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Awareness of Social Presence on Virtual Fitness Platforms and Relationship with Exercise Motivation and Physical Activity Levels

RESEARCH

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ABSTRACT

The health benefits of physical activity are well-known, however, only 20% of the U.S. population meets the Physical Activity Guidelines for Americans. This study aimed to explore the association of awareness of social presence in a virtual fitness platform with motivation and physical activity levels (PAL). Virtual fitness users (n = 590, 42 ± 12.7 years old) completed the International Physical Activity Questionnaire and Behavioral Regulation of Exercise Questionnaire. Relative autonomy was correlated with PAL (r = .21, p < .001, 95.00% CI = [.13, .29]) and predicted PAL (F(1,588) = 27.03, p < .001). Awareness of social presence was significantly related to motivation (U = 41864.5, z = −5.99, p < .001), and predictive of relative autonomy ($F(1,588) = 27.03$, $p < .001$). The results suggest that higher relative autonomy is associated with higher PAL in virtual fitness users. Awareness of social presence on virtual platform appears to correlate to higher levels of relative autonomy, which may influence exercise adherence.

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INTRODUCTION

The benefits of physical activity on physiological and mental health are well-known; however, nearly 80% of the American population fail to meet the Physical Activity Guidelines for Americans (Garber et al., 2011; Haskell et al., 2007). Physical inactivity is linked to an increased risk of morbidity and mortality from chronic diseases (Ahmad & Anderson, 2021; World Health, 2009). To reduce the risk of developing physical and mental illness, increasing motivation to exercise and reduce sedentary behavior is critical to long-term physical activity. The health and fitness industry capitalizes on strategies to initiate exercise participation, but various barriers and difficulties in sticking with an exercise program can lead to subsequent dropout. Despite efforts in the industry to reduce attrition, dropout rates suggest that over 63% of individuals will stop their exercise routine within three months of starting, and only 4% continue after 12 continuous months (Sperandei et al., 2016). Understanding the psychological determinants of physical activity can help to promote the long-term adoption of physical activity behaviors.

Virtual at-home exercise offerings have become increasing popular (Sharma & Singh, 2022). With the goal of reaching a wider audience, brick-and-mortar fitness facilities have added "on-demand" classes. Other companies have developed online platforms for cardiovascular training, strength training, boot camp, guided running, meditation, and yoga. At-home virtual exercise machines offer livestream classes, allowing users to feel in the room with the instructor and fellow participants—uniquely combining the motivational factors of group exercise or personal training with the convenience and autonomy of at-home virtual exercise.

The growth of technology introduced the opportunity for live-streamed group exercise classes. Previous literature suggests exercising in groups with the right coaching is beneficial versus exercising individually in improving intrinsic motivation, enjoyment, and adherence with decreased anxiety, stress, and depression (Burke et al., 2005; Kanamori et al., 2016; Pedersen et al., 2017; Yorks et al., 2017). In previous research, findings indicated individuals participating with a partner in exergames tended to have more motivation to exercise for a longer duration and higher intensity than alone (Anderson-Hanley et al., 2011; Samendinger et al., 2019; Snyder et al., 2012). While researchers have explored psychological factors associated with virtual reality fitness and virtual exergame interventions, there is little research on how virtual fitness classes relate to the user's exercise experience and propensity to engage and continue the exercise.

There is a growing collaboration between virtual fitness companies and behavioral science professionals to increase the rigor and evidence-based approach of these platforms (Sucala et al., 2021). When grounded in behavior change theory, mobile app interventions can influence physical activity behaviors (Fanning et al., 2012). Despite the widespread popularity of health and fitness apps, there often needs to be more behavioral modification techniques incorporated into an app experience. McKay et al. (2019) found 344 Australian mobile health apps were classified as facilitating behavior change however, they showed low-to-moderate functionality and a low-to-moderate number of behavior change techniques based on the Mobile App Rating Scale and App Behavior Change Scale. DeSmet et al. (2019) explored the preferences of 86 participants regarding behavior change strategies embedded in health and fitness apps. Researchers found that information on the health consequences of movement behaviors, self-monitoring of behavior, feedback on performance, insights into healthy lifestyles, and tips or instructions on completing the behavior were the most preferred (DeSmet et al., 2019). The individuals with lower levels of moderate-to-vigorous physical activity per day, measured by wearing a wearable fitness device, preferred having a virtual coach (DeSmet et al., 2019). The preference for a virtual coach in individuals who participate in low levels of physical activity presents an opportunity for the mode of virtual fitness discussed in the current research project and its potential to engage a higher percentage of the general population in regular physical activity.

