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Effect of augmented reality game Pokémon GO on cognitive performance and emotional intelligence in adolescent young

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ABSTRACT

The main aim was to analyse the effect of 8 weeks of Pokémon GO on cognitive performance (memory, selective attention, concentration, mathematical calculation and linguistic reasoning) and emotional intelligence (well-being, self-control, emotionality and sociability) in Spanish adolescents between 12 and 15 years. A longitudinal design was used, with a Control Group (n = 103) that did not use Pokémon GO, and Experimental Group (n = 87) that used Pokémon GO during 8 weeks. Age, sex, BMI, maternal educational level, number of computers at home and moderate to vigorous physical activity (MVPA) were used as confounders. Results showed that players walked 54 km and spent 40 min/day playing in this period. Boys played more, won more points and reached a higher level in the game than girls. The players playing Pokémon GO significantly increased their selective attention ($p = 0.003$), concentration levels ($p < 0.001$), and sociability levels ($p = 0.003$) against their peers. It is concluded that Pokémon GO increases, in a playful way, the amount of daily exercise in adolescents, could positively affect their cognitive performance, and improve the social relationships. Further studies are required to perform comparisons between single and collaborative play and to identify the pedagogical benefits through some subjects such as Physical Education.

1. Introduction

Cognitive performance (CP) is the mental capacity affected by the inhibitory control and executive functions, which are the factors responsible for the planning, intellectual organization and behaviour control (Diamond, 2013; Ruiz-Ariza, Grao-Cruces, Loureiro, & Martínez-López, 2017). Memory, selective attention, concentration, and numeric-linguistic reasoning abilities appear among the most important variables in CP (Diamond, 2013; Esteban-Cornejo, Tejero-Gonzalez, Sallis, & Veiga, 2015; Ruiz et al., 2010; Ruiz-Ariza et al., 2017). It has been found that young people with high CP have a greater self-esteem and self-concept (Fati-Ashtiani, Ejei, Khodapanahi, & Tarkhorani, 2007) and they show less risk of chronic widespread pain

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(Gale, Deary, Cooper, & Batty, 2012). However, low CP has been associated with anxiety disorder (Martin et al., 2007), psychological distress (Gale, Hatch, Batty, & Deary, 2008), and depression (Jaycox et al., 2009).

When cognition interacts with emotional aspects, behavioural responses and adaptations appear, and they compose Emotional Intelligence [EI] (Salovey & Mayer, 1990). For some authors, EI is a construct composed of well-being, self-control, emotionality and sociability (Petrides, 2009, pp. 85–101; Petrides et al., 2016). A good level of EI is associated with adaptive behaviours and social skills (Frederickson, Petrides, & Simmonds, 2012), with leadership qualities, and with few possibilities for being disruptive, aggressive, and dependent in the school context (Mavroveli, Petrides, Sangareau, & Furnham, 2009). Moreover, EI can inhibit maladaptive actions like bullying, victimization and psychopathology in adolescence (Kokkinos & Kipritsi, 2012; Petrides et al., 2016; Salovey & Mayer, 1990). Both, CP (Esteban-Cornejo et al., 2015; Ruiz-Ariza et al., 2017) and EI (Frederickson et al., 2012; Mavroveli & Sanchez-Ruiz, 2011; Petrides et al., 2016) are highly determinant to get better academic performance at school and greater future job success (Laidra, Pullman, & Allik, 2007; Perera & DiGiacomo, 2013).

CP and EI share the influence of some socio-cultural factors such as family socioeconomic status (Esteban-Cornejo et al., 2015), school environment (Ruiz-Ariza et al., 2017), educational level of family (Ruiz et al., 2010; Petrides, 2009), and the weekly practice of Physical Activity [PA] (Esteban-Cornejo et al., 2015; Hogan, Catalino, Mata, & Fredrickson, 2015; Laborde, Dosseville, & Allen, 2016; Ruiz-Ariza et al., 2017). The last variable is a key element because it improves the memory (Chaddock-Heyman, Hillman, Cohen, & Kramer, 2014), selective attention and concentration (Cadenas-Sanchez et al., 2016; Vanhelst et al., 2016), arithmetic skills (Moore, Drollette, Scudder, Bharij, & Hillman, 2014), linguistic reasoning abilities (Scudder et al., 2014), well-being (Ruiz-Ariza, de la Torre-Cruz, Redecillas-Peiró, & Martínez-López, 2015), self-control (Donnelly & Lambourne, 2011), emotionality (Azevedo, Burges-Watson, Haighton, & Adams, 2014) and sociability (Kato et al., 2016; Tateno, Skokauskas, Kato, Teo, & Guerrero, 2016). In addition, PA practice is easily modifiable in young people because it largely depends on parental (Martínez-López, Lopez-Leiva, Moral-Garcia, & De la Torre-Cruz, 2014) and social support, especially from their peers (Hogan et al., 2015). Despite the above, 81% of adolescents do not reach the minimum recommended daily amount of PA, and demotivation to PA as well as the sedentarism level have increased in the last years (Mielgo-Ayuso et al., 2016; WHO, 2016). The young currently spend around 8.6 h/day in sedentary behaviours, mostly associated with the use of new technologies watching television, smartphones, computers, or playing videogames (Norris, Hamer, & Stamatakis, 2016). The Global Monitoring Framework for Noncommunicable Diseases established a global objective of 10% reduction of sedentarism by 2025 (WHO, 2012). Thus, there is an urgent need to find new strategies aimed at motivating the young to go outside and practise more PA (LeBlanc & Chaput, 2016).

