

Connect, compete, compare: motivational implications of social fitness platform-based exercise

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Abstract:

Problem Statement: The health benefits of sport and exercise are well documented. Accordingly, understanding people's motivation for sustained sport and exercise participation is of vital importance. However, over the last decade, this aim is gradually challenged due to the strong rise in exercise with use of digital fitness tracking applications and social fitness platforms (SFP; online fitness community where users can share their recorded activities to a network of other users). Despite this trend, research on motivational implications of exercising with use of a SFP is limited; specifically, two well-established antecedents for explaining sport and exercise motivation in the 'broad domain of sport', *motives* and *achievement goals* have been largely overlooked in this line of research. Hence, more understanding of motivational patterns for SFP-based exercise is important as it can contribute to improve the quality of the sport and exercise experience in this context. **Approach:** This study used a cross-sectional design and focused on users of the social fitness platform Strava. Strava users (481 males and 99 females; *M* age = 35.20) completed questionnaires measuring: motives and goals for SFP use; motivational responses self-regulation, effort, enjoyment, and relatedness; and SFP/sport user features. **Purpose:** This study had two purposes: To examine whether (1) motives and goals were related to motivational responses, and (2) these relationships were moderated by user features, when exercising with use of a SFP. **Results:** Regression analysis revealed that: Competence motives and task involvement were associated positively, and ego involvement negatively with self-regulation; Intrinsic, extrinsic, and competence motives, and task involvement were associated positively and social motives negatively with effort; Intrinsic, extrinsic, and competence motives were positively associated with enjoyment; Extrinsic and social motives were positively associated with relatedness. In addition, 'number of posts' moderated the relationship between competence motives and self-regulation, and 'main sport activity' (i.e., cyclists vs. runners) moderated the relationship between ego involvement and self-regulation, and between ego involvement and effort; 'privacy settings' (i.e., allowing others to follow you) moderated the relationship between extrinsic motives and enjoyment; and, 'social exercise context' (i.e., exercising mostly alone or in a group) moderated the relationships between extrinsic motives and relatedness, and between social motives and relatedness. **Conclusions:** The current findings highlight the value to examine achievement motivation specific to sport and exercise with use of a SFP and can help to provide practical applications to facilitate adaptive achievement motivation in this exercise context.

Key Words: sport & exercise motivation, online fitness community, Strava, motives, achievement goals

Introduction

The health benefits of sport and exercise are well documented (e.g., Eime et al., 2013). Hence, understanding people's motivation for engaging in physical activity has taken an important place in the literature (Teixeira et al., 2012). Yet, the continuous digitalization of society has brought new developments in this area. One of such are social fitness platforms (SFPs; e.g., Strava, Garmin Connect, Nike+ Run Club) which are online platforms that transform data collected via wearable fitness apps and activity-tracking devices (as integrated in smartphones and GPS watches) into physiologic (e.g., heart rate) and performance (e.g., distance, speed/pace) data. Arguably, SFPs fundamentally change sport and exercise experiences as a regular training session "has become a quantifiable manifestation of individual digital achievement that endures and can be shared with friends and strangers" (Barratt, 2017; Whelan & Clohessy, 2020, p.2). The impact of this development is also illustrated by the growing body of research, with a particular focus on design and usability features of wearable fitness technology (Aroganam et al., 2019). Research on the motivational implications of exercising with use of SFP has received less attention. In particular, two well-established antecedents for explaining sport and exercise motivation in the broad domain of sport, *motives* and *achievement goals* (Inglelew & Markland, 2008; Lochbaum et al., 2016), have been largely overlooked in this line of research. Examining these relationships is deemed important for gaining more understanding of sport and exercise motivation with use of a SFP.

Motives have been conceptualized as reasons for participating in a particular domain of behaviour (Ingledeu & Markland, 2008). Based on self-determination theory, motives can be divided into intrinsic, extrinsic, competence, and social motives. Intrinsic motives are based on the desire to have fun, pursue interest, and be stimulated; extrinsic motives on the desire to obtain outcomes (e.g., rewards or social approval) that are separate from the behavior itself; competence motives on the desire for challenge and developing skills; and social motives on the desire for connectiveness (Ryan et al., 1997).

With respect to motives for SFP use, research is still scarce and mainly linked them to SFP ‘motivational affordances’ (i.e., SFP features that support users’ motivational needs; Zhang, 2008). In a study by Stragier et al. (2018) it was found that runners’ achievement motives (i.e., competition, personal goal achievement) positively predicted SFP self-regulation features (i.e., progress evaluation). In addition, James et al. (2019) found that intrinsic-enjoyment and competence-based exercise motives predicted the use of SFP data-management features (i.e., features that allow users to collect and analyse exercise progress) of social fitness apps. Moreover, they found that social exercise motives predicted the use of exercise control (e.g., rewards and reminders) and social interaction (e.g., data sharing, encouragement, competition, and coaching) features.

Achievement goals refer to the criteria that people use to define and appraise one’s own competence. When this concept is applied to a specific achievement situation then it refers to *goal involvement* and has been distinguished in task- versus ego involvement. When task involved, people evaluate competence using self-referenced criteria and feel successful when they master a task or improve their skills. In contrast, when ego involved, people evaluate competence using other-referenced criteria and feel successful when they establish superiority over others, such as outperforming others. People also have a proneness to the two types of involvement, known as task and ego orientation (Nicholls, 1989).

Regarding achievement goals and SFP use, empirical research is even more scarce. With respect to goal orientations, Rockman and Gewald (2019) found that both task (i.e., mastery) and ego (i.e., performance) orientation were positively related to exercise guidance (e.g., reminders), rewards (e.g., virtual trophies), and social comparison (e.g., leader boards) affordances, while task orientation was related positively and ego orientation negatively to self-monitoring affordances (e.g., activity metrics) of fitness apps. To date, no study examined this issue from a situation-specific goal perspective, that is goal involvement. This is deemed important as achievement goals may depend on the specific exercise context (e.g., van de Pol et al., 2012), and in the current study this context reflects ‘exercising while having the intention to upload the activity on an SFP’.

Motives, Goals, User Features and Motivational Responses

Motives and goals have been also identified as two well-established antecedents of important *motivational responses* in the sport and exercise domain, such as self-regulation, effort, enjoyment, and relatedness. Specifically, research has shown that intrinsic, competence and social motives, and task goals are adaptive, whereas extrinsic motives and ego goals are less adaptive and/or maladaptive in relation to these responses (Ingledeu & Markland, 2008; Kitsantas et al., 2018; Lochbaum et al., 2016; Roberts et al., 2007).

Despite this demonstrated potential of motives and goals as antecedents for explaining motivational responses, this issue has been largely overlooked in the context of exercising with SFP use. Though, research has examined motives for SFP use in relation to motivational indicators like continuation of SFP use. Specifically, Stragier et al. (2016) found that social and enjoyment motives were both positively correlated with habitual use of Strava. In addition, Attig and Franke (2019) found that decreased intrinsic tracking (usage) motivation was the main reason why people quit with using wearable tracking devices for exercise. To date, goal involvement for SFP use has not been examined in relation to specific motivational responses for exercising with use of an SFP.