Virtual platforms are designed to replicate the motivational factors of exercising with others in a variety of ways including participating live with others, high-fiving participants, connecting with others by posting images, and providing instructor shout-outs. Based on the Self-Determination Theory, connection is one of the primary drivers of long-term exercise adherence, indicating the potential importance of social connection via online networks in virtual fitness platforms (Deci & Ryan, 1985). Arigo and Suls (2018) discussed how virtual platforms connect users to improve

the social influence of behaviors and engagement through social support and accountability (Arigo & Suls, 2018). Utilizing social networking on social media platforms to create a sense of community during an exercise program can help improve exercise participation and adherence (Lee et al., 2020). Lee et al. (2020) found that individuals with the highest interaction on social platforms geared toward exercise had the highest sense of community, self-efficacy for exercise, and social support for exercise indicating a benefit of online social interaction that is a central part of virtual fitness.

Social support via online platforms offers advantages including a broad reach audience, immediate interaction, and anonymity while emulating the interpersonal support of face-to-face interactions (Petersen et al., 2019). Petersen et al. (2019) found that web-based social networking users engaged in pro-longed app usage and thus sustained physical activity while app-only users' engagement generally decreased over time. Apps encouraging users to utilize social media to communicate and share workouts can improve engagement and social support (Higgins, 2016). The social connection strategies found in specific platforms of virtual fitness may be a determining factor of engagement in the virtual program and subsequent exercise adherence.

How an individual experiences exercise through positive reinforcement in coaching, autonomous support, and social connections can predict their propensity to engage and persist in their exercise program. Virtual streaming classes create an opportunity for live coaching, real-time feedback, and social connections to invoke a supportive environment conducive to exercise intention and adherence. While in-person exercise experiences constitute most of the current literature, this study was designed to elucidate the association of awareness of social presence in a virtual fitness platform on motivation and physical activity levels.

METHODS

Participation criteria included adults between 18 and 75 years old residing in the United States and proficient in reading and writing in English. Participants were included if they were virtual exercise users utilizing any platform, including equipment-based, virtual fitness apps, and streaming fitness classes. Participants were expected to have reliable internet to use the virtual fitness platform and a device to complete the online survey. Social media groups were used for recruitment, including those connected to a company, specialty fitness groups targeting virtual training, and groups created to support brick-and-mortar for virtual training. Social media group administrators were contacted for permission to post the survey on private and public groups. Snowball sampling was also used to obtain a convenience sample through email outreach and reposting on social media. The weblink to the survey was posted on social media groups after obtaining permission to post from group administrators. Regular follow-up posts were made every two weeks until the survey was closed in December 2021.

The study was a cross-sectional, exploratory design with participants completing the survey once online on a computer, tablet, or personal cellphone. The survey included four sections in the following order: (1) opt-in/out, inclusion/exclusion criteria, (2) the International Physical Activity Questionnaire- Short Form, (3) the Behavioral Regulation of Exercise Questionnaire – 3, and (4) demographics and questions regarding awareness of social presence on the virtual fitness platform. All participants completed informed consent, and all study procedures were approved by the university institutional review board (Protocol #1785820-2). Data collection occurred between August and December 2021 to encompass different users and behaviors depending on the season.

