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Research article

Psycho-Physiological Effects of Television Viewing During Exercise

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Abstract

We propose that enjoyment is an important factor in the adoption and long-term maintenance of exercise. Television (TV) viewing is believed to be a highly enjoyed leisure-time activity, combining it with exercise may make for a more enjoyable exercise experience. The objective of this study was to examine the effects of television (TV) viewing on psychological and physiological variables during a moderate-intensity exercise bout. Twenty-eight insufficiently active (<150 minutes per week of moderate intensity PA and/or 75 minutes of vigorous PA) adults (Age: M = 47.4 ± 7.6 years) participated in this study. Each participant performed three separate 30-minute walking bouts on a motorized treadmill. During each bout, participants watched a program they selected (30-minute scripted show) (self-selected TV condition), a British Broadcasting Corporation (BBC) nature program (standardized TV condition), or no TV program (no TV condition). Participants were unable to select the nature program as their self-selected program, as it was not a 30-minute scripted program. A Polar Heart Rate (HR) monitor and validated surveys on affect and enjoyment were used. Participants reported greater enjoyment of exercise for both self-selected and standardized TV conditions (97.1 ± 15.2 and 92.7 ± 15.2), compared to the No TV condition (77.5 ± 13.4, $p < 0.001$). The two TV conditions resulted in similar levels of focus on TV viewing (self-selected TV: 81.2 ± 19.7; standardized TV: 79.1 ± 14.2, $p > 0.05$) and dissociation from walking (self-selected TV: 38.1 ± 6.7 and standardized TV: 33.2 ± 3.9); they also resulted in more dissociation than the no TV condition (TV: 72.6 ± 5.6, $p = 0.002$). The findings indicate that TV viewing, regardless of whether the programming is self-selected or standardized, associates with greater enjoyment of exercise.

Key words: Enjoyment, dissociation, physical activity.

Introduction

Enjoyment is considered an important factor in the adoption and long-term maintenance of exercise and physical activity (PA) behaviors (Dishman et al., 1985). In a review of the determinants of PA, Trost, et al. (2002) reported that enjoyment of exercise showed a strong positive association with PA. A growing body of literature also suggests assessing core affective responses during exercise (pleasure vs. displeasure), as these responses are also related to continued exercise behavior and can inform appraisals of enjoyment. (Booth et al., 2000; Ekkekakis et al., 2013; Leslie et al., 1999; Williams et al., 2012b). This hypothesis is rooted in Hedonic Motivation Theory (HMT), which states that individuals will engage in activities they find pleasurable and avoid those they find unpleasurable (Higgins, 2006). Specifically, HMT purports that affective responses (e.g. pride, satisfaction, disappointment) to an activity drives future engagement in that activity (Higgins, 2006).

One plausible way of improving affective responses during exercise (and thus increasing perceived enjoyment) is through distraction. According to the Rejeski's (1985) parallel processing conceptualization theory, external and internal sources of information must compete for the individual's attention, since both cannot be processed simultaneously (Rejeski, 1985). When an individual is distracted by external cues, an accompanying change in mood is often linked to dissociation from internal cues (e.g. increased heart rate, fatigue) (Bigliassi et al., 2016; Lind et al., 2009). Thus, when external stimuli (potential distractors) and internal stimuli (e.g., monitoring of HR or breathing) are both present, the external stimuli must be cognitively salient for dissociation to occur (Pennebaker and Lightner, 1980). Recent research into the brain mechanisms occurring while listening to motivational audiovisual stimuli during exercise has illustrated the effect of the external stimuli on both low and high-frequency waves in the pre frontal cortex (Bigliassi et al., 2016). The authors found that in the presence of a motivational stimuli (sport scene from a movie) the electrical activity in the brain adjusted to decrease the sensation of fatigue in the working muscles. This alteration did not occur in the absence of the motivational stimuli. Thus, in order to improve exercise behavior, it is likely that the addition of distracting stimuli may be beneficial.