In sum, motives and goals have been identified as key antecedents for important motivational responses in the broad domain of sport and exercise, such as self-regulation, effort, enjoyment, and relatedness. However, so far, it has not been examined how these relationships manifest in the context of exercising with SFP use. Furthermore, when examining these relationships, it is important to acknowledge the potential moderating role of SFP- and sport features. For example, a social motive for SFP use (e.g., ‘to get more connected to other athletes’) may be positively related to the motivational response relatedness (e.g., ‘feeling related to other athletes on the platform’). However, this relationship may be strengthened when users’ ‘number of followers’ (as a SFP feature) increases. Likewise, a high task goal involvement (e.g., ‘feel most successful when reaching personal goals’) may be positively related to self-regulation (i.e., planning, monitoring, and evaluating one’s own exercise goals; Kitsantas et al., 2018). However, this relationship may be strengthened when users’ activity on the platform increases (e.g., a higher ‘number of posts’ or ‘number of followers’ may provide more performance feedback opportunities).

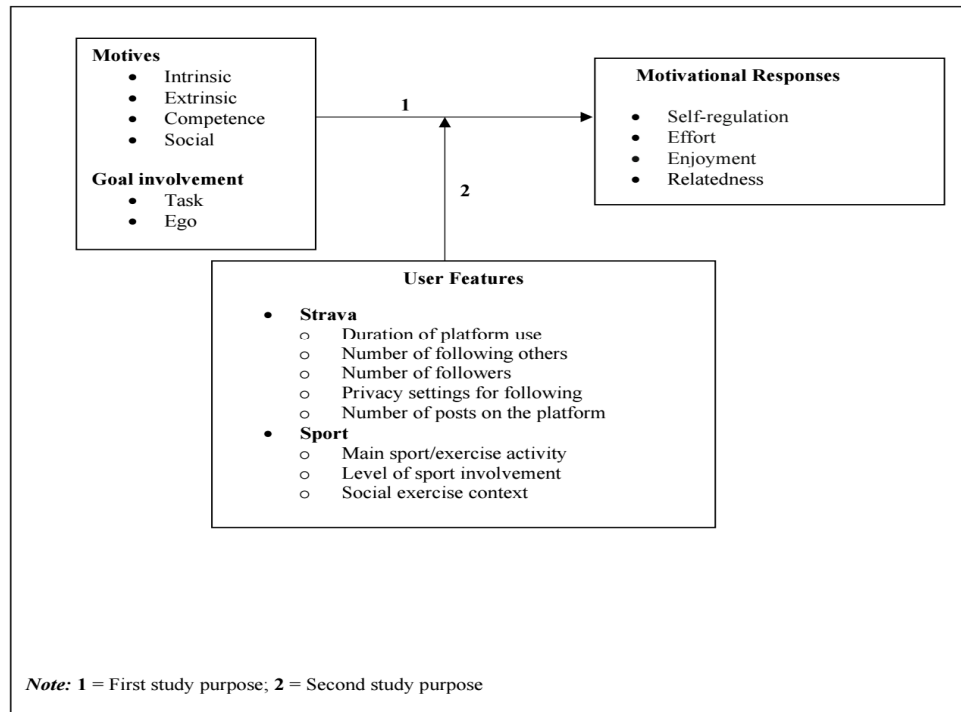
The Present Study

Research has started to explore the role of motives and goals in relation to SFP use. Yet, this work mainly focused on how general participation motives and goals for exercise predicted SFP affordances. However, motives and goals have been typically identified as important antecedents for motivational responses in the broad domain of sport and exercise. Hence, it is deemed an important next step to examine how these constructs, as antecedents, may explain motivational responses, both measured on a situation-specific level of exercising with SFP use, and how user (SFP and sport) features may moderate these relationships.

In view of this, the current study had two purposes: To examine whether 1) motives and goals were related to motivational responses, and 2) these relationships were moderated by user features, when exercising with SFP use (see Figure 1 for a conceptual overview of the study purposes). Regarding motivational responses, this study focused on self-regulation, effort, enjoyment, and relatedness. With this choice, it aimed for a selection of motivational responses which together represent a combination of cognitive (i.e., self-regulation), behavioural (i.e., effort), and affective (i.e., enjoyment, relatedness) motivational responses, which have been shown to be highly influential on the quality of sport and exercise experiences (Ingledeu & Markland, 2008; Kitsantas et al., 2018; Lochbaum et al., 2016). Examples of the included ‘user features’ are ‘main sport/exercise activity’ and ‘number of followers’ on the platform (see Figure 1 and/or Table 1 for a complete overview).

Regarding the first study purposes it was expected that self-regulation would be related positively to intrinsic and competence motives and task involvement, negatively to extrinsic motives, and unrelated to social motives. It was also expected that intrinsic, competence and social motives, and task involvement would be positively related to both effort and enjoyment. Finally, it was hypothesised that intrinsic motives and social motives would be related positively, and competence motives and task involvement unrelated to relatedness. For the associations of ego involvement with self-regulation, and extrinsic motives and ego involvement with enjoyment, effort and relatedness, no hypotheses were set due to mixed or a lack of empirical support. (Attig & Franke, 2019; Ingledeu & Markland, 2008; Kitsantas et al., 2018; Lochbaum et al., 2016; Roberts et al., 2007; Stragier et al., 2016, 2018). No hypotheses were set a priori regarding the second study purpose because of the explorative stage of knowledge of this issue.

To address the study purposes, the present study used a cross-sectional questionnaire design and focused on users of the social fitness platform Strava. Strava is currently the biggest SFP for athletes/exercisers with more than 75 million accounts in 195 countries, predominantly runners and cyclists. Moreover, Strava offers a unique combination of features that makes it highly suitable for addressing the present study purposes, including self-tracking (e.g., heart rate, distance, times), gamification (e.g., badges, challenges), social comparison/competition (e.g., leader boards) and social bonding (e.g., community/clubs to join, follow other users) (Couture, 2021; Strava, n.d.).



Method

Procedure and Participants

The author's institution's ethical assessment procedures were followed and indicated that the study adhered to the institution's ethical guidelines. The required sample size was calculated with an a-priori power analysis using the program G*Power 3.1.9.2. (Faul et al., 2007). This analysis showed that for a linear multiple regression (Fixed model, R^2 deviation from zero) with six predictors, a sample size of 146 was required to obtain a 95% power for detecting a medium-sized effect ($f^2 = .15$, Cohen, 1992) with an alpha of 0.05 (two tailed). This effect size was based on previously found correlates of the examined variables (Kitsantas et al., 2018; Lochbaum et al., 2016; Teixeira et al., 2012).

This study aimed for a sample of adult (i.e., 18 years and older) Strava users with a wide range of demographics, sport features (e.g., sport ‘involvement level’) and social networking (Strava) features (e.g., ‘number of followers’) allowing to test these variables as covariates and/or moderators in addressing the study purposes. The aimed Strava users were recruited via 16 different online athlete community blogs/forums focused on runners and cyclists (which are the predominant type of athletes active on Strava), such as *Reddit* and *Runner’s World*. All blogs/forums were English-speaking websites with a global reach. Website administrators were asked for permission to place an informed (i.e., explaining study purpose and requirements) invitation to take part in the study including a link to the online questionnaire, developed with the online survey program Qualtrics. Before completing the questionnaire, participants had to sign an informed consent in which was highlighted that participation was completely anonymous and voluntary and that participants could decide any moment to stop and withdraw from this study. The questionnaire was open for 4.5 months and took approximately 15 minutes to complete.