The Behavioral Regulation of Exercise Questionnaire-3 (BREQ-3) was used to assess different subscales of motivational constructs including amotivation, external, introjected, identified, integrated, and intrinsic regulation (Markland & Tobin, 2004; Wilson et al., 2006). The questionnaire is based on the Self-Determination Theory in which motivation is assessed in the context of the psychological needs of autonomy, competence, and relatedness (Cid et al., 2018; Deci & Ryan, 1985, 2008; Ryan & Deci, 2000) A common survey instrument used in exercise and physical activity research, the BREQ-3 contains 24 items, four for each subscale, displayed in Table 1 (Teixeira et al., 2012). Sample items include: "I exercise because other people say I should" and "I value the benefits of exercise." Responses are on a 5-point scale ranging from 0 ("not true for me") to 4 ("very true for me"), and the relative autonomy index (RAI) was calculated.

REGULATION SCALE	ITEM NUMBER	ITEM
Amotivation	*2*	I don't see why I should have to exercise
	8	I can't see why I should bother exercising
	14	I don't see the point in exercising
	20	I think exercising is a waste of time
External Regulation	*6*	I exercise because other people say I should
	12	I take part in exercise because my friends/family/partner say I should
	18	I exercise because others will not be pleased with me if I don't
	24	I feel under pressure from my family/friends to exercise
Introjected Regulation*	*4*	I feel guilty when I don't exercise
	10	I feel ashamed when I miss an exercise session
	16	I feel like a failure when I haven't exercised in a while
	22	I would feel bad about myself if I was not making time to exercise
Identified Regulation	*1*	It's important to me to exercise regularly
	7	I value the benefits of exercise
	13	I think it is important to make the effort to exercise regularly
	19	I get restless if I don't exercise regularly
Integrated Regulation	*5*	I exercise because it is consistent with my life goals
	11	I consider exercise part of my identity
	17	I consider exercise a fundamental part of who I am
	23	I consider exercise consistent with my values
Intrinsic Regulation	*3*	I exercise because it's fun
	9	I enjoy my exercise sessions
	15	I find exercise a pleasurable activity
	21	I get pleasure and satisfaction from participating in exercise

Table 1 Behavioral Regulation of Exercise Questionnaire – 3.

Note: * Regulation stage is new to the BREQ-3.

The RAI was developed to provide an unbiased and efficient indicator of the overall level of motivation and represents the overall state of an individual's motivation (Sheldon et al., 2017). The RAI is a composite score of all the forms of behavioral regulation weighted according to their position on the SDT continuum. The calculation results in a single score representing the degree of relative autonomy. Mean values were calculated on the six behavioral regulation scales on the BREQ-3 (amotivation, external, introjected, identified, integrated, and intrinsic). The weighted total for Relative Autonomy Index (RAI) was calculated with the following formula: RAI = (intrinsic regulation *3) + (integrated regulation*2) + identified regulation – introjected regulation – (external regulation*2) – (amotivation*3). The RAI can provide an overall motivation score where a lower RAI score would indicate lower levels of autonomous motivation, and a higher score would indicate higher levels of autonomous motivation.

Physical activity levels were measured using the International Physical Activity Questionnaire – Short Form (IPAQ-SF). The IPAQ-SF is a seven-item questionnaire that assesses time participating in moderate physical activity, vigorous physical activity, and walking and sitting time in a seven-day recall format (Craig et al., 2003; Sylvia et al., 2014). A sample question includes, "During the last seven days, how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking." The IPAQ long and short forms have been translated and tested for reliability and validity in several languages and across countries and ages (Helmerhorst et al., 2012). Despite the criterion validity challenges of collecting self-reported physical activity patterns (Lee et al., 2011), the IPAQ-SF is the most feasible way to collect physical activity levels in a large population utilizing an online survey.

Participant responses were recorded as total weekly metabolic equivalent (MET) levels. All time duration data on IPAQ-SF for vigorous- and moderate-intensity physical activity, walking time, and sedentary time was converted to total minutes. Median MET, minutes per week, were calculated utilizing the following equations: Walking MET-minutes/week = 3.3 * walking minutes * walking frequency, Moderate MET-minutes/week = 4.0 * moderate-intensity activity minutes * moderate-intensity frequency, Vigorous MET-minutes/week = 8.0 * vigorous-intensity activity minutes * vigorous-intensity frequency, Total Weekly MET-minutes/week = sum of Walking + Moderate + Vigorous MET-minutes/week scores.

