A Longitudinal Study of Exercise Addiction and Passion in New Sport Activities: The Impact of Motivational Factors

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Abstract

Recent research suggests that the risk of exercise addiction (REA) is primarily predicted by passion. However, this relationship stems from cross-sectional studies. The objective of this 12-week longitudinal investigation was to examine and compare the temporal changes in REA and passion among women and men (N=149) who just started a new sport activity. To further test their similarities and distinctiveness, we also examined how exercise motivations predict REA and passion. Latent growth modeling showed that REA and passion were high at baseline and showed a slight increase over the 12 weeks. Passion was predicted by several motivational factors, whereas REA was predicted by being female, team sport participation, higher exercise intensity, and identified motivation. These findings suggest that the development of passion and REA over time, both being associated with sport motivations, manifest independent patterns. Consequently, despite the reported strong relationship between the two, they appear to be independent constructs.

Keywords: athletics; harmonious passion; obsessive passion; physical activity; sport

Development of Exercise Addiction and Passion in Newly Adopted Sports: A Longitudinal Investigation

An active lifestyle has many health benefits (Bellocco et al., 2010; Lee et al., 2011). Regular physical activity and sport participation are also connected to better mental health (Clow & Edmunds, 2013). Based on mass-media information, many people engage in physical activities or play sports to manage the challenges of daily life (Berczik et al., 2012). Paradoxically, sports, and exercise could also become sources of stress (Stevens et al., 2013). The need to exercise in increasingly higher volumes could turn into an urge, which culminates in a loss of control over the activity. This transformation results in a dysfunctional behavior known as "exercise addiction" in the literature (Szabo, 2010; Szabo, Griffiths, Marcos, Mervó, & Demetrovics, 2015). Other synonyms used in the literature are: "exercise dependence" (Adams, 2009), "compulsory exercise" (Murray et al., 2012), "obligatory exercise" (Thome & Espelage, 2007), and/or "exercise abuse" (Calogero & Pedrotty, 2004).

Exercise addiction is occasionally confounded with high levels of commitment to exercise (Szabo, 2010), possibly stemming from passion for- and/or dedication to the sport. MaClaren and Best (2007) posited that while exercise addiction may be associated with exercise volume, high levels of the latter are not necessarily a sign of addiction. Passion for an activity implies engaging in a loved activity that one finds appealing, important, and invests both time and energy into it. Vallerand et al. (2003) presented a dual model for passion encompassing harmonious (HP) and obsessive passion (OP). On the one hand, HP surfaces when the beloved activity is autonomously internalized when the person flexibly engages in the selected activity, which is directly related to positive affect and inversely related to negative affect (Vallerand et al., 2003; Vallerand et al., 2006). On the other hand, OP emerges when the individual internalizes the beloved activity in a controlled way when doing the activity is rigidly controlled, which is associated with negative affect (Vallerand et al., 2003; Vallerand & Miquelon, 2007). Furthermore, a person with OP attaches substantial importance to activity contingencies like self-esteem and escape from hassles and challenges, which renders difficult the termination and/or control of the passionate activity (Vallerand, 2010).

Currently, there is limited empirical evidence connecting exercise addiction and passion. However, OP was reported to be positively associated with the risk of exercise addiction (REA) in endurance sports and other leisure physical activities (Kovacsik, Griffiths, et al., 2018; Schipfer & Stoll, 2015). It was revealed that OP is related to all dimensions of REA (time, reduction in other activities, tolerance, withdrawal, continuance, intention effects, and lack of control), which was different from HP that was merely related to time and tolerance (Paradis, Cooke, Martin, & Hall, 2013). Further, it was shown that exercisers with HP can increase the time spent on exercise without jeopardizing the time spent on other important life activities, which was not true for exercisers with OP who spent an exaggerated time on exercise while sacrificing the time spent with other important life activities (Paradis et al., 2013). The key points of these findings were strengthened by another study revealing that OP has a stronger relationship to exercise addiction than HP (Parastatidou, Doganis, Theodorakis, & Vlachopoulos, 2014).

The link between REA and passion in athletes was explored in a study examining a sample of low- and high-level competitive athletes and a group of non-competitive recreational exercisers (De la Vega, Parastatidou, Ruíz-Barquín, & Szabo, 2016). The results of the work revealed that OP was a strong predictor of REA, accounting for 37% of its total variance. However, HP was not a significant predictor in the model. While athletes scored higher than leisure exercisers on all the measures, no differences were found in REA and passion between athletes competing at low- and high-levels. De La Vega et al. (2016) also showed that athletes in team sports might report greater HP as well as OP than those taking part in individual sports. These findings were later expanded in another study which also revealed that OP accounted for half (25% versus 50%) of the total variance in REA in team-sports compared to individual sports while HP added little to the shared variance (1-4%) with REA (Kovacsik, Soós, De La Vega, Ruíz-Barquín, & Szabo, 2018). Therefore, new research results show that there is substantial overlap (communality) between REA and passion, especially OP (Szabo, 2018). Similar findings were reported in non-sports contexts, too, such as in the field of screen-based online behaviors (Orosz, Tóth-Király, & Bőthe, 2016; Tóth-Király, Bőthe, Márki, Rigó, & Orosz, 2019), gambling (MacKillop, Anderson, Castelda, Mattson, & Donovick, 2006), and work (Birkeland & Buch, 2015).