A strong body of literature indicates that music promotes dissociation from the internal cues of exercise, resulting in a more positive exercise experience (Karageorghis and Jones, 2014). Two comprehensive reviews (Karageorghis and Priest, 2012a; 2012b) have concluded that listening to music can increase enjoyment of exercise. The evidence shows evidence that both tempo and volume (Edworthy and Waring, 2006; Wilsont and Herbstein, 2003) can impact psychological and physiological responses to exercise to improve enjoyment. More recently, Hutchinson, Karageorghis and Jones (2014) found that exercising to both music-and-video elicited the highest levels of dissociation, lowest RPE, and most positive affective responses regardless of exercise intensity when compared to a music-only group and no music control group. Given this finding, it is reasonable to speculate that watching television during exercise, which combines visual and auditory stimuli, may have a similar impact on psycho-physiological responses to acute exer-

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cise.

The rationale for assessing the impact of TV watching on exercise responses is multifaceted. First, television viewing is rated as a highly enjoyable leisure-time activity (Epstein et al., 1995) Whereas previous studies have attempted to reduce screen time to be replaced with PA (Ramsey Buchanan et al., 2016) or use it as a reward for engaging in PA (Vaughn et al., 2013) neither approach would necessarily improve enjoyment of exercise itself. Second, combining the two behaviors may present the opportunity to remove a major barrier to PA (i.e. lack of time), considering that the average US adult watches approximately 20 hours of TV per week (U.S. Department of Labor and Bureau of Labor Statistics, 2013), Third, the results from two studies lend initial support for this approach, warranting the collection of additional empirical data (Overstreet et al., 2016; Privitera et al., 2014). Privitera, et al. (2014) reported that college students who exercised while viewing a pleasurable TV program had a significant increase in pleasant mood, compared to those who exercised while viewing an unpleasurable program or no TV program. However, the study has limitations. Mainly, that despite referring to their primary outcome as "mood" the authors actually assessed "affect" by using what is referred to as the Affect Grid (Russel et al., 1989) and these are distinct concepts. Additionally, the measurements were taken outside the time boundaries (pre and post) of the 10-minute exercise bout. Thus, these measurements might more accurately reflect the "rebound effect" (Bixby et al., 2001) indicating the scores are more representative of a positive experience *post* exercise and not during it. Overstreet et al. (2016) found that exercise was rated as more enjoyable when watching a nature documentary compared to a no-TV condition. In order to increase the applicability of these findings to a wider range of people and more varied program-type, it is important to determine whether this effect persists when allowing individuals to choose a program to watch (as they have the option to do in free-living situations). Recent research suggests that the content of the distraction impacts mood scores during exercise (Russell et al., 2003) (Privitera et al., 2014). If people watch a preferred TV program, it serves as an enjoyable distraction that could increase enjoyment of exercise and positive affect (Privitera et al., 2014).

Thus, the purpose of the current study was to examine the effects of TV viewing on both psychological (enjoyment, affect) and physiological (heart rate) variables. Adults (age 30-60) enrolled in the study completed three 30-minute bouts of moderate-intensity treadmill walking on separate days. Each session was randomly assigned one of three conditions: 1) watching a favorite 30-minute scripted television program of their choosing, 2) watching a 30-minute section of a nature documentary chosen by the investigators, and 3), a control condition, with no TV or external stimuli allowed during exercise.

Methods

Participants

Twenty-eight individuals participated in the study. Individuals were recruited by word of mouth, flyers placed on community bulletin boards, and email. The inclusion criteria were as follows: 30 to 60 years of age, body mass index between 18.5-44.0 $kg \cdot m^{-2}$, accumulating insufficient levels of PA (less than 150 minutes per week of moderate intensity PA and/or 75 minutes of vigorous PA) (Centers for Disease Control and Prevention (CDC), 2001) and able to perform 30 minutes of continuous moderate intensity exercise on a treadmill. Individuals who had contraindications to exercise, determined by administering a physical activity readiness questionnaire (PAR-Q) (Thomas et al., 1992), or an injury/physical limitation that rendered them unable to meet this requirement, were excluded. Potential participants were also asked to list their three favorite half-hour TV programs. If none of the programs were available (via Amazon Prime or Netflix.com) the participant was excluded from the study.