Data was collected on Qualtrics and exported to Excel. Responses under the age of 18, not proficient in reading and writing English, and international participants were removed. Following the guidelines of assessing the IPAQ-SF and BREQ-3, any incomplete submission was removed. All data analysis procedures were performed on Intellectus Statistics software (Daniel Island, SC). Pearson's bivariate correlation coefficients were calculated to examine the potential relationships between social presence and IPAQ-SF Median MET minutes and social presence and RAI on BREQ-3. Non-parametric Mann Whitney-U tests were performed to identify differences between those who identified the presence of others and those that did not sense the presence of others on the virtual platform. Multiple linear regression was performed to understand the predictive nature of awareness of social presence on IPAQ-SF and BREQ-3 responses. Interaction effects between BREQ-3 and IPAQ-SF responses were tested using an ANOVA. All statistical tests were set at a p-value < .05 for statistical significance.

RESULTS

A total of 803 responses were collected on the online survey. After incomplete responses, those participants outside of the United States, under the age of 18, and not proficient in English were removed, a sample of 590 virtual fitness users analyzed. Demographic data are provided in Table 2. The mean age was 42±12.70 years, consisting of 474 females, 114 males, and two who identified as non-binary. A total of 451 participants indicated, "Yes, there are other members taking the class virtually," and 139 responded, "No, I am not aware of other people in the class." RAI rating was an average of 15.82 (SD = 5.29, SEM = 0.22, Min = –9.50, Max = 23.75). Virtual fitness users showed high physical activity levels with an average total METs of 4,223 (SD = 2,492.82, SEM = 102.63, Min = 1,175.00, Max = 10,716.00).

VARIABLE	*n*	%
gender		
Female	474	80.34
Male	114	19.32
Nonbinary	2	0.34
social		
Yes, there are other members taking the class virtually.	451	76.44
No, I am not aware of other people in the class.	139	23.56
race		
Black or African American	35	5.93
White	465	78.81
Other	38	6.44
Asian	19	3.22
American Indian or Alaska Native	5	0.85
employment		
Working (paid employee)	396	67.12
Not working (looking for work)	16	2.71
Not working (other)	63	10.68

(Contd.)

VARIABLE	*n*	%
Not working (retired)	36	6.10
Working (self-employed)	61	10.34
Not working (disabled)	2	0.34
Not working (temporary layoff from a job)	5	0.85
Prefer not to answer	5	0.85
marital		
Separated	1	0.17
Single	155	26.27
Married	409	69.32
Divorced	17	2.88
education		
Professional degree (JD, MD)	52	8.81
Associate degree in college (2-year)	41	6.95
Some college but no degree	57	9.66
Doctoral degree	38	6.44
Master's degree	161	27.29
Bachelor's degree in college (4-year)	201	34.07
High school graduate (high school diploma or equivalent including GED)	38	6.44
ethnicity		
None of these	516	87.46
Yes (Hispanic)	67	11.36
income		
More than $200,000	214	36.27
$50,000 – $100,000	80	13.56
$100,000 – $200,000	192	32.54
Less than $25,000	31	5.25
$25,000 – $50,000	41	6.95

Table 2 Demographic Characteristics of the Sample.

Note: Missing and preferred not to answer responses removed.

A significant positive correlation was observed between the RAI and total METs, with a correlation of .21, indicating a small effect size ($p < .001$, 95.00% CI = [.13, .29]), see Figure 1. The results of the linear regression model were significant ($F(1,588) = 27.03$, $p < .001$) indicating that approximately 4.39% of the variance in relative autonomy is explainable by physical activity levels. Physical activity predicted motivation ($B = 0.0004$, $t(588) = 5.20$, $p < .001$), see Figure 2.