One possible means of untangling the two is the examination of the etiology of REA and passion over time in people who start up a new, or previously not regularly practiced, sports activity. The interactional model of exercise addiction (Egorov & Szabo, 2013) conjectures that despite REA, dysfunctional exercise behavior (i.e., actual exercise addiction) surfaces in a "revolutionary', rather than "evolutionary" fashion because of major trauma or life-stress which is dealt with through an unhealthy pattern of self-harming exercise regimen. Accordingly, if REA and passion show dissimilar evolutionary patterns, the two concepts, despite the positive relationship between the two, might be considered to be relatively independent. However, if REA and passion show a similar etiology (change) over time, then they are not only related, but also encompass each other. Prior studies focusing on the development of passion reported moderate-to-high levels of stability throughout various periods (e.g., Carbonneau et al., 2008; Tóth-Király, Bőthe, Jánvári, Rigó, & Orosz, 2018), suggesting that passion remains relatively stable once it is developed. Still, based on a past study (Schellenberg & Bailis, 2015), passion might increase when individuals engage in a newly adopted sports activity. No comparable previous studies are available for the changes in REA over time, which underscores the importance of the present study.

Predictors of the Risk for Exercise Addiction and Passion

Motivation has been shown as one of the key factors influencing behavior (Fortier, Vallerand, & Guay, 1995); thus, it is reasonable to assume that athletes' motivations for engaging in sports might underlie their passion for sports as well as their REA. Following the well-established conceptual model of self-determination theory (SDT; Ryan & Deci, 2017), we can distinguish intrinsic motivation (i.e., doing sport for the enjoyment and pleasure derived from it) and four types of extrinsic motivations ranging from the more autonomous to the more controlled ones including integrated (i.e., doing sports is congruent with one's values and self), identified (i.e., doing sports is personally valued), introjected (i.e., doing sports due to internal pressures), and external regulations (i.e., doing sports due to external pressures). Finally, amotivation refers to the complete lack of motivation and intention to perform sports. Typically, more autonomous motivations (intrinsic, identified and integrated motivations) have been associated with positive outcomes, while controlled motivations (introjected, external and amotivation) with negative outcomes (Ryan & Deci, 2017).

Motivational factors were associated with REA too. In earlier work, it was reported that introjected regulation, and, to a lesser extent, identified regulation predicted REA, while external regulation and intrinsic motivation were either weak or non-significant predictors (Hamer, Karageorghis, & Vlachopoulos, 2002). This research also revealed that the total variance in REA explained by motivation was about 15%. Later work revealed that REA was predicted through ego-involving climate and perceived competence in a mediated way via introjected, integrated, and external regulation (González-Cutre & Sicilia, 2012). In accordance with these findings, it was proposed that integrated and identified regulation are predictors of exercise behavior in general (Duncan, Hall, Wilson, & Jenny, 2010). Subsequently, a study with youth has revealed that integrated and introjected regulation are determinants of REA for both genders, whereas external regulation is a predictor of REA only for boys (Downs, Savage, & DiNallo, 2013). Therefore, a handful of research suggests that motivational factors may be connected to REA, begging for the clarification of this relationship via a longitudinal design that allows one to track the dynamics of REA and to examine how motivations are related to these dynamics.

So far, there have only been some studies (Lafrenière, Vallerand, Mageau, & Charest, 2014 cited by Vallerand et al., 2006) that examined how autonomous and controlled functioning (which are conceptually similar to autonomous and controlled motivations, respectively) predicted HP and OP. These studies reported that autonomous functioning predicted HP, while controlled functioning predicted OP. Similar findings have been revealed in relation to work (Curran, Appleton, Hill, & Hall, 2011) and sports (Houlfort, Philippe, Vallerand, & Ménard, 2013). Moreover, a recent meta-analysis (Curran, Hill, Appleton, Vallerand, & Standage, 2015) also reported autonomous motivations to be more strongly related to HP, while controlled motivations more strongly related to OP. One advantage of the present study, contrary to the previous ones, is that the full range of motivations was used instead of the more generalized and simplified representations which have been recently criticized (e.g., Wang, Morin, Ryan, & Liu, 2016).

The objective of the current 12-week longitudinal study was to investigate the pattern of changes over time in REA and passion, and the role of motivation in the relationship between the two, in individuals starting up a new sport. Based on the reported relationship between REA and passion, and passion and motivation, we predicted that REA and passion would show similar, but not completely identical patterns of changes over time. In addition, we also expected the more autonomous motivations of intrinsic, integrated, and identified regulation to predict HP, while the more controlled motivations of introjected and external regulations to predict OP. As integrated and introjected regulation has relatively consistently been shown to predict exercise behaviors, we expected both to predict REA. In all analyses, we controlled for age, gender, sport type, and sport/exercise intensity.