After cleaning up the data (for procedure, see Results: Preliminary Analysis) the final data set consisted of 580 participants (481 males and 99 females), with a mean age of 35.20 ($SD = 10.62$; range 18-68) years; this sample size was more than adequate for the planned analyses of this study (see ‘a-priory power analysis’). The sample represented athletes from 34 different countries with most of them from the Netherlands ($n = 193$) and the USA ($n = 175$). From this sample, 59% of the athletes reported to be native English speakers; from the non-native English speakers, 21% reported their level of English as ‘advanced’, 18% as ‘intermediate’, and 2% as ‘beginner’. Categories and percentages of all Strava and sport user features are presented in Table 1.

Table 1.
Categories and Percentages of Strava- and Sport Features

		Categories: Percentages				Not included*	
		1	2	3	4		
Strava features							
Duration ¹ use (n =580)	SFP	< 3: 8.4%	4-12: 17.9%	13-24: 23.9%	24 >: 50.3%		
Nr. of following others (n = 579)		0-10: 32.0%	11-50: 41.8%	50 >: 26.3%	-	51-150; 151-250; 250 >; ‘unknown’	
Nr. of followers (n = 579)		0-10: 35.9%	11-50: 41.8%	50 >: 22.3%	-	51-150; 151-250; 250 >; ‘unknown’	
Nr. of posts on SFP (n = 559)		0-50: 15.9%	51-150: 22.4%	151-250: 17.5%	251 >: 44.2%		
Privacy settings (n = 550)		No approval: 61.1%	Approval: 38.9%	-	-	‘unknown’	
Sport features							
Main sport activity (n = 552)		Running: 33.9%	Cycling: 66.1%	-	-	Swimming; Duathlon; Triathlon; Other	
Level of involvement (n = 548)		Recr.: 61.1%	Recr.-compet.: 38.9%	-	-	Competitive; Elite; None	
Social exercise context (n = 579)		Only alone: 14.3%	Mostly alone: 52.0%	Even mix: 27.1%	Mostly in a group:6.6%	Only in a group	

Note: ¹measured in months; *see section Data Preparation (in Results): cells/categories with an insufficient sample size ($n < 30$) were combined with the nearest cell or ignored (= ‘missing values’) in the main analyses (Van Voorhis & Morgan, 2007). Recr.-compet. = Recreational-Competitive; Nr. = Number

The questionnaire was developed based on validated measures, drawing from the existing literature. The scales were adapted and/or shortened by making these relevant and specific to the context of this study (Franke et al., 2013). In addition, due to construct consistency and proximity of relationships, it is deemed important to use the same level of analysis for antecedents and consequences (Indik, 1968). Hence, the same level of analysis was used for all variables, that is ‘situation-specific motivation for exercising with use of SFP’. Responses were scored on a Likert scale ranging from 1) “not at all true for me” to 5) “extremely true for me”. The mean for each subscale was computed and used in all analyses.

Motives for Strava use

Intrinsic (3 items), competence (4 items), and social (3 items) motives were measured with modified scales from the Motives for Physical Activities Measure-Revised (MPAM-R; Ryan et al., 1997). These scales have shown very good to excellent reliability, with alpha coefficients of .92 for intrinsic, .91 for competence, and

.83 for social motives (Ryan et al., 1997). Extrinsic motives were, in line with van Scheppingen et al. (2014) measured by a combined scale of the external and introjected regulation scales from the Exercise Self-Regulation Questionnaire (SRQ-E). This 6-item scale represents 'controlled forms of extrinsic motivation' (Ryan & Deci, 2000) and showed good reliability in previous research ($\alpha = .78$; van Scheppingen et al., 2014). The items of the four motives were combined in one scale and presented in a random order. The preceding stem for each item was: "*I use Strava in my sport/exercise because...*", and example items were: "I enjoy it" for intrinsic, "I like to receive approval on my performance from other athletes (e.g., via Kudo's)" for extrinsic, "It helps me to improve my current level in my sport(s)" for competence, and "It makes me feel more connected to other athletes" for social motives.

Goal involvement

Strava users' goal involvement was measured with the Perception of Success Questionnaire (POSQ; Roberts et al., 1998), which consists of two six-item subscales measuring task and ego goals. Participants were asked: "*When I exercise using Strava, I feel most successful when ...*", and examples of items were: "I show clear personal improvement" for task involvement, and "I outperform others on Strava (e.g., on segments, winning KOM's/ CR's)" for ego involvement. The POSQ has demonstrated good to excellent internal consistency with alpha coefficients of .90 for the task and .84 for the ego goal subscale (Roberts et al., 1998).

Self-regulation

Participant's self-regulation was measured with an adapted/shortened scale of the Self-Regulation Scale (SRS; Toering et al., 2012). The current scale consisted of nine items reflecting the three phases of self-regulation: planning, performance, and self-reflection (Zimmerman, 2000). The items were preceded by the stem: "*My performance data derived from my Strava profile helps me ...*", and example items were: "To set my exercise goals *before* an activity" for the planning phase, "To monitor my performance *during* an activity" for the performance phase, and "To evaluate my exercise goals *after* an activity", for the self-reflection phase. For this study the nine items were combined into one single scale.

Effort & Enjoyment

Three items from the Intrinsic Motivation Inventory (IMI; Ryan, 1982) were used to measure effort. This scale has demonstrated good reliability in previous research with an alpha of .84 (McAuley et al., 1989). Enjoyment was measured with five items from the Physical Activity Enjoyment Scale (PACES) and has shown excellent reliability ($\alpha = .90$; Moore et al., 2009). Effort and enjoyment were measured in one combined scale in a random order. The preceding stem was: "*When I am exercising with the intention to upload my activity on Strava...*", and example items were: "I put a lot of energy in my activities" for effort, and "I enjoy my activities" for enjoyment.

Relatedness

This variable was measured with five items of the Psychological Need Satisfaction in Exercise Scale (PNSE) which has shown excellent reliability with an alpha of .94 (Wilson et al., 2006). An example item was: "I feel related to other athletes on Strava with whom I interact".

User Features

Strava and sport features (see Table 1) were measured via self-constructed scales. We used ordinal scales for 'duration of platform use' ("How long do you already use Strava?"); 'number of following others' ("What is the number of athletes that you are *following*?"); 'number of followers' ("How many *followers* do you have *yourself*?"); 'number of total posts on the platform' ("What is your current total number of posted activities on Strava?"); and 'level of sport involvement' ("Which level of athlete do you consider yourself?"), and nominal scales for: 'privacy settings' ("Who can follow you on Strava?"); 'main sport/exercise activity' ("What is your *main* sport activity (i.e., upload an activity and share it with others) on Strava?"); and 'social exercise context' ("How do you typically undertake your main activity (e.g., ride/run/swim), *alone* or *in a group*?"). For the used answer categories, see Table 1. Regarding the Strava features, participants were also notified that they could check/verify their answers via their own 'stats' on the platform.