The result of the two-tailed Mann-Whitney U test exploring how awareness of social presence related to motivation was significant ($U = 41864.5$, $z = -5.99$, $p < .001$), displayed in Figure 3. The awareness of social presence group mean rank was 318.83 (Mdn = 17.50), and the mean rank for no awareness of social presence was 219.82 (Mdn = 14.25). The relationship between awareness of social presence and activity levels trended towards significance ($U = 34736.5$, $z = -1.93$, $p = .054$). The results of the linear regression model were significant between awareness of the social presence and relative autonomy ($F(1,588) = 48.12$, $p < .001$, $R2 = .08$), see Figure 4, indicating that approximately 7.56% of the variance in relative autonomy is explainable by social. The no awareness of social presence category significantly predicted relative autonomy ($B = -3.43$, $t(588) = -6.94$, $p < .001$). This sample suggested that moving from the "Yes, there are other members taking the class virtually" to "No, I am not aware of other people in the class" category will decrease the mean value of RAI by 3.43 units on average.

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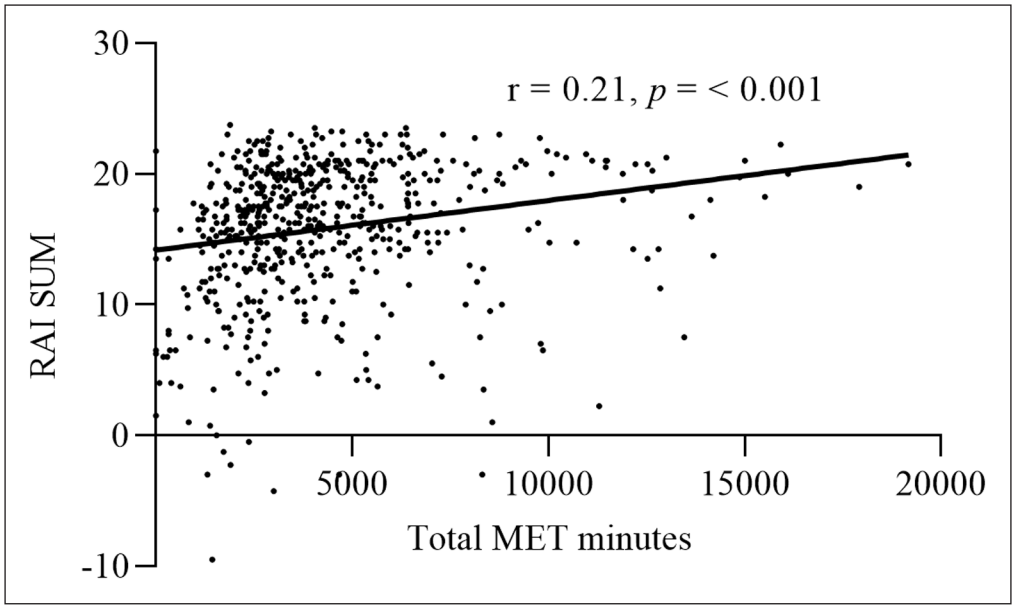

Figure 1 Correlation Between Relative Autonomy Index and Total Median MET minutes.