Method

Participants

The research was conducted at a large university's athletic club incorporating nine organized sports (aerobics, badminton, basketball, cheerleading, futsal, kettlebell, running, tennis, and volleyball). Systematic randomization was used in soliciting beginners starting up one of the nine extracurricular sports activities. In total 149 eligible student volunteers (53 men and 96 women; mean age = 21.08, SD = 2.98 years) completed the study[1]. The only criteria for participation were 80% presence in training and the completion of the study, which included physical presence (and the completion of questionnaires) at three sampling occasions. Accordingly, data from those volunteers who completed the questionnaires only once or twice were not considered. All sporting activities were performed only once a week for an identical duration of 90 minutes. Ethical permission for the work was granted by the Research Ethics Committee at a large urban university[1], which ensured that the study was conducted in accordance with the ethical principles for research with human participants of the Helsinki Declaration (World Medical Association, 2013).

Materials

At the beginning of the study, a demographic questionnaire assessed the age, gender, and perceived exercise intensity of the participants. Three psychometrically validated questionnaires, described below, were completed three times during the 12-week long study.

The Exercise Addiction Inventory (Terry, Szabo, & Griffiths, 2004). This instrument was adopted for measuring the risk of exercise addiction (REA). Sample items include: *"If I have to miss an exercise session, I feel moody and irritable"* or *"*Exercise *is the most important thing in my life"*. This 6-item questionnaire is rated on a 5-point Likert scale ranging from *"strongly disagree"* to *"strongly agree"* with higher scores indicating higher REA. The EAI comes with good psychometric properties (Griffiths et al., 2015; Terry et al., 2004).

Passion Scale (Marsh et al., 2013). Another paper and pencil instrument employed was the revised Passion Scale which assesses harmonious passion (HP), obsessive passion (OP), and passion criteria (PC) with three subscales that are rated on a 7-point Likert scale, ranging from *"not agree at all"* to *"very strongly agree"*. Sample items include: *"If I could, I would only do my activity"* for HP or *"This activity is in harmony with the other activities in my life"* for OP, or *"This activity is part of who I am"* for PC. Again, higher scores refer to higher harmonious passion, obsessive passion, and passion criteria. The psychometric properties of the Passion Scale are excellent in terms of factor structure and reliability (Marsh et al., 2013; Tóth-Király, Bőthe, Rigó, & Orosz, 2017).

Sport Motivation Scale II (SMS-II; Pelletier, Rocchi, Vallerand, Deci, & Ryan, 2013). Motivation for exercise was measured with the SMS-II, which consists of six subscales that measure amotivation, external regulation, introjected regulation, identified regulation, integrated regulation, and intrinsic motivation. Each subscale has three items which are rated on a 7-point Likert scale ranging from 1 (not true at all) to 7 (very true) with higher scores referring to higher motivation. Sample items include answers to why one is motivated to participate in sport, such as: "*Because participating in sports is an*

[1] Previous studies have shown that LGM models should include at least 100 participants (Curran, Obeidat, & Losardo, 2010; Hamilton, Gagne, & Hancock, 2003) for adequate convergence and identification.

integral part of my life." or "*Because I feel better about myself when I do."* The psychometric properties (i.e., factor structure and reliability) of the scale are excellent (Pelletier et al., 2013).

Procedure

At the start of the study, hereafter referred to as *baseline*, participants read and signed the written informed consent form, answered the demographic questions, and completed the three questionnaires in their natural training environments before their scheduled training. Four and 12 weeks later, they completed the three questionnaires again. Names were replaced with codes that were used for electronic recording of the data. One experimenter entered and verified the data, and another experimenter re-verified them again before subjecting them to statistical analyses.

Statistical Analysis

Preliminary data analyses were conducted in SPSS 22 to investigate the demographics of the participants as well as internal consistency indices, factor means, standard deviations, and inter-factor correlations. Subsequent analyses were performed in Mplus 8 (Muthén & Muthén, 1998-2017) using the robust maximum-likelihood estimator that provides standard errors and model fit statistics that are robust to the non-normality of the data. To test our hypotheses, latent growth modeling (LGM; Bollen & Curran, 2006) was performed in a two-step approach. First, an unconditional model was estimated, with two growth factors, following common specifications (Geiser, 2012): an intercept factor (set to one for all time-points) representing the initial mean value of variables and a linear slope factor (set to 0-4-12 to reflect weekly intervals between the repeated measures) representing changes over time. Second, a conditional LGM model was constructed where time-invariant predictors were then incorporated into the final models to assess their effects on the growth factors. Models were estimated separately for HP, OP, PC, and REA using manifest scores to avoid unnecessary model complexity relative to the sample size.

For model evaluation, commonly used goodness-of-fit indices were interpreted: the comparative fit index (CFI), the Tucker–Lewis Index (TLI), and the root mean square error of approximation (RMSEA) with its 90% confidence interval. According to various interpretation guidelines (e.g., Marsh, Hau, & Grayson, 2005), for CFI and TLI, values higher than .90 and .95 are considered adequate and excellent, respectively. As for RMSEA, values smaller than .08 or .06 indicate acceptable and excellent model fit, respectively. However, given that RMSEA can be inflated in conditions of modest sample size (Bollen & Ting, 2000; Garland, Geschwind, Peeters, & Wichers, 2015) and/or low degrees of freedom (Kenny, Kaniskan, & McCoach, 2015), we put less emphasis on the interpretation of this indicator and simply report it for the sake of transparency. As an alternative, the standardized root mean square residual (SRMR) is considered with values below .08 being acceptable.