Experimental protocol

The participants attended four laboratory visits led by the same researcher. Informed consent was obtained in accordance with a study protocol approved by the university's institutional review board (IRB). Subsequently, individuals were enrolled in the study and were randomly assigned to perform condition one, two, or three for the first trial. During the first visit, height was measured to the nearest millimeter using a standard Seca stadiometer (Birmingham, United Kingdom), and weight was measured to the nearest 0.05 kilogram (kg) with a calibrated Health-o-meter digital scale (Boca Raton, Florida) (Table 1). Resting heart rate (HR) and blood pressure (BP) were measured after the participant had been seated at rest for five minutes. Participants completed a series of questionnaires designed to assess basic demographic characteristics and TV viewing habits.

Table 1. Participant characteristics.

Variables	n = 28 (82% female)
Age (y)	47.4 (7.6)
Weight (kg)	84.5 (17.8)
Height (cm)	168.3 (7.7)
BMI ($kg \cdot m^{-2}$)	30 (5.3)
Racial Group (%)	
White	89
Black	7
Other	0
Refuse	4
Hours Worked per Week (%)	
1 to 15	4
16 to 30	14
31 to 40	39
41 to 50	29
50 +	11
Hours Spent Watching TV per Week (%)	
Less than 10	46
10 to 20	21
21 to 30	18
31 to 40	11
41 +	4

Participants were instructed to arrive at the initial lab visit having not consumed any caffeine for six hours prior to their visit, and having not eaten or exercised for

three hours prior to their visit. Participants were asked to complete a submaximal exercise test on a treadmill. For the initial stage, the speed was set at 2.0 mph for three minutes. Speed was increased by 0.5 mph every three minutes, while HR and ratings of perceived exertion (RPE) (Borg, 1982) were recorded every minute. The exercise tests continued until the participants reached 85% of their age-predicted maximal HR. This was done in order to keep the test submaximal for participant safety. Via extrapolation of the HR data, we were able to estimate the participants' workload at their estimated maximal HR, and use that information to accurately set up individualized intensity settings for each participant that would keep them at a moderate exercise intensity (approximately 50% of their Heart Rate Reserve) according to the American College of Sports Medicine Guidelines for Exercise Testing and Prescription (ACSM, 2014). Previous works from Ekkekakis et al. (2005; 2008) has shown that the ventilatory threshold (VT) is often the intensity at which an individual switches from an external to an internal focus, and it is beyond this point that affective responses are typically negative During low-intensity exercise, individuals have an ability to focus their attention towards external cues, such as auditory and visual stimuli. Attentional focus on toward environmental distractions (e.g. TV) could then evoke a positive affective response (Bigliassi et al., 2016) Thus by keeping participants below that threshold we would better be able to identify the effect of TV viewing on measurements of their enjoyment and affect.

Procedures

Participants performed three 30-minute exercise bouts on the treadmill. They were fitted with a Polar HR T-31 monitor (Lake Success, NY) to measure HR. Throughout each of the exercise bouts, the treadmill speed (exercise intensity) was kept the same. The intensity was set at a rate that elicited approximately 50% of the estimated HRR, determined from the initial exercise testing session. Bouts occurred at the same time of day with a minimum of 48 hours separating each bout, and all bouts were completed within two weeks of one another. The order of bouts was determined using a balanced Latin square design with each participant serving as his/her own control.

Heart rate (HR) and ratings of perceived exertion (RPE) (Borg, 1982) were measured as indicators of exercise intensity. The Feeling Scale (FS) (Hardy CJ, 1989), was used to examine the affective valence of the bouts. These variables were assessed every 10 minutes throughout the test (10, 20, and 30 minutes). Following completion of the exercise bout, the participant immediately completed surveys to assess acute exercise enjoyment, and degree of focus directed to exercise and/or TV. The height and location of the TV remained the same throughout the trials, as did the TV volume. The testing was performed in a laboratory setting where temperature and ambient noises were controlled. All clocks were removed from the lab and participants were instructed to remove their watches. The investigator obscured the participants' view of the treadmill control panel so that they could see neither the walking speed nor the amount of time elapsed/remaining in the bout. For all three conditions, only essential communication between investigator and participant occurred, so as not to interfere with or impact the psychological and physiological variables being assessed.

Self-selected TV condition: During the prescreening process, participants listed their three favorite 30-minute scripted TV programs. If the program was unavailable on either Netflix or Amazon prime, the participant was excluded from the study. However, no one was excluded based on his or her TV program preference (Figure 1). Since these programs were viewed without commercials, and only lasted on average 22.5 minutes, a second episode of the same program was started and the participant was given the option of finishing the second episode after completing the post-exercise surveys.