Design and Analysis

The current study used a cross-sectional questionnaire design. Strava users' motives (4x) and goals (2x) were used as independent variables, motivational responses (4x) as dependent variables, and user features (8x) as moderator variables (see Figure 1 for a conceptual overview). Preliminary analyses were conducted in order to clean up the dataset, identify outliers, and examine scale's reliability. In addition, descriptive statistics were examined via means and correlation analysis; the correlation analysis was also used in order to identify potential confounding variables.

For addressing the study purposes the Univariate General Linear Model (GLM) with SPSS-version 26 was used. The GLM Univariate procedure provides regression analysis and analysis of variance for one dependent variable by one or more factors and/or continuous variables. For all tested models/analyses a Bonferroni adjustment was applied to control the family-wise error rate with multiple comparisons, and partial eta-squared (η_p^2) was used as a measure of effect size with values of .02, .13 and .26 indicating small, medium, and large effect sizes, respectively (Cohen, 1992). Accordingly, a separate model was build for each motivational response (i.e., dependent variable). Specifically, for the first study purpose, motives and goals (i.e.,

independent variables) and age (i.e., control variable) were entered as covariates in each model. Main effects were examined using a separate model without interaction terms which allows to estimate the unique effect of each predictor on each motivational response (e.g., Hayes et al., 2012). Motives and goals were entered in the same model as it allows to examine and compare the predictive ability of these different constructs with respect to the selected dependent variables (see Tabachnick & Fidell, 2007). For the second study purpose, the model tested all possible two-way interaction effects between each motive and goal (entered as covariate) and moderator 'user feature' (entered as fixed factor) on each single motivational response (entered as dependent variable), with controlling for age (entered as additional covariate). These reduced models were used in order to increase power as it only included the main (first order) effects which are part of the tested interaction of interest (e.g., Hayes et al., 2012). Zero is a meaningful value of the continuous independent variable (motives and goals) in each model. Hence, for interpretation purposes, the continuous independent variables in creating interaction terms were not centered. Specifically, regarding the obtained parameter estimates (see Table 3) the intercept reflects the mean of the dependent variables (i.e., 'motivational response') for the (by default) last reference category (i.e., 'user feature') when the independent variable (i.e., 'motives' and 'goals') is zero.

Results

Data Preparation and Preliminary Analyses

First the data set was cleaned. In total, 937 participants submitted the online questionnaire. From this response, the incomplete and invalid (i.e., no informed consent and/or not meeting the age criterium) questionnaires were removed from the dataset (Rowley, 2014), resulting in 586 questionnaires retained for analysis (i.e., a valid response rate of 63%). Accordingly, six outliers (i.e., cases with scores in excess of 3.29 *SD* from the mean; Tabachnick & Fidell, 2007) were removed, leaving a final data set of 580 participants.

Prior to the main analyses, the data was prepared for factorial designs with unequal cell scores for independent categorical variables. Specifically, when a medium-to-large effect size is assumed in ANCOVA, 30 participants per cell/category is recommended for achieving a power of .80. Therefore, for 'user features' variables measured on ordinal scales (with an ascending order), the cells/categories with an insufficient sample size were combined with the nearest cell in order to attain at least 30 scores per cell. For 'user features' measured on a nominal scale (i.e., answer categories without a meaningful order) the categories with an insufficient sample size were recoded as 'missing values' and thereby ignored in the analysis (Tabachnick & Fidell, 2012; Van Voorhis & Morgan, 2007). Reliability analysis showed good to excellent internal consistency (see Nunnally & Bernstein, 1994) for all subscales with alpha scores ranging from .77 to .94 (see Table 2).

Descriptive Statistics

The means showed that, based on the scales range (1-5), participants reported: moderate to high intrinsic and competence motives, task involvement, effort, self-regulation, and enjoyment; moderate social motives and relatedness; low to moderate ego involvement; and low extrinsic motives. Correlation analysis showed positive bivariate relationships among all main variables, varying from small to large effect sizes (Cohen, 1992). In addition, age was correlated to competence motives, task and ego goals, and all four motivational responses; due to its potential confounding effect, the main analyses were controlled for age as a covariate. A complete overview of the descriptive statistics is presented in Table 2.

Table 2.
Means, Standard Deviations, Internal Consistency, and Pearson Correlations for Main Variables (N= 580)

	<i>M</i>	<i>SD</i>	α	1	2	3	4	5	6	7	8	9	10
1. Intrinsic motives	3.81	.76	.79 ¹										
2. Extrinsic motives	1.87	.67	.80	.26**									
3. Competence motives	3.46	.93	.86	.43**	.33**								
4. Social motives	2.64	.98	.77	.40**	.62**	.37**							
5. Task involvement	3.56	.95	.86	.18**	.12**	.53**	.21**						
6. Ego involvement	2.34	1.07	.92	.23**	.40**	.37**	.28**	.36**					
7. Self-regulation	3.11	.88	.90	.29**	.18*	.54**	.24**	.56**	.22**				
8. Effort	3.13	1.03	.90	.34**	.33**	.49**	.23**	.39**	.33**	.51**			
9. Enjoyment	3.32	.99	.93	.43**	.29**	.47**	.27**	.29**	.23**	.82**	.47**		
10. Relatedness	2.76	1.01	.94	.29**	.52**	.23**	.71**	.15**	.25**	.22**	.18**	.26**	
11. Age	5.20	10.62	-	.02	.03	-.14**	.02	-.35**	-.22**	.17**	-.27**	-.16**	.11*
12. Gender	-	-	-	-.07	-.04	.04	-.05	.10*	-.06	.01	.02	.03	.00

Note. ¹one item was deleted which increased alpha from .65 (= three-item scale) to .79 (= two-item scale). ** $p < .001$; * $p < .01$. Values of .10, .30, and .50 are considered small, medium, and large effect sizes, respectively (Cohen, 1992).

Main Analyses

Motives, Goals, User Features and Motivational Responses

The results regarding the first and second purpose are presented below per motivational response. The Bonferroni adjusted alpha for study purpose one was .0071 ($\alpha = .05/7$ comparisons) and for purpose two .0125 ($\alpha = .05/4$ comparisons). Results for both study purposes are presented in the text below; the regression parameter estimates for interaction effects (i.e., study purpose 2) in Table 3, and scatterplots (see Figure 2 -7) are used for further interpretation of significant interaction effects.

Self-regulation. For main effects on self-regulation, the model was significant, $F(7, 569) = 60.78, p = .000, \eta_p^2 = .43$. Controlled for age ($b = -.01, SE = .00, t = -3.62, p = .000, \eta_p^2 = .02$), self-regulation was positively predicted by competence motives ($b = .30, SE = .04, t = 7.37, p = .000, \eta_p^2 = .09$), and task involvement ($b = .35, SE = .04, t = 9.11, p = .000, \eta_p^2 = .13$), negatively predicted by ego involvement ($b = -.09, SE = .03, t = -2.73, p = .007, \eta_p^2 = .01$) and unrelated to intrinsic, extrinsic and social motives. R^2 adjusted = .42, indicating that the model explained 42% of the variance.