Results

Internal consistency indices, descriptive statistics, and inter-factor correlations are reported in Table 1, and goodness-of-fit indices for the models are reported in Table 2. Findings were similar across the four variables in the unconditional models: the intercept factors were statistically significant, suggesting that respondents had elevated levels of HP (M = 20.919, SE = .475, p < .001), OP (M = 31.085, SE = .473, p < .001), PC (M = 26.670, SE = .458, p < .001) and REA (M = 15.598, SE = .290, p < .001) at Time 1. The slope factor was also positive and statistically significant in all four models (HP: M = 0.139, SE = .032, p < .001; OP: M = 0.103, SE = .029, p < .001; PC: M = 0.088, SE = .028, p = .002; REA: M = 0.271, SE = .024, p < .001), suggesting that, on average, there was a slight increase in scores over time (see Figure 1 for a graphical representation of the trajectories). Finally, the correlation between the intercept and the slope factors was statistically significant and negative in all four models (HP: r = -0.266, SE = .106, p = .012; OP: r = -0.247, SE = .119, p = .038; PC: r = -0.425, SE = .084, p < .001; REA: r = -0.332, SE = .144, p = .021), indicating that respondents with larger initial values tended to have smaller slope factor values than respondents with smaller initial values.

Insert Tables 1, 2, 3 and Figure 1 about here

In the second step, we added the predictors into the unconditional LGM models to examine whether they would explain the two growth factors (see standardized parameter estimates in Table 3). The intercept factor of HP was predicted by integrated and identified regulation, while the slope factor was predicted by integrated regulation and doing team sports. The intercept factor of OP was predicted by being younger, higher sport intensity, intrinsic, and integrated motivations, whereas the slope factor was predicted by being female and doing team sports. The intercept factor of PC was predicted by being female, higher sport intensity as well as intrinsic, integrated, and external motivations, while the slope was predicted by being female and doing team sports. Finally, the intercept factor of REA was predicted by higher sport intensity, whereas the slope was predicted by being female, doing team sports, and having high identified motivations.

Discussion

Starting a new sport could provide new experiences and opportunities for athletes that might, in turn, lead to potential increases or decreases in passion for sport and in REA. Therefore, it is essential to examine the development of passion and REA in an initial period of exposure to a sports activity to better understand their nature and their temporal changes. The main finding in the current work is that after adopting a new sport, with a very low frequency (only once a week) involvement, a small but significant change can be observed in HP, OP and passion in general as well as REA, showing that people became more passionate and had elevated REA over the course of the relatively short 12 weeks. While OP and REA showed similar growth trends (as it can be seen in Figure 1), these trends were not the exact same, and the two variables were predicted by different motivations, suggesting that these two concepts are overlapping, but not to the extent that they would be totally redundant. These findings lead to a number of important implications.

Trajectories of the Risk for Exercise Addiction and Passion

To the best of these authors' knowledge, this is the first longitudinal study on REA integrating motivation into the examination of the changes over a short period of time after starting up a new sport activity. REA showed a small, yet significant increase over a 12-week period, indicating that athletes' risk for exercise addiction has elevated marginally. These results are in contrast with a similar earlier work (Rodgers, Hall, Blanchard, & Munroe, 2001), where the authors did not observe a change in obligatory exercise scores over a 10-week period. However, Rodgers et al.'s participants already exercised between 6 months to 14 years, and 93% of them reported exercising twice or more per week, in contrast to our participants who were beginners in a new sport activity participating only once a week.

Similarly to REA, our findings also show that all three measures of passion were elevated at baseline, suggesting that participants were highly passionate for the sports they adopted. Further, all slopes were statistically significant, indicating that passion for sports increased over the 12-week period. Our results agree with those of Schellenberg and Bailis (2015), who examined passion for academics over the course of five months and only reported small changes for a subsample of the students, while passion was highly stable for the majority of the participants. The common point between Schellenberg's and Bailis' (2015) and the present work is that both focused on passion in the initial (adoption) period. Even though athletes only exercised once a week, their passion for sports still increased, underscoring the importance and the changes in the initial periods of adoption. It could be conjectured that a greater frequency of training might have resulted in greater increases in passion, which is a hypothesis for future investigations.

The trajectories of REA and OP are particularly important as previous studies (De La Vega et al., 2016; Kovacsik, Soós, et al., 2018) demonstrated a strong positive relationship between the two. In this study, the relationship was also strong but not as strong as in these earlier works. In the past research, about one third to nearly half of the variance in REA was predicted by OP (De la Vega et al., 2016; Kovacsik, Griffiths, et al., 2018; Kovacsik, Soós, et al., 2018). The lower relationship in the current work may be due, at least in part, to the lower exercise frequency, but within-sport/exercise activity differences may also negate this finding. For example, it was shown that the REA-OP relationship is twice as high in individual exercisers than in team exercisers (Kovacsik, Soós, et al., 2018).

