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Perceived treadmill function is correlated with enjoyment of use in trained runners: A user-centred approach

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ABSTRACT

Physical inactivity, a primary cause of most chronic diseases, has been associated with low levels of physical activity enjoyment. Physical activity enjoyment can be impacted by an individual's experience with exercise equipment. The purpose of this study was to adopt a user-centred approach to determine the relationship between physical activity enjoyment and functionality and usability of four treadmills. A running protocol was completed by 57 trained runners (41 male) on four treadmills. Runners reported enjoyment levels as well as their perceptions about treadmill running surface, controls, safety and stability, physical interaction, learnability of data console and aesthetic appeal. Repeated measures ANOVAs showed significant differences between the treadmills for each variable. Multiple regression analysis reported aesthetic appeal significantly predicted enjoyment of use. Results suggest that adopting a user-centred approach to compare exercise equipment usability and features can correlate with enjoyment and further impact on physical activity adherence.

1. Introduction

Regular physical activity is a vital component of individual health and wellbeing (World Health Organization, 2010), yet physical inactivity now plagues public health globally (Trost et al., 2014). Approximately 31% of the world's population is physically inactive (Hallal et al., 2012) and this rate continues to climb (Brownson et al., 2005), causing an estimated cost of $53.8 billion in health-care systems worldwide (Ding et al., 2016). Modifying key determinants to promote physical activity while counteracting the negative health effects of physical inactivity remains a social and economic priority (Andersen et al., 2016; Reis et al., 2016).

One key determinant of physical activity is the affective response (i.e. positive or pleasurable feelings) of individuals during and after exercise (Reed and Ones, 2006; Williams, 2008). In particular, enjoyment during physical activity has been linked with positive psychological responses to exercise, and has been reported as one of the main reasons for participation (Allender et al., 2006) and adherence to exercise (Williams et al., 2006; Marcus and Forsyth, 2009). Enjoyment of physical activity can be influenced by the physiological activation, by the social aspects of the activity, and by the feeling of pleasure or lack thereof while using exercise equipment. A recent study reported that exercising on treadmills was more enjoyable and perceived as more natural in comparison to other aerobic machines (Carraro et al., 2014). In this light, enjoyment is an important component of the *user experience*, or "a person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service" (ISO 9241- 210; 2010). Research on exercise equipment could inform designers about the emotions, beliefs, preferences, physical and psychological responses, behaviours, and accomplishments of the equipment user and/or intended user (Ritter et al., 2014). Moreover, combining advances in technology with a user-centred approach (Norman and Draper, 1986) in the research design of exercise equipment may improve the user experience by eliciting positive emotions before, during and after use, ultimately impacting exercise adherence.

In the field of physical activity, aerobic exercise, particularly running, is reported as offering high levels of health benefits (Ooms et al., 2013) and it has grown in popularity as a leisure pursuit (Bridel et al., 2015). Technological advancements have enhanced the accessibility of running at a customised and controlled pace, distance, and incline through equipment such as motorized treadmills. Despite the health benefits of running on treadmills, there is an inherent risk of injury (Eickhoff-Shemek, 2010). Treadmill use/misuse accounts for one of the highest injury rates of all fitness equipment (Gray and Finch, 2015; Gray et al., 2015), thus users' perceptions of safety and stability when using these exercise machines can be of great importance during their design. Moreover, the affective response, and particularly, the enjoyment during exercise on a treadmill, has received little attention in the

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scientific literature.

In this study, the user experience during exercise on four treadmills of different brands were evaluated according to methods proposed by Ritter et al. (2014) on functionality, usability, learnability, efficiency, reliability, and utility or usefulness. Moreover, since exercise intensity (i.e. heart rate and mental arousal) could influence physical comfort/discomfort (Turner et al., 2010) and positive/negative affective response (Ekkekakis et al., 2011), the user experience was tested in a controlled setting. Thus, the purpose of the present study was twofold: firstly, it attempted to investigate the specificity of the user experience, not only inter-, but intra-individually by adopting a comparison usability testing approach; secondly, the study examined the relationship between subjective perceptions of usability features and enjoyment of use across the four treadmill models, while controlling for mental and physiological arousal and heart rate.

2. Method

2.1. Participants

The institutional ethical review board approved this study in accordance with the Declaration of Helsinki. Participants received written explanations regarding the study protocol and were required to provide written informed consent prior to participating in the study. All participants were over age 18 so no parental consent was required. Participants were informed they could withdraw at any time without consequence. At the end of the test, all participants were given a fitness towel for their participation.