For self-regulation, two significant interaction effects were found. First, the interaction between competence motives and ‘number of posts’ on self-regulation, whilst controlling for age, $F(3, 548) = 5.62, p = .001, \eta_p^2 = .03$. Parameter estimates indicate that the positive relationship (see also Figure 2) between competence motives and self-regulation is significantly weaker for ‘athletes who posted between 51 and 150 activities’ compared to ‘athletes who have posted more than 250 activities’. The other categories did not show a significant deviation from each other. Second, the interaction between ego involvement and ‘main activity’ on self-regulation, whilst controlling for age, $F(1, 544) = 14.90, p = .000, \eta_p^2 = .03$. This effect indicates that an increase in ego involvement is associated with an increase in self-regulation for cyclists but not for runners (see Figure 3).

Effort. For main effects on effort, the model was significant, $F(7, 569) = 41.24, p = .000, \eta_p^2 = .34$. Controlled for age ($b = -.01, SE = .00, t = -1.90, p = .058$), effort was positively predicted by intrinsic motives ($b = .24, SE = .05, t = 4.50, p = .000, \eta_p^2 = .03$), extrinsic motives ($b = .37, SE = .07, t = 5.24, p = .000, \eta_p^2 = .05$), competence motives ($b = .29, SE = .05, t = 5.72, p = .000, \eta_p^2 = .05$) and task involvement ($b = .20, SE = .05, t = 4.16, p = .000, \eta_p^2 = .03$), negatively predicted by social motives ($b = -.14, SE = .05, t = -2.89, p = .004, \eta_p^2 = .01$) and unrelated to ego involvement. R^2 adjusted = .33.

A significant interaction effect was found between ego involvement and ‘main activity’ on effort, whilst controlling for age, $F(1, 544) = 6.45, p = .011, \eta_p^2 = .01$. Based on the parameter estimates (see Table 3), the simple slope coefficient for runners indicates a significant deviation ($b = -.21, t = -2.54, p = .011$) with the effect of cyclists (= reference group). This negative b -value indicates that the positive relationship between ego involvement and effort is significantly weaker for runners compared to cyclists (see also Figure 4).

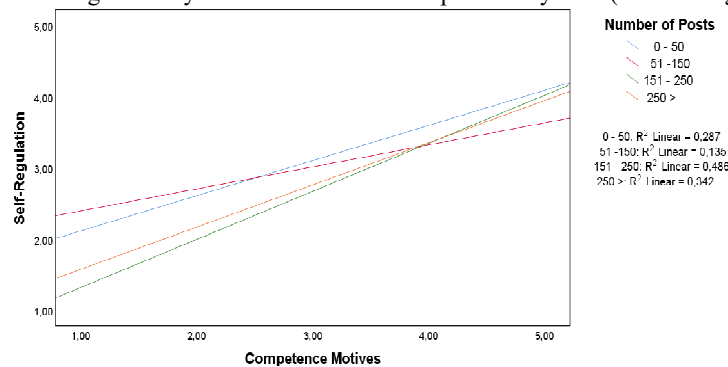


Figure 2. Simple regression lines for self-regulation on competence motives at number of posts

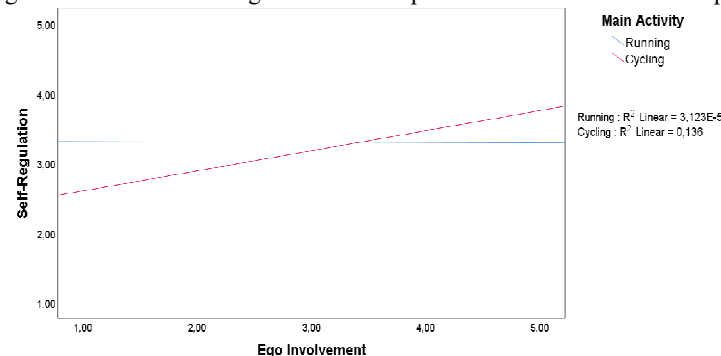


Figure 3. Simple regression lines for self-regulation on ego involvement at main activity

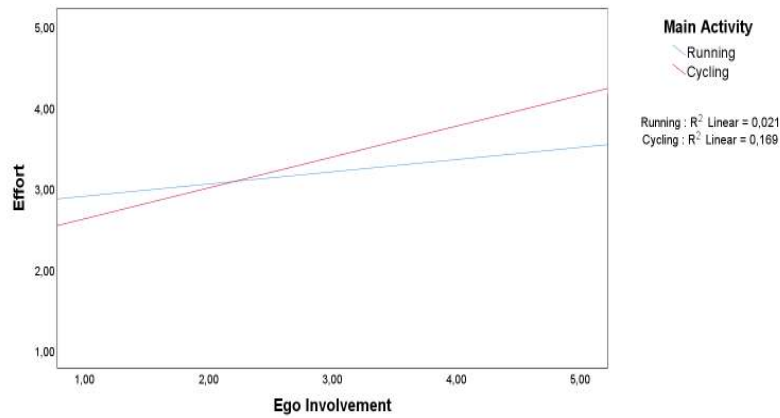


Figure 4. Simple regression lines for effort on ego involvement at main activity

Table 3|

Parameter Estimates for GLM Regression Analysis Predicting Motivational Responses from Motives, Goals and User Features (N= 580)

Effort				Enjoyment				Self-regulation			
Parameter	B	SE	t	Parameter	B	SE	t	Parameter	B	SE	t
Intercept	2.75	.23	12.21***	Intercept	3.34	.21	15.58***	Intercept	2.94	.19	15.35***
Age	-.01	.00	-2.69**	Age	-.02	.00	-3.92**	Age	-.01	.00	-3.95***
EI	.35	.05	7.12***	EM	.26	.09	3.02**	EI	.25	.04	6.00***
MA=1	.39	.21	1.89	PS=1	-.56	.24	-2.37*	MA=1	.87	.18	4.90***
MA=2	0a	-	-	PS=2	0a	-	-	MA=2	0a	-	-
MA=1 x EI	-.21	.08	-2.54**	PS=1 x EM	.32	.12	2.71**	MA=1 x EI	-.27	.07	-3.86***
MA=2 x EI	0a	-	-	PS=2 x EM	0a	-	-	MA=2 x EI	0a	-	-

Self-regulation				Relatedness				Relatedness			
Parameter	B	SE	t	Parameter	B	SE	t	Parameter	B	SE	t
Intercept	1.58	.22	7.37***	Intercept	2.10	.44	4.72**	Intercept	1.14	.38	2.98**
Age	-.02	.00	-5.40***	Age	.01	.00	1.87	Age	.01	.00	2.80**
CM	.58	.05	11.50***	EM	.39	.21	1.85	SM	.58	.12	4.71***
NoP=1	.66	.33	1.97*	SEC=1	-1.55	.50	-3.07**	SEC=1	-.98	.42	-2.35*
NoP=2	1.15	.31	3.77***	SEC=2	-1.27	.45	-2.84**	SEC=2	-.68	.38	-1.76
NoP=3	-.24	.33	-.72	SEC=3	-.14	.47	-.30	SEC=3	.01	.42	.02
NoP=4	0a	-	-	SEC=4	0a	-	-	SEC=4	0a	-	-
NoP=1 x CM	-.13	.09	-1.34	SEC=1 x EM	.53	.27	1.97*	SEC=1 x SM	.29	.15	1.89
NoP=2 x CM	-.31	.09	-3.60***	SEC=2 x EM	.49	.23	2.20*	SEC=2 x SM	.18	.13	1.41
NoP=3 x CM	.05	.09	.58	SEC=3 x EM	.04	.23	.17	SEC=3 x SM	-.04	.14	-.28
NoP=4 x MC	0a	-	-	SEC=4 x EM	0a	-	-	SEC=4 x SM	0a	-	-