More importantly, although the trajectories of OP and REA were similar, there was some discrepancy in these trajectories (see Figure 1), further supporting their theoretical distinctiveness. Accumulating evidence on OP and problematic behaviors suggests that OP (and passion, in general, could also be interpreted as high engagement; Deleuze, Long, Liu, Maurage, & Billieux, 2018) only fulfills the so-called peripheral criteria of addictions, namely euphoria and cognitive salience (Ferguson, Coulson, & Barnett, 2011). Empirical studies within the online gaming literature (Brunborg et al., 2013; Charlton & Danforth, 2007) supported the distinction of high engagement and addiction with the latter including additional components such as withdrawal symptoms that manifest when the individual cannot engage in the given activity. In addition, while addiction is often associated with negative outcomes, this is not necessarily the case for high engagement (e.g., Deleuze et al., 2018; Gillet, Morin, Sandrin, & Houle, 2018; Tóth-Király, Bőthe, et al., 2019). For these reasons, OP might be considered as a potential precursor of addiction.

Predictors of Risk for Exercise Addiction and Passion Changes

As change does not happen in a vacuum, the current longitudinal data provide information about the etiology of REA and passion as a function of motivation. Initial values of REA were predicted by higher sport intensity at baseline; that is, the more intensively athletes trained, the higher the initial REA scores were. This result is in line with prior work (Kovacsik, Griffiths, et al., 2018), showing that higher exercise intensity is associated with greater REA, but it is a modest predictor (less than 5% common variance) of REA. Increases in REA were positively predicted by gender (being female) and by type of sport (doing team sports). For gender, these findings do not agree with previous studies (Modoio et al., 2011; Szabo, De La Vega, Ruiz-Barquín, & Rivera, 2013) and a recent literature review (Dumitru, Dumitru, & Maher, 2018). However, Weik and Hale (2009) showed that depending on the instruments used, either men or women may score higher on REA. Since none of the earlier findings examined the development of REA in the sport or exercise adoption phase, it is possible that women show a stronger affinity for their new activity in the early stage, which can mirror in greater REA scores. Further examination of this possible explanation is warranted. Similarly, the finding that team sport participation is a predictor of REA is also inconsistent with past reports that showed no difference in REA between team and individual exercisers (De La Vega et al., 2016; Lichtenstein, Larsen, Christiansen, Støving, & Bredahl, 2014). Therefore, in accordance with a study addressing the conceptual limitations of measuring exercise addiction (Szabo et al., 2015), it is possible that interaction in team sports manifests as a greater affinity for the practice that translates into greater overall scores of REA. Again, this explanation is speculative because no previous research examined REA in team and individual sports in the adoption period in a longitudinal design.

Among the motivational factors, only identified regulation predicted the slope of REA, which is in contrast to prior studies (e.g., González-Cutre & Sicilia, 2012). That is, the higher their identified regulation was, the smaller the change was in REA scores. Identified regulation entails that athletes perceive doing sports as personally significant for them and as an activity that can have valuable benefits associated with it (e.g., improved health). It is logical to hypothesize that athletes predominantly motivated by identified regulation see the benefits and the drawbacks of doing sports as well, which might help them in avoiding REA. Still, the results also suggest that other factors might influence REA.

Following previous studies on passion and motivation (Curran et al., 2011; Vallerand et al., 2006), it was expected that more autonomous motivational (intrinsic, identified and integrated motivations) forms would predict HP, while more controlled motivations (introjected, external and amotivation) would predict OP. Strictly speaking, this was not the case in the present study. All three passion factors were positively predicted by integrated regulation, which refers to the notion that doing sports is in line with personal goals, objectives, and values. Via this motivation source, doing sports is still extrinsically regulated and is not done out of enjoyment and satisfaction (i.e., intrinsic motivation), but it is an important aspect of how people perceive themselves. Thus, when they perceive themselves as “athletes”, they might become more passionate for sports.

In addition to integrated regulation, there were some unique predictive effects as well. HP was further predicted by identified regulation, suggesting that when athletes consider sports to be important for its inherent positive characteristics, they are more likely to become harmoniously passionate and engage in sports in a mindful and willful manner. By the same token, apart from integrated regulation, OP and PC were predicted by intrinsic motivation. People with intrinsic motivation might find sports so enjoyable, satisfying, and stimulating that they might become more and more passionate for it (i.e., PC), or they might start to lose control over the activity (i.e., OP). Inherent activity enjoyment (i.e., intrinsic motivation) appears to be important in relation to these two factors. This proposition is in line with the theoretical model of Grubbs and colleagues (2019), which underlies the importance of pleasure-seeking in problematic pornography use. While OP is not problematic per se, it might lead to problematic behaviors (i.e., REA) in the long run. Finally, PC was negatively predicted by external regulation, indicating that when athletes are forced to do sports (i.e., to obtain a reward or to avoid punishment), they are less likely to develop a passion for it. Overall, it appears that the relation between passion and motivation might not be as straightforward as it has been suggested in previous studies (see also Tóth-Király, Vallerand, Bőthe, Rigó, & Orosz, 2019 on this issue), encouraging future studies for a more thorough understanding of the relationship.