A novel strategy for promoting PA among young people are the Augmented Reality Games (ARG), defined as a kind of exergame active video game that requires participants to be physically active or to do exercise in order to play the game (Anderson, Steele, O'Neill, & Harden, 2016; Clark & Clark, 2016). ARG combine the physical and virtual worlds into one interface, replacing stationary play with active play by requiring users to explore their physical surroundings (Serino, Cordrey, McLaughlin, & Milanaik, 2016). In addition, some recent researches have shown that augmented reality could also increase other educational development characteristics as the quality of writing (Wang, 2017), mathematical abilities (Sommerauer & Müller, 2014) or to learn a foreign Language in young people (Hsu, 2017). Among ARG, Pokémon GO has gained significant fame in a very short time. It is the first mass market app that is fully immersed into actual geographical space and that transcends the virtual, the spatial, the social and the physical (Clark & Clark, 2016; Tateno et al., 2016). It was released on 7 July 2016 in the USA and Oceania, and on 16 July in Spain and other European countries. Within 1 week of its release, the game attracted over 65 million users, most of them teenagers (Nigg, Mateo, & An, 2016; Serino et al., 2016). The aim is to catch and level up Pokémon and your avatar across various tasks and by visiting several physical locations using mobile GPS (Anderson et al., 2016). In this way, Pokémon GO allows young people to keep motivated by playing video games and at the same time to increase daily PA levels (Clark & Clark, 2016; LeBlanc & Chaput, 2016; Serino et al., 2016), decrease sedentary behaviours (Nigg et al., 2016), enhance fitness and overall cardiometabolic health (Krittanawong, Aydar, & Kitai, 2017; Sharma & Vassiliou, 2016), prevent and treat many chronic diseases (Anderson et al., 2016), decrease obesity (Smith, 2016), carry out family activities (De Oliveira-Roque, 2016), or prevent depression and anxiety (McCartney, 2016). According to Serino et al. (2016), other benefits could be increased socialization and group outdoor activity. In this sense, Tateno et al. (2016) and Kato et al. (2016) have currently concluded that Pokémon GO may help youth with severe social withdrawal.

The relationship of PA practice with improvements in CP and EI has been verified by cross-sectional (Cadenas-Sanchez et al., 2016; Laborde et al., 2016; Vanhelst et al., 2016) and longitudinal studies (Laborde et al., 2016; Stephan, Sutin, & Terraccioano, 2014). However, these results need to be treated with caution due to the possible mediation of major confounders like age (Esteban-Cornejo et al., 2015), sex (Ardoy et al., 2014), socioeconomic status (Ruiz-Ariza et al., 2017), maternal education (Cadenas-Sanchez et al., 2016; Vanhelst et al., 2016), body mass index (BMI) (Bezold et al., 2014), or moderate to vigorous physical activity [MVPA] (Ruiz-Ariza et al., 2017). The potential of exergames for the transformation of sedentary time into physically active time has recently been demonstrated in young people (LeBlanc & Chaput, 2016; Nigg et al., 2016), but knowing if the combination of PA with search objectives, by using Pokémon GO, improves CP and EI has not yet been studied enough. This research aims to focus on adolescence because it is a key stage to consolidate healthy lifestyles and increase the PA level. In addition, during this period there is a high degree of plasticity in the brains of young people, which is decisive in enhancing CP and EI, improving academic performance, securing appropriate behaviours, and fostering future social success (Esteban-Cornejo et al., 2015; Petrides et al., 2016; Ruiz-Ariza et al., 2017).

From the preceding reasoning, we hypothesize that young people who have played Pokémon GO could show higher levels of CP and EI than their peers. The main aim was to analyse the effect of 8 weeks of Pokémon GO on CP and EI in Spanish