Note. * $p < .05$; ** $p \leq .01$; *** $p \leq .001$; a= Redundant and set to Zero; IM= Intrinsic Motives; EM= Extrinsic Motives; CM= Competence Motives; SM=Social Motives; TI= Task Involvement; EI= Ego Involvement; MA= Main Activity; PS= Privacy Settings; NoP= Number of Posts; SAC= Social Exercise Context

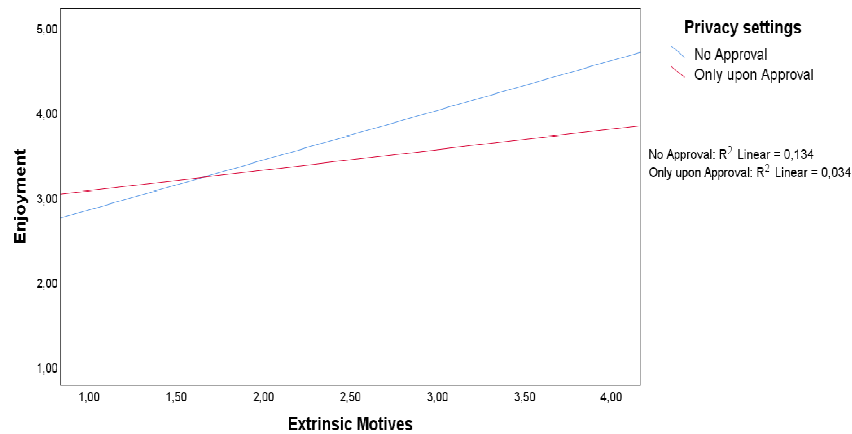


Figure 5. Simple regression lines for enjoyment on extrinsic motives at privacy settings

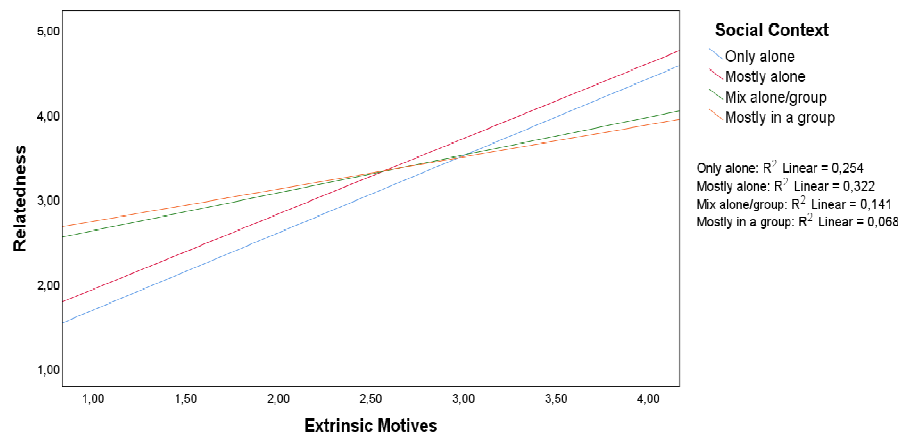


Figure 6. Simple regression lines for relatedness on extrinsic motives at social exercise context

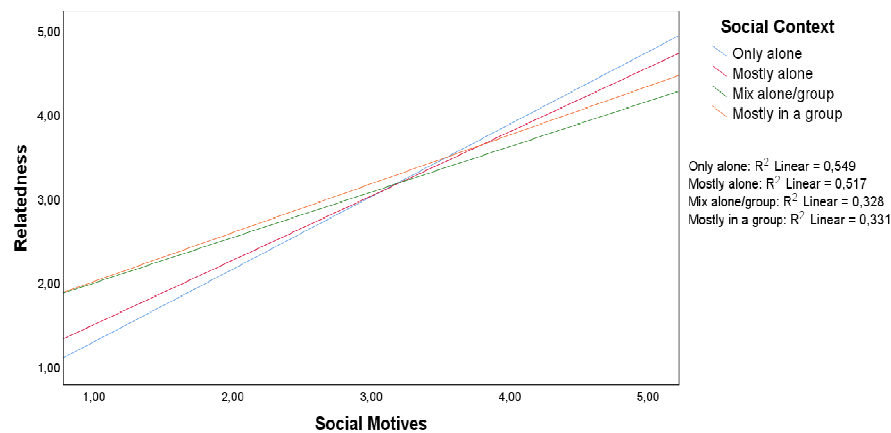


Figure 7. Simple regression lines for relatedness on social motives at social exercise context

Enjoyment. For main effects on enjoyment, the model was significant, $F(7, 569) = 37,18, p = .000, \eta_p^2 = .31$. Controlled for age ($b = -.01, SE = .00, t = -3.12, p = .002, \eta_p^2 = .02$), enjoyment was positively predicted by intrinsic motives ($b = .39, SE = .05, t = 7.29, p = .000, \eta_p^2 = .09$), extrinsic motives ($b = .25, SE = .07, t = 3.56, p = .000, \eta_p^2 = .02$), and competence motives ($b = .28, SE = .05, t = 5.71, p = .000, \eta_p^2 = .05$) and unrelated to social motives, task and ego involvement. $R^2_{adjusted} = .31$.

One significant interaction effect was found between extrinsic motives and 'privacy settings' on enjoyment, whilst controlling for age, $F(1, 542) = 7.36, p = .007, \eta_p^2 = .01$. Parameters estimates and plot (see Figure 5) for this effect indicate that the positive relationship between extrinsic motives and enjoyment is significantly stronger for Strava users who 'allow that all Strava users can follow them' compared to participants who 'only allow others to follow them upon approval'.

Relatedness. For main effects on relatedness, the model was significant, $F(7, 569) = 88.95, p = .000, \eta_p^2 = .52$. Controlled for age ($b = .01, SE = .00, t = 3.55, p = .000, \eta_p^2 = .02$), relatedness was positively predicted by extrinsic motives ($b = .18, SE = .06, t = 3.03, p = .003, \eta_p^2 = .02$) and social motives ($b = .65, SE = .04, t = 15.96, p = .000, \eta_p^2 = .31$) and unrelated to intrinsic and competence motives, and task and ego involvement. $R^2_{adjusted} = .52$.