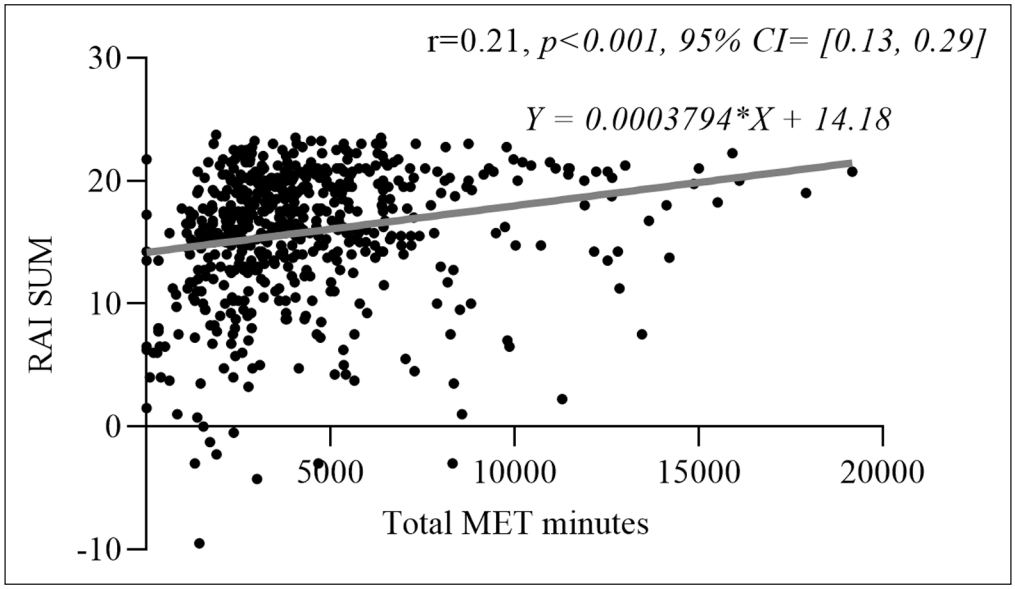

Figure 2 Predictive Relationship of Relative Autonomy Index and Total Median MET minutes.

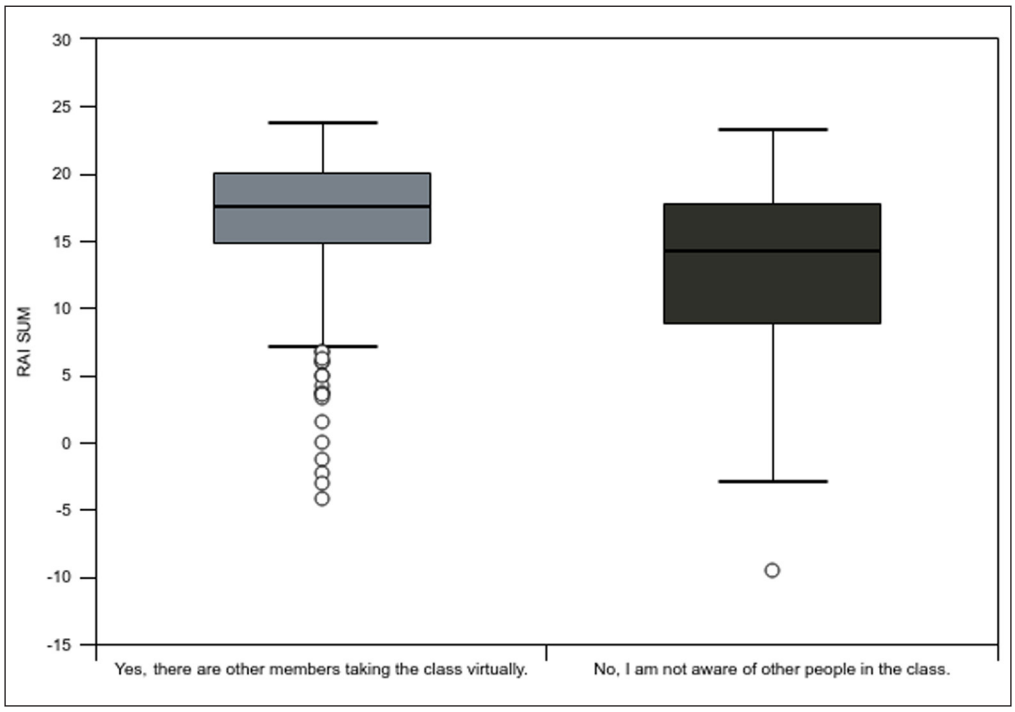

Figure 3 Mann Whitney-U Results of Relative Autonomy Based on Awareness of Social Presence.