Returning to the comparison of OP and REA as a final note, it should be mentioned that the two constructs were differentially predicted by the underlying sport motivations: only the slope of REA was predicted by identified regulation, whereas the initial values of OP were predicted by the more autonomous motivational forms. These findings, coupled with the similar growth trajectories, are indicative and supportive of the notion that OP and REA are similar, yet unique (or independent) constructs at the same time. Consequently, the finding shed light on and untangle, to some extent, the consistently reported strong relationship between passion and REA in the recent literature.

Limitations and Future Studies

Despite the promising findings, the present study also has some limitations that need to be mentioned. A convenience sample was recruited, and the sample size was also modest. This is a general problem in multiple repeated measures within-subjects study designs. Future large-scale studies are needed to support the generalizability of the findings. A larger sample might also provide an opportunity to use latent variables that are naturally corrected for measurement error. Recruiting a large sample would also allow one to conduct growth mixture analysis that could be useful in identifying subgroups of participants who are characterized by distinct growth trajectories. Some of the fit indices for the conditional OP model were less than satisfactory and, therefore, the corresponding results should be interpreted cautiously. Self-reported questionnaires were administered, which might be prone to biases (e.g., social desirability bias); multi-informant assessment might be used to address this issue that includes trainers and teammates. Future studies should also aim to examine a wider time period (e.g., one year or possibly more).

As for the predictors, bi-directional paths might equally be possible; future studies should investigate these potentially reciprocal effects. The fact that the current sample only practiced the new sport once a week may be the reason for the more modest relationship between OP and REA in contrast to past research. Exaggerated exercise volume is one of the features of REA (Szabo, 2010) and seeing REA along OP increase in participants who only exercise once a week over a relatively short 12-week period may point to the addictive nature of exercise behavior, or alternatively that the current conceptualization of REA - in evolutionary perspective - may be inadequate, in accord with the interactional model of exercise addiction (Egorov & Szabo, 2013), which predicts that the morbidity is “revolutionary” and not “evolutionary”. Finally, apart from the here studied predictors, other variables might also affect passion and REA trajectories, and future studies should strive to include more variables that might influence passion and REA.

Conclusion

The current study shows that a single weekly session of 90-minutes training might result in a modest but statistically significant increase in passion and the risk for exercise addiction (REA). Motivation is a partial predictor of the observed effects. While the rise in passion is theoretically sound, the rise in REA could reflect a conceptual misinterpretation of the items and responses on the assessment tools and not merely the rise in obsessive passion (OP), which shares a relatively large proportion of the variance with REA in committed or long-term exercisers, but less so in beginners, as shown in the current work. This longitudinal inquiry shows that OP and REA are independent constructs in the early stage of exercise adoption. The disputed 'evolutionary' aspect of REA (Egorov & Szabo, 2013) gains support in the current work, which strengthens the interactional model of exercise addiction.

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Table 1

Descriptive statistics, internal consistency indices, and inter-factor correlations

Variables	M	SD	α	1	2	3	4	5	6	7	8	9	10	11	12
1. HP (T1)	21.01	5.85	.83	—											
2. HP (T2)	20.87	6.22	.82	.83**	—										
3. HP (T3)	22.58	6.33	.85	.68**	.77**	—									
4. OP (T1)	31.36	5.87	.73	.60**	.61**	.57**	—								
5. OP (T2)	30.87	5.93	.76	.56**	.67**	.62**	.82**	—							
6. OP (T3)	32.32	5.76	.80	.49**	.57**	.73**	.74**	.82**	—						
7. CP (T1)	26.70	5.63	.85	.66**	.62**	.52**	.84**	.75**	.63**	—					
8. CP (T2)	26.91	5.42	.82	.64**	.68**	.62**	.78**	.87**	.74**	.87**	—				
9. CP (T3)	27.72	5.17	.82	.50**	.53**	.70**	.70**	.72**	.84**	.72**	.80**	—			
10. REA (T1)	15.78	3.95	.64	.55**	.53**	.42**	.52**	.41**	.35**	.54**	.50**	.39**	—		
11. REA (T2)	16.54	3.47	.58	.55**	.62**	.50**	.50**	.55**	.51**	.45**	.61**	.47**	.68**	—	
12. REA (T3)	18.91	3.65	.65	.45**	.45**	.56**	.43**	.46**	.60**	.40**	.49**	.58**	.54**	.67**	—
13. Gender	1.64	0.48	—	-.04	-.07	.05	.02	.13	.17*	-.07	.05	.08	.12	.14	.28**
14. Age	21.09	2.98	—	-.13	-.19*	-.12	-.14	-.08	-.06	-.04	-.05	-.01	-.03	-.03	.00
15. Sport form	1.68	0.47	—	.08	.08	.19*	.08	-.00	.12	.10	.09	.17*	-.05	-.07	.01
16. Intensity (T1)	74.51	15.37	—	.19*	.16*	.17*	.41**	.24**	.30**	.37**	.31**	.29**	.29**	.26**	.13
17. Intrinsic (T1)	13.79	4.07	.90	.41**	.40**	.43**	.48**	.42**	.39**	.45**	.40**	.38**	.38**	.22**	.17*
18. Integrated (T1)	8.93	3.01	.82	.41**	.39**	.44**	.56**	.54**	.51**	.59**	.55**	.53**	.33**	.27**	.27**
19. Identified (T1)	14.72	3.96	.82	.46**	.43**	.38**	.46**	.42**	.33**	.45**	.42**	.35**	.42**	.29**	.17*
20. Introjected (T1)	10.36	2.49	.57	.32**	.30**	.21*	.43**	.32**	.26**	.40**	.32**	.25**	.36**	.23**	.09
21. External (T1)	4.95	2.69	.72	.23**	.13	.10	.07	-.03	.06	.07	.01	.04	.10	.06	-.04
22. Amotivation (T1)	5.54	3.25	.74	.12	.11	.07	-.00	-.02	.01	.03	.01	.00	.01	.05	.06