For relatedness, two interaction effects were found, for extrinsic motives and 'social context', $F(3, 567) = 5.93, p = .001, \eta_p^2 = .03$, and social motives and 'social context', $F(3, 567) = 4.25, p = .006, \eta_p^2 = .02$. Parameter estimates and scatterplot (see Figure 6) indicate that when extrinsic motives increase, relatedness increases more strongly for athletes who exercise 'only alone' or 'mostly alone' compared to athletes who typically exercise 'mostly in a group'.

However, for the interaction between social motives and social context on relatedness, the slopes showed no significant contrast. Thus, although the mean slope for this effect differs significantly from zero, the simple slopes showed no significant deviation, as also illustrated by the rather clustered slopes (see Figure 7) compared to the more dispersed slopes for the effect of extrinsic motives and social context on relatedness (see Figure 6).

Discussion

This study aimed to advance understanding of the motivational implications of exercising with use of an SFP. Overall, the results indicate that motives and goals were related to self-regulation, effort, enjoyment and relatedness; and some of these relationships were moderated by user features. The findings are discussed below.

Motives, Goals, User Features and Motivational Responses

The first and second study purpose were respectively, to examine whether motives and achievement goals were related to motivational responses, and whether these relationships were moderated by user features. The findings are discussed per motivational response.

Self-regulation

In line with the hypothesis, self-regulation was positively associated with task involvement. This finding supports previous research that showed that this goal is critical for self-regulatory processes in athletes (Kitsantas et al., 2017). Self-regulation was negatively associated with ego involvement. Thus, when athletes are ego involved when using Strava this can undermine the potential of using SFP performance data for planning, monitoring and evaluating their exercise goals. However, the moderation analysis revealed that this relationship may depend on users' type of sport activity. Specifically, an increase in ego involvement was associated with an increase in self-regulation for cyclists but not for runners. It could be possible that the provided normative rewards on Strava (e.g., KOM's and leaderboards) may more facilitate ego involved cyclists in planning, monitoring and evaluating their own performance compared to ego involved runners. However, promoting self-regulation for cyclist via an ego goal may not be desirable as the main effects model also showed that in the presence of task involvement and competence motives, ego involvement becomes maladaptive for using Strava data for self-regulation. These current findings contribute to the ongoing debate in the literature on whether ego goals are maladaptive or not, and which contextual factors can play a role in this (e.g., Roberts et al., 2007).

The positive relationship between competence motives and self-regulation confirms the conceptual premise that self-regulation is associated with competence needs (Ryan & Deci, 2000), and that the self-monitoring features of SFP provide opportunities to fulfil these needs (Stragier et al., 2016). However, the moderation analysis also showed that this relationship is stronger for athletes who post more activities. This makes sense as more posts reflect more SFP activity and thereby more opportunities to test and evaluate one's own competence.

Effort

In line with the hypotheses, effort was positively related to intrinsic and competence motives, and task involvement. This supports previous research in other achievement domains and indicates that when athletes exercise with having the intention to upload the activity on Strava, these antecedents for using this SFP may lead users to put more effort into their sporting activities. Regarding intrinsic motives, the current findings support and extend the work by Stragier and colleagues (2016) in which enjoyment (i.e., 'intrinsic'; Ryan & Deci, 2000) motives were positively linked to a general higher exercise motivation (e.g., 'more motivated to work out' as indicator of 'perceived usefulness') since using Strava.

Social motives were negatively related to effort, and although it was a small effect size, this finding was not expected. However, this finding could be explained by self-determination theory. In essence, social motives are not regarded as 'self-determined' as these reasons for behaviour are regulated based on a social factor, and which can be potentially maladaptive for the maintenance of sport activities (Vallerand & Losier, 1999). This may also explain why social motives were associated with lower effort when exercising with use of Strava.

Extrinsic motives were positively related to effort. Although the majority of previous studies associated this motive with more maladaptive outcomes (see Teixeira et al., 2012), also more adaptive patterns have been found, for example, a positive relationship with effort in exercise activity (Sebire et al., 2009). The positive relationship between extrinsic motives and effort may also be explained by how this motive was measured in the present study. The measure mainly comprised of items that typically reflect 'introjected regulation' (i.e., taking on regulations to behaviour but not fully accepting as their own). This type of extrinsic regulation is driven by the goal to maintain self-worth and avoid guilt and/or shame (Deci & Ryan, 2000), and has been found to be adaptive in some situations (Tsorbatzoudis et al., 2006). This may explain why Strava users with this motive (e.g., "If I don't use Strava in my sport/exercise I would feel guilty") put effort in their exercise. However, this motive type is considered as vulnerable and not enduring as individuals may only put effort into the activity as far as it helps them in achieving their extrinsic ambitions; hence, tasks are only valued to the extent that they are instrumental for reaching extrinsic goals (Vansteenkiste et al., 2004). Another nuance regarding the potential benefits of this motive is the fact that, on average, participants' extrinsic motives was low ($M = 1.87$, $SD = .69$). Hence, low levels of an extrinsic motive may be adaptive to some extent (Tsorbatzoudis et al., 2006) but more maladaptive when becoming more dominant (Vallerand & Losier, 1999).

The positive relationship between effort and ego involvement was moderated by 'main activity'. Previous research also found a positive relationship between an ego goal and effort in individual sports in competition (van de Pol & Kavussanu, 2011, 2012). Hence, competition may encourage ego-involved athletes to put effort in their activities with the prospect that this could facilitate their desired normative success (Wilson et al., 2006). In the specific context of exercising with SFP use, this prospect is highly salient. Strava provides a surplus of 'earning achievements' (e.g., 'king/queen of the mountain') which are all based on normative comparison

criteria, and only 'to earn' when outperforming other users. Moreover, the current finding indicates that another contextual characteristic 'sport type' may affect this relationship in this competitive context. The positive relationship between an ego goal and effort was stronger for cyclists than for runners. Compared to runners, cyclists reported higher levels of ego involvement, and this may explain why they put also more effort in their activities when using Strava.

Enjoyment

This response was positively associated with intrinsic and competence motives, which is line with the set hypotheses, and previous research in other achievement settings (Ingledeu & Markland, 2008; Lochbaum et al., 2016). Previous research found enjoyment motives also positively related to 'having more fun since working out using Strava' (as an aspect of 'perceived usefulness' of SFP; Stragier et al., 2016). The current results extend this finding by showing that intrinsic and competence motives for SFP use are positively related to enjoyment in 'an activity which is intended to upload on the platform'.

Enjoyment was also positively related to extrinsic motives. No hypothesis was set for this relationship due to opposing previous findings. However, in line with the *behavioural* response effort, in previous research the *affective* response enjoyment has also been positively linked to extrinsic motives, and particularly to introjected regulation (e.g., Garcia-Mas et al., 2010). This suggests that when athletes use Strava for obtaining approval on their performance from other athletes on the platform, they may get a sense of pleasure when they are actually involved in the attempt to (virtually) outperform others during their activities. In addition, the interaction effect indicates that this positive relationship between an extrinsic motive and enjoyment is significantly stronger for Strava users who 'allow that all Strava users can follow them'. This makes sense, as more followers provide a 'bigger pond' for obtaining the desired normative approval (e.g., via 'Kudo's') and subsequent enjoyment.