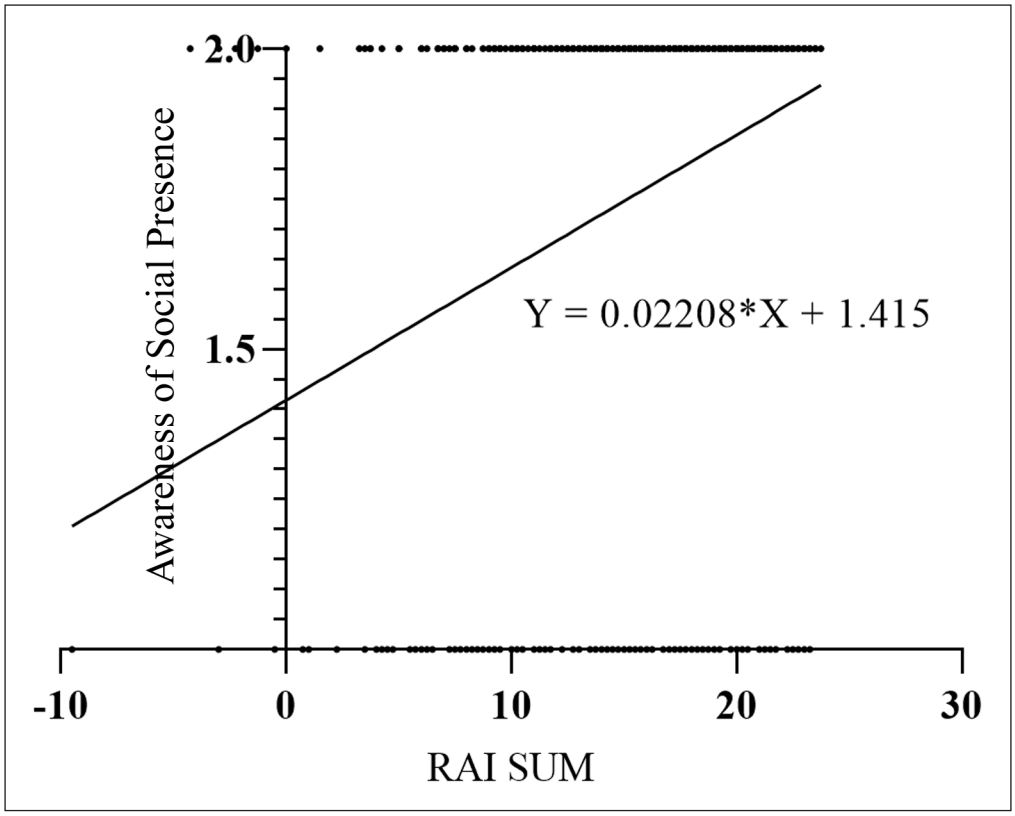

Figure 4 Predictive Relationship of Awareness of Social Presence and Relative Autonomy.

DISCUSSION

The current study was designed to elucidate the association of awareness of social presence in a virtual fitness platform on motivation and physical activity levels. The results indicated that virtual fitness users have high physical activity levels performing well above the recommended physical activity guidelines of 150 minutes of moderate physical activity or 75 minutes of vigorous activity designated by the American College of Sports Medicine (Garber et al., 2011). This finding is consistent with studies in virtual fitness users participating in high levels of moderate and vigorous physical activity when compared with non-virtual fitness users (Parker et al., 2021).

Participants indicating high physical activity levels also were determined to have higher relative autonomy and motivation. The correlation and regression analyses showed that the more exercise an individual performs, the more motivated they feel, and the more self-determined they are to perform the exercise. Previous research on the Self-Determination Theory of behavior change supports this relationship where in-person physical activity levels were dependent on feelings of autonomy, competence, and connectedness (Cid et al., 2018; Rodrigues et al., 2020). Few studies have been focused on relative autonomy and self-determination in virtual fitness users; however, Kaushal et al. (2022) identified behavior change fostering techniques such as goal monitoring, incentives (achievement badges), and relatedness. In previous research focused on virtual fitness platforms, relative autonomy and self-determined exercise have been shown to support and cultivate with the ability to customize workouts based on the type of exercise, time of day and duration, instructor and teaching style, music genre, and whether the workouts are live or on-demand (DeSmet et al., 2019; Sequi-Dominguez et al., 2020; Sucala et al., 2021). The virtual fitness platforms also provided ease of progress-tracking and accountability functions such as nudge notifications, which improve motivation and adherence in mobile health app users (Fukuoka et al., 2019; Gabbiadini & Greitemeyer, 2019; Lindgren et al., 2019). While much of the research in motivation on digital platforms is with mobile health apps, the increasing popularity of virtual fitness platforms that provide streaming services warrants further investigation built on the current findings.