Standardized TV condition: During the 30-minute exercise bout, all participants viewed the first 30 minutes of the BBC's program *Life* (Disc One, 2010*)*. The segment viewed was chosen as it was considered to be a relatively neutral nature program that was free of potentially upsetting (animal death) or polarizing topics (e.g. politics, sexism, racism) that could impact a participant's enjoyment levels. This same program has previously been used in a study where TV watching during treadmill exercise was used in an effort to reduce boredom (Unick et al., 2015). Additionally, this program was chosen in an effort

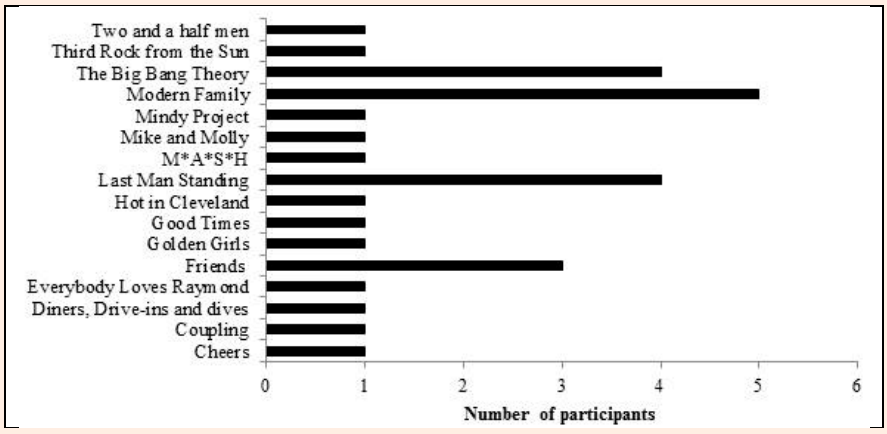

Figure 1. List of programs chosen by participants and number of participants who chose each program.

to avoid participants viewing something they might find aversive, thus negatively impacting their enjoyment scores. The exercise protocol was identical to that used during the self-selected TV condition.

No TV condition: This bout used the same exercise intensity and duration as the other bouts. However, no TV program or other forms of entertainment were available to the participants. For all three sessions, participants exercised at the same, individualized, imposed intensity (Approximately 50% of HRR).

Instruments

Feeling Scale (FS): This survey is used as a measure of core affect (i.e., pleasant versus unpleasant feelings) during the exercise bout. Participants responded to the question, "How do you feel right now?" using an 11-point scale ranging from −5 (very bad) to +5 (very good). The FS is a valid measure of exercise-related affect (Hardy CJ, 1989).

Rating of Perceived Exertion (RPE): Borg's RPE scale (6-20) was used to determine each participant's subjective rating of exertion at minutes 10, 20 and 30 of exercise (Borg, 1982).

Physical Activity Enjoyment Scale (PACES): Participants were asked to rate their enjoyment of the preceding PA bout, immediately after the walking bouts during each condition. The PACES consists of 18 items that are rated on a 7-point Likert scale with opposite descriptions at each end of the scale (1=I enjoyed it or It made me depressed, 7=I hated it or It made me happy) (Kendzierski and DeCarlo, 1991).

Visual Analogue Scales (VAS): The purpose of the VAS was to determine whether TV viewing served as a distraction from the walking bout itself (Wewers and Lowe, 1990). Participants were asked to assess, on three separate visual analogue scales (VAS): a) how much they liked the TV program they viewed, b) how focused they were on the program they viewed, and c) how focused they were on the exercise (walking bout) they just completed. The participants were instructed to indicate their answer by drawing a vertical line on the 100 mm horizontal line provided. Each VAS was anchored with "not at all" and "extremely." A VAS attempts to measure characteristics or attitudes that range across a continuum of values and are not easily measured by direct methods

Statistical analysis

All analyses were conducted using SPSS v.21 (Cary, NC). To determine enjoyment sores, a one-way repeated measures analysis of variance (ANOVA) was used to compare differences in PACES scores between the three conditions. In examining physiological, affective, and dissociation scores, a two-way repeated measures ANOVAs (condition x measurement time points) were performed on HR and RPE, FS rating, and VAS. A two-tailed t-test was used to analyze differences in "focus" between both TV condition VAS scores. All values were reported as mean ± standard deviation (SD) and Bonferroni corrections were run on all analysis. The significance level was set at $p < 0.05$. Effect size (ES) was calculated using Cohen's D.