Relatedness

Similar as for the other responses, the bivariate correlations showed (see Table 2) that all motives and goals had a positive relationship with relatedness. However, when considering all motives and goals together, then only extrinsic and social motives appear to be the critical contributors to relatedness. The strong association between social motives and relatedness can be explained based on the 'matching hypothesis'. This hypothesis states that needs satisfaction, in this case 'relatedness', is more beneficial to individuals with a high corresponding motive, in this case 'social motives' (Schüler et al., 2013), and seems also applicable to this exercise context.

The strong positive relationship between extrinsic motives and relatedness was not expected and may signify the ongoing discussion about the nature and desirability of extrinsic motivation. For instance, Cooper (2013) has argued that it is problematic to distinguish between the intrinsic need for affiliation, and the extrinsic need for positive regard and admiration, as they both arise from the 'actualizing tendency' and the adaptiveness of each may depend on the context. Hence, Strava users with a predominant extrinsic motive may be occupied with obtaining positive regard from others, however, when this is perceived as 'genuine affiliation' from other users, this may result in feelings of relatedness. Hence, this finding suggests that in certain situations, people may experience greater well-being, for example by feelings of relatedness, via extrinsic motives as compared to intrinsic motives. Although, the need for relatedness may be satisfied via such controlled regulation, it is also a vulnerable form of regulation as it is considered to be contingency dependent (Deci & Ryan, 2000), for instance in this case, when not obtaining the desired normative approval on Strava.

Both extrinsic and social motives interacted with 'social exercise context' on relatedness. Both interactions revealed similar patterns and indicate that these motives and social exercise context have compensatory effects on relatedness. Specifically, for athletes with lower levels of extrinsic motives for using Strava (e.g., to show others how capable they are), exercising with more people together seems to contribute stronger to relatedness with other Strava users compared to athletes who exercise alone or mostly alone. However, when extrinsic motives gradually become stronger, then (i.e., beyond the crossing point $M = 2.50$) this positive relationship with relatedness is weakened by a situation in which athletes exercise together. This suggests that when the need for extrinsic rewards (e.g., normative approval) becomes too high it becomes more difficult to satisfy this need via the social environment in which they exercise compared to lower levels of extrinsic motives. For social motives we found a similar pattern, relatedness can be derived from exercising in a group (in line with Ehrlén, 2021, and Zeng et al., 2017) but this positive effect is weakened when social motives for using Strava (e.g., to feel more connected to other athletes) become stronger. In other words, particularly for athletes who typically exercise alone and have high extrinsic and/or social motives, the SFP may be more important in relatedness need fulfillment than for athletes who typically exercise in a group, for whom this need may be fulfilled to a greater extent by the experience of bonding with fellow athletes in the 'real life' exercise setting (e.g., Lovel et al., 2016).

Finally, the null-relationships for self-regulation and relatedness with intrinsic motives, and for enjoyment with social motives and task involvement, were not expected. However, in contrast to the regression analysis, bivariate correlations (Table 2) showed significant positive relationships between these variables. This indicates the value to examine motives and goals simultaneously as antecedents as it revealed the unique contribution (i.e., importance) of each in predicting the examined motivational responses (e.g., Sheldon et al., 2004).

Strengths, Limitations and Recommendations

The present study added to a better understanding of the motivational implications of exercising with use of an SFP. Compared to previous work (Rockman & Gewald, 2019; Stragier et al., 2016) this study examined this issue by measuring antecedents and consequences *both* on a situation-specific level of analysis, that is exercising with use of (and the intention to upload the activity on) an SFP. In addition, motives and goals were examined together (simultaneously) as antecedents which provided a more precise account of their unique relationships with the examined motivational responses (Sheldon et al., 2004). Moreover, this study was the first which examined whether Strava- and sport user features moderated relationships between motives, goals and motivational responses. By including both SFP and sport features it provided a more complete picture of these processes.

Despite these advantages there were also limitations of the current study. First, this study used a cross-sectional design. This method was deemed most appropriate in order to identify relationships at this exploratory stage of this study area. Though, the allocation of variables (antecedents, moderators, and consequences) and subsequent interpretations of relationships were purely based on conceptual grounds and inherently does not allow making causality claims. Future research may use longitudinal designs to examine these relationships over time and thereby establish support for the direction of causality.

Second, also the selection of variables was strongly based on the exploratory nature of the current study. As such, it was deemed important to select variables which have been shown previously to be influential on the quality of the sport and exercise experience. However, evidently, other variables need to be considered, and particularly variables which are also characteristic for SFPs. For example, 'self-quantification' may be a valuable moderator to consider in the examined relationships, particularly because this concept may be affected differently by motives and goals. For example, due to the controlling aspects of self-quantification it may undermine intrinsic and facilitate extrinsic motives, respectively (Etkin, 2016) and thereby also differently affect the relationship with motivational responses.

Third, due to the explicit focus on Strava, the current findings cannot be generalized to other SFPs. In addition, Strava is a male-dominated platform (Zeng et al., 2017), which is also reflected in the current sample. Hence, more research is needed to replicate and extend the current findings to a wider variety of SFPs and including more female athletes. Fourth, the used self-reports measures may have been vulnerable to social-desirability response bias; although it was sought to address this issue by securing participant's anonymity, the potential occurrence of this bias cannot be excluded (Podsakoff et al., 2003). Fifth, although the used questionnaires for capturing Strava- and sport features should not be particularly susceptible for recall bias (e.g., Strava features can be viewed in users' own profile), the current self-reports method could be combined with objective data provided by the platform (e.g., via 'Strava's Application Programming Interface (API); Zeng et al., 2017).

Practical Implications

Social fitness platforms like Strava may use the current findings to identify and promote adaptive motivational profiles for individual users. This can be accomplished by offering their users an assessment tool which helps them to create their own adaptive motivational profile of motives, goals and desired outcomes. Based on this profile, users can be offered an advice for using specific existing SFP features, which should then promote a motive and/or goal which helps them to obtain desired outcomes. For example, when this profile reveals a strong social motive for using SFP, the user can be informed that this motive could promote relatedness with other users. When such outcome is desired, users can be offered the suggestion to set the privacy settings as such that it 'allows that all (other) Strava users can follow him/her', but also the notice that relatedness can be obtained in an alternative way, i.e., via exercising in a group when using SFP. Hereby, users are offered a rationale for making their own choices in how to accomplish desired outcomes. In this way, SFPs can further contribute to identifying adaptive motivational patterns for exercising with use of SFP and help to improve the quality of the sport and exercise experience in this exercise context.

Conclusion

This study examined motivational patterns in the context of exercising with use of a social fitness platform. Specifically, it was examined how on a situation-specific level of exercising with Strava, user's motives and goals were related to their motivational responses self-regulation, effort, enjoyment and relatedness. In addition, this was the first study which examined whether Strava- and sport user features moderated these relationships. The results revealed context-specific relationships between motives, goals and motivational responses, and that user features played a moderating role in these relationships. Hereby, the findings of the current study indicate the value to examine achievement motivation specific to sport and exercise with use of a SFP, and that this knowledge can help to advance theoretical understanding and provide practical applications in order to facilitate adaptive achievement motivation in this exercise context.

Conflicts of interest. The author declares no conflict of interest.

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