Fifty-seven trained runners (41 male) were recruited by posters which were displayed in participating sport clubs and fitness centres located in north-eastern Italy. Participants were between 18 and 50 years of age ($M = 30.7 \pm 10.8$), had a mean body mass index (BMI) of $22.7 \pm 2.4\,kg/m^2$, and were classified as normal weight ($n = 49$, $BMI \leq 24.9$) or overweight ($n = 8$, $25 \leq BMI \leq 29.9$). Participants were habitual runners who reported training over the previous 3 months or between 2 and 5 times a week on average ($M = 3.1$). A total of 30 runners typically run on asphalt, 17 on a treadmill, 9 on grass, trails or unpaved surfaces and one on a synthetic track. In addition to running, 35 practiced one or more sports regularly, namely strength training, soccer and cycling.

2.2. Equipment

The International Health, Racquet & Sportsclub Association (IHRSA) is the trade association serving the global health club and fitness industry. The IHRSA (2014) has identified the four largest manufacturers of exercise equipment in the fitness industry. One premium quality professional-grade treadmill of a similar range price from each manufacturer was selected for testing in the study (*Life Fitness Elevation Discover SE, Matrix T7xi, Precor TRM 885 and Technogym RUN 1000 Unity 3.0*). The selected treadmills belong to the same market segment and have very similar target users, essentially in professional settings like gyms or fitness clubs. They share similar technical specifications such as: engine power, dimensions and texture of the running surface, maximal speed and incline achievable, maximal weight permitted for the user, Wi-Fi enabled, multimedia (TV, music, social media) connectivity, device interface capabilities (e.g. heart rate).

2.3. Measures

Objective data and subjective perceptions were collected during the comparative test in addition to a demographic questionnaire. The objective measures included heart rate and running speed gathered during the treadmill tests. Mean heart rate was collected with a Polar Team^2 Pro$^®$ monitor for each running session. Borrowing the age-predicted maximal heart rate (maxHR) formula (208 - 0.7 x age) from Tanaka et al. (2001), maxHR percentage was calculated for each individual during each test. Running speed (km/h) was controlled on the treadmills' console.

The subjective measures consisted of seven Visual Analogue Scales (VAS) and the Felt Arousal Scale. The VAS is a pen and paper test, which consists of several 100-mm horizontal lines, each of which is anchored by one word descriptors on each end used for assessing the change of individual characteristics or attitudes (Crichton, 2001). The participants are asked to mark a point on the line that best represents the perception of his/her state according to the descriptors on each end. The VAS continuous score is determined by measuring (in millimetres) from the left end of the line to the mark (Crichton, 2001). According to the principles and guidelines established by the research of Ritter et al. (2014), seven VAS factors were used to measure the following dimensions (anchors listed in brackets); 1. Functionality/usability of the cushioned moving treadmill belt (very unpleasant/very pleasant); 2. learnability of equipment controls (very difficult to operate and complicated/very easy and intuitive); 3. reliability of treadmill for stability and safety (extremely unstable and insecure/extremely stable and secure); 4. physical interaction with the machine, i.e. usability for general comfort, habitability, controls and supports, position and noise (poor/very good); 5. readability of data on console (extremely complex, unintuitive/extremely clear and simple); 6. aesthetic appeal (very unpleasant/very pleasant); and 7. enjoyment of use (very unpleasant/very pleasant).

The Felt Arousal Scale (FAS) (Svebak and Murgatroyd, 1985) is a single item ("Please, estimate here how aroused you actually feel") measured on a 6-point Likert scale, ranging from 1 to 6 (low to high arousal) and was developed to assess perceived physiological and mental activation. In this study, the FAS measured participant arousal levels before and after each treadmill test to determine the degree of mental and physical activation or intensity, strictly related to physical performance (Abernethy et al., 2013).

2.4. Procedure

Treadmills were located in a quiet room within a fitness centre and were positioned in front of a white wall, with a distance of 1.5 m between one another. All logos and markings were covered so that subjective preferences were not impacted by brand name recognition. Multimedia connections of the equipment (i.e. TV, radio, media players and Internet connection) were turned off during the test to avoid potential distraction. The inclination of the running belts was set at 0°.

The test was performed individually to avoid social influence. Participants tested the four treadmills in the same day; the sequence of use was randomized by means of a random number generator. Participants were instructed to self-select their preferred running speed at the beginning of the first running bout and to maintain this speed constant on all the treadmills. Prior to commencing the test, participants were asked to complete the FAS and the demographic questionnaire. The test of each treadmill lasted 8 min, it started with a 2-min period where participants were encouraged to become familiar with the controls, then they were prompted to run for the remaining 6 min at the selected speed (Lavcanska et al., 2005). A 4-min rest was allowed for recovery after each bout of running. During this rest, participants completed the FAS and the seven VAS factors related to the treadmill which was just tested. The protocol was repeated on all four treadmills for each participant.

2.5. Statistical analysis

Descriptive statistics were calculated for all variables. Independent sample t-tests were conducted to examine differences on the measured variables by gender and age. The relationship between the VAS and FAS measures were investigated with Pearson's correlations. Data analysis comprised of repeated measures ANOVAs to test for differences