(continued on the following page)

Table 1 (continued)

Variables	M	SD	α	13	14	15	16	17	18	19	20	21	22
13. Gender	—	—	—	—									
14. Age	—	—	—	.08	—								
15. Sport form	—	—	—	-.35**	-.08	—							
16. Intensity (T1)	—	—	—	.03	-.12	.12	—						
17. Intrinsic (T1)	—	—	—	.12	-.03	.06	.23**	—					
18. Integrated (T1)	—	—	—	.08	.06	.00	.23**	.47**	—				
19. Identified (T1)	—	—	—	.12	-.00	-.02	.23**	.64**	.62**	—			
20. Introjected (T1)	—	—	—	.04	-.00	-.04	.31**	.47**	.40**	.54**	—		
21. External (T1)	—	—	—	-.37**	-.06	.27**	-.02	.18**	.18**	.20*	.16	—	
22. Amotivation (T1)	—	—	—	-.35**	-.09	.16*	-.17*	-.09	.01	-.03	-.20*	.32**	—

Note. HP: harmonious passion; OP: obsessive passion; CP: passion criteria; REA: risk of exercise addiction; T1: Time 1; T2: Time 2; T3: Time 3; M: mean; SD: standard deviation; α: Cronbach's alpha; Gender was coded as 0 = male and 1 = female; Sport form was coded as 0 = individual sport and 1 = team sport.; **p*<.05; ***p*<.01

Table 2

Goodness-of-Fit Statistics for the Estimated Models

	χ^2	df	CFI	TLI	RMSEA	90% CI of RMSEA	SRMR
Unconditional Latent Growth Models							
Harmonious passion	4.277*	1	.985	.954	.148	.028-.304	.036
Obsessive passion	5.157*	1	.980	.939	.167	.050-.321	.042
Passion criteria	0.449	1	1.000	1.010	.000	.000-.188	.006
Risk of exercise addiction	2.042	1	.990	.969	.084	.000-.252	.022
Conditional Latent Growth Models							
Harmonious passion	15.563	11	.987	.961	.053	.000-.108	.025
Obsessive passion	28.144*	11	.957	.870	.102	.056-.150	.030
Passion criteria	7.693	11	1.000	1.025	.000	.000-.063	.025
Risk of exercise addiction	8.340	11	1.000	1.039	.000	.000-.068	.027

Note. χ^2: Robust chi-square test of exact fit; df: Degrees of freedom; CFI: Comparative fit index; TLI: Tucker-Lewis index; RMSEA: Root mean square error of approximation; 90% CI: 90% confidence interval of the RMSEA; SRMR: standardized root mean square residual; The fact that CFI and TLI equaled or were higher than one could be attributed to multiple reasons. First, in these particular models, the chi-square value was smaller than the accompanying degrees of freedom, and TLI is calculated from these two indices, which could sometimes result in obtaining a TLI value that falls outside the typical range of 0 and 1 (Schermelleh-Engel et al., 2003). It is also possible that TLI, which naturally incorporates a penalty for the lack of parsimony (Marsh, 2007), overcompensated for these parsimonious models. *$p < .05$.

