Figure 4).

Widen

To properly develop adequate motor normality that allows employees to preserve high quality of life, it is necessary to increase exercise opportunities. Therefore, widening means changing the workplace by offering more exercise and physical activity, both related to the physical office space (outdoor, indoor, at the office, at home during smart-working) and technological devices. To better distribute physical activity during the day, it should be split into five features describing the motor normality: self-perception (i.e., RPE detection); articular, muscular, and cardio-respiratory fitness; motor and postural schemas. These areas characterize different moments or sites within the workplace that have to be structured to embrace all features of motor normality.

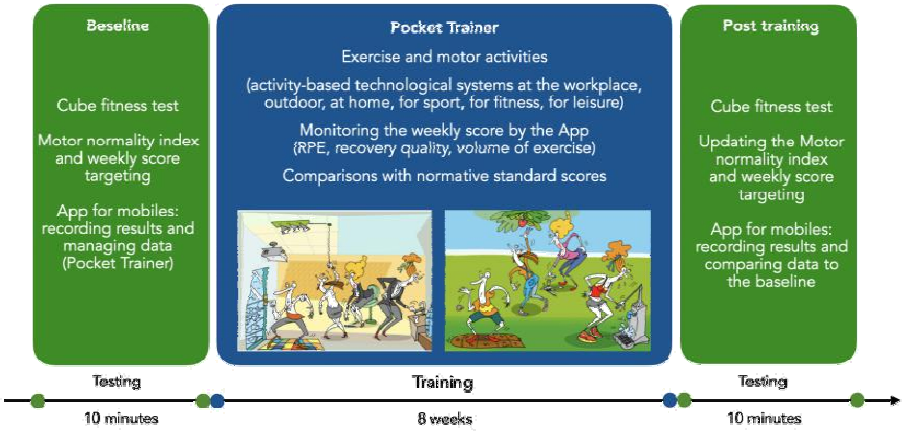

Figure 4: Timeline of the application of the cube fitness test and pocket trainer.

Organize

The CFT monitoring procedure ensures the detection of most critical aspects connected to the expected employee's motor normality so that the necessary volume and type of exercise can be organized. The index of motor normality obtained from CFT further indicates the minimum amount of weekly points to earn to reach or maintain motor normality. Owing to individual scoring, information about less efficient areas that need to be improved is obtained. Employees can select which activity better fits their condition and adapt daily routines to individual requirements.

Disseminate

Completing PT and CFT using apps for mobile devices and implementing the integration in the workplace architectural design, improving benefits, and lowering employer costs represent the primary source of dissemination of the project.

Conclusions

CFT is a reliable instrument that trains and evaluates at submaximal intensity the following characteristics, i.e., cardio-respiratory and muscular endurance, flexibility, core muscular efficiency, shoulder mobility, and upper body strength. Owing to its portability and easy-to-use application, it can be included in the new workplace concept of the "Ufficio Proattivo 150" project and integrated into the usual employee workflow. CFT contributes to developing awareness, culture, and motivation toward physical activity starting from the workplace by providing knowledge of the advantages of good behaviour on the health status and the quality of working life.

CFT helps PT to achieve health status benefits and recover, reach, and maintain motor normality that sedentarism or actual lifestyle lost compared to the past situation. Improved wellbeing levels (actual and perceived) show that a new vision of workplace that educates is possible and can successfully encourage employees to engage in lifelong physical activity.

Conflicts of interest

None.

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