The results from this study suggested that those aware of a social presence or others simultaneously taking the class had higher levels of relative autonomy based on their BREQ-3 responses. Additionally, the regression analysis suggested that if individuals removed the awareness of social presence, their relative autonomy would decrease. Social connection as

part of the Self-Determination Theory is well-established as a predictor of exercise participation and adherence (Deci & Ryan, 2012; Rodrigues et al., 2020). Virtual fitness workouts create a unique experience where participants are aware of other users in the class virtually at the same time. This awareness may mimic the positive environment created in group exercise, which may promote exercise motivation (Burke et al., 2005; Kanamori et al., 2016). Kaushal et al. (2022) saw similar results in social constructs in virtual exercise as a predictor for intention and habit of exercise.

Awareness of social presence in other types of virtual exercise, such as exergames and virtual racing, shows a propensity for higher efforts of physical activity and duration when engaged in competition with a virtual partner (Anderson-Hanley et al., 2011; Samendinger et al., 2019; Snyder et al., 2012). The findings in the current study indicated a higher level of physical activity when individuals are aware of others in the class; however, it did not reach statistical significance. Future research could look at the exploration of live versus on-demand classes and their effects on activity levels.

While investigations were conducted about physical activity patterns of virtual fitness users in Australia (Parker et al., 2021) and France (Marchant et al., 2021) during the Covid-19 pandemic, based on the literature reviewed, this is the first study exploring physical activity in this population in the United States. Several leading companies in the virtual fitness industry are owned and operated in the United States suggesting there may be higher accessibility levels and a wide variety of virtual fitness options. Future research can explore the different experiences of virtual fitness internationally and compare physical activity and motivational patterns across different platforms. The participants in the current study identified themselves as college-educated, white, employed, and in the highest household income bracket(s). Demographic data must be noted when translating these results to the general population. The general population may need more access to expensive virtual fitness equipment and experience other limitations and barriers to participating in virtual fitness in a diverse population. More research is needed to understand the experiences of virtual fitness in a diverse group of users and how this may affect public health strategies in increasing physical activity levels across the entire population in the United States.

The current study has its limitations. Self-reported physical activity are often inflated (Lee et al., 2011); therefore, an objective measure of activity may provide more accuracy and reduce inherent error. Sampling from social media outlets also poses response bias; participants of a social media outlet may already exhibit higher levels of motivation. Self-regulation of behavior is dynamic in nature, which would not be captured in a cross-sectional design. Social awareness and social interaction on virtual platforms have not yet been defined in the literature. This study measured awareness of social presence but did not include social interaction through virtual features, such as high-fives or cheers to others and the opportunity for direct engagement with instructors through shout-outs in livestream classes which may influence physical activity behaviors. Despite its limitations, the current study is unique in exploring an emerging form of exercise in virtual fitness and a population and behavioral determinants not studied before.

CONCLUSIONS

Based on the findings in this study, virtual fitness platforms can facilitate physical activity behaviors and build intrinsic motivation. Promoting social connection through awareness of social presence can provide meaningful differences in motivation, evident with those who took virtual classes with others and those who did not. New research should explore the environments created on virtual fitness platforms and their efficacy in changing physical activity behaviors. This line of research will be essential for health promotion efforts to improve exercise adherence and reduce the risk of developing co-morbidities associated with sedentary behavior.

COMPETING INTERESTS

The authors have no competing interests to declare.

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