Table 3

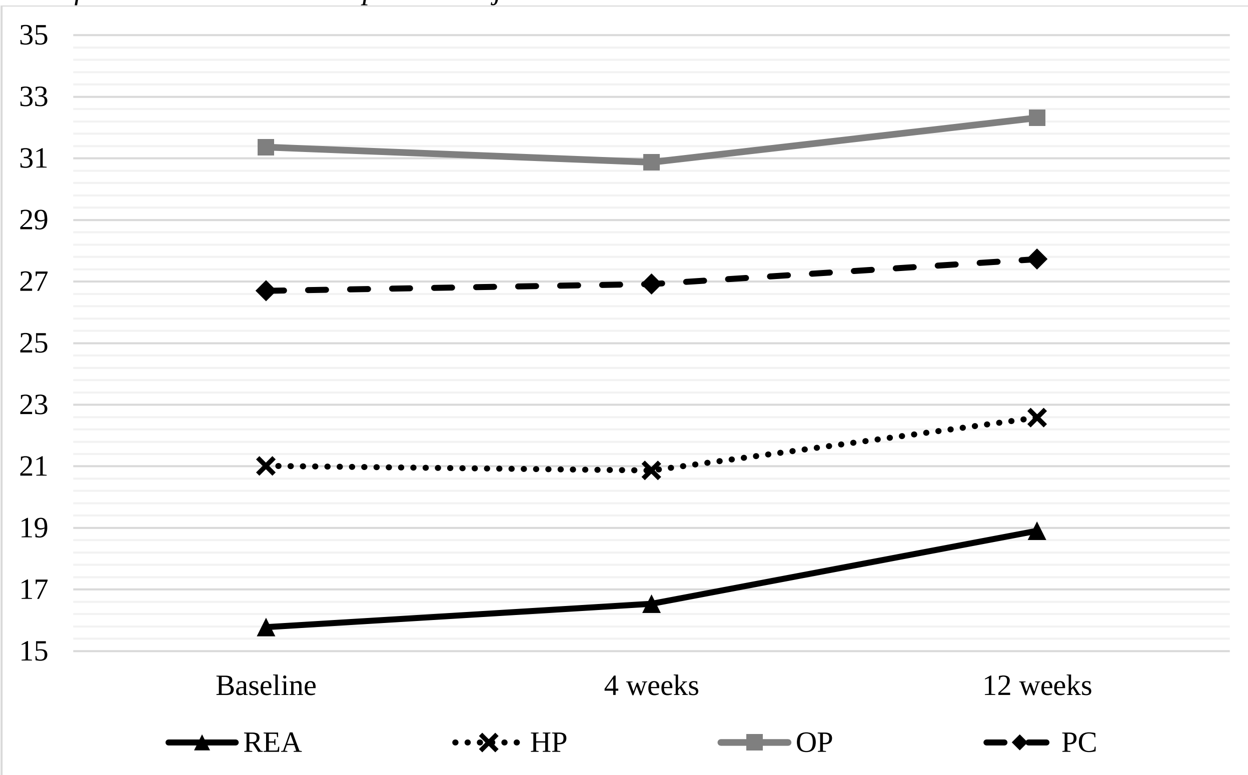
Standardized regression coefficients (with standard errors) between the predictors and the growth factors

Predictors	Harmonious passion		Obsessive passion	
	Initial	Slope	Initial	Slope
Age	-.125 (.070)	-.009 (.074)	-.128 (.064)*	.090 (.080)
Gender	-.027 (.088)	.140 (.093)	-.041 (.073)	.381 (.101)**
Sport form	.009 (.070)	.250 (.078)**	.025 (.068)	.195 (.083)*
Intensity T1	.046 (.088)	-.031 (.095)	.201 (.078)*	-.070 (.098)
Intrinsic T1	.161 (.096)	.169 (.106)	.227 (.090)*	-.059 (.089)
Integrated T1	.172 (.079)*	.223 (.104)*	.417 (.083)**	.071 (.108)
Identified T1	.216 (.103)*	-.211 (.113)	.001 (.113)	-.203 (.113)
Introjected T1	.083 (.108)	-.155 (.115)	.144 (.079)	-.142 (.108)
External T1	.047 (.074)	-.142 (.117)	-.144 (.082)	.161 (.096)
Amotivation T1	.134 (.087)	-.030 (.099)	.087 (.093)	.035 (.116)
Predictors	Passion criteria		Risk of exercise addiction	
	Initial	Slope	Initial	Slope
Age	-.028 (.072)	.029 (.059)	-.006 (.087)	-.007 (.091)
Gender	-.147 (.072)*	.311 (.085)**	.085 (.099)	.384 (.135)**
Sport form	.042 (.074)	.181 (.080)*	-.117 (.087)	.281 (.113)*
Intensity T1	.187 (.083)*	-.082 (.093)	.269 (.080)**	-.221 (.128)
Intrinsic T1	.191 (.082)*	-.048 (.076)	.105 (.115)	-.076 (.136)
Integrated T1	.463 (.075)**	-.042 (.098)	.043 (.118)	.283 (.172)
Identified T1	-.016 (.113)	-.062 (.113)	.215 (.129)	-.366 (.174)*
Introjected T1	.135 (.092)	-.175 (.108)	.147 (.112)	-.165 (.148)
External T1	-.164 (.071)*	.098 (.084)	.050 (.083)	-.116 (.107)
Amotivation T1	.093 (.065)	-.046 (.077)	.151 (.123)	.082 (.104)

Note. Gender was coded as 0 = male and 1 = female.; Sport form was coded as 1 = individual sport and 2 = team sport.; *p < .05; **p < .01.

Figure 1

Risk of exercise addiction and passion trajectories



Note. Numbers on the vertical axis represent the range of answer options for the scales which ranged from 6 to 30 for the risk of exercise addiction scores, from 6 to 42 for harmonious and obsessive passion, and from 5 to 35 for the passion criteria scores. Models were estimated separately, but are depicted on the same figure for the sake of simplicity. All intercept and slope values were significant, suggesting minor increases for all four factors.