Results

Demographics

Participants were primarily female (89%), 47.4 ± 4.6 years of age (mean ± SD), and had an average BMI of 30.0 ± 5.3 $kg \cdot m^{-2}$. Due to the small percentage of male participants, main analyses were completed within the sex-stratified samples. This yielded no significant changes in the results; therefore all participants were included together in the analysis reported herein. Most participants (99%) were employed, reported working 31 to 50 hours per week, with over 50% reporting watching more than 10 hours of TV per week (Table 1). There were no significant differences in average HR or RPE between conditions (Figure 2). RPE increased over time ($f(3,27) = 40.53$, $p < 0.001$) but did not differ between conditions ($f(3,27) = 2.28$, $p = 0.123$) (Figure 2).

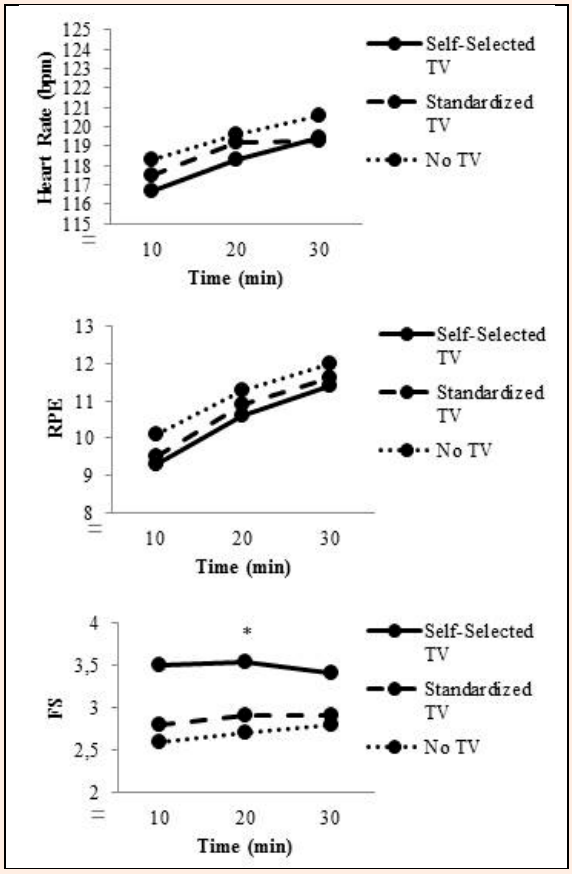

Figure 2. Average (± standard error) heart rate (HR, top), rating of perceived exertion (RPE, middle), and affect (FS, bottom) measurements at 10, 20 and 30 minutes of exercise for self-selected TV viewing, standardized TV viewing, and no-TV viewing conditions. * Mean affective response (FS) was significantly greater during the self-selected TV condition relative to the no TV control condition ($p < 0.05$)

Enjoyment of exercise was higher for both the self-selected and standardized TV conditions (97.1 ± 15.2, ES = 1.37) and (92.7 ± 15.2, ES = 1.06), compared to the no-

TV condition (77.5 ± 13.4, p < 0.001). Mean affective response (FS) was significantly greater during the self-selected TV condition relative to the no TV control condition (3.49 ± 0.17 vs. 2.7 ± 0.3, p = 0.025) (ES = 3.2) (Figure 2).

There were no significant differences in reported "focus" on the TV program between TV conditions, despite participants liking the self-selected program more than the standardized nature program (84.3 ± 2.1 vs. 67.2 ± 4.3, ES = 5.3, p = 0.001). Participants reported focusing more on the walking bout itself during the no TV condition (72.6 ± 5.6), as compared to the self-selected (38.1 ± 6.7, ES 5.6) and standardized TV conditions and (33.2 ±3.9, ES= 8.2) (p= 0.002).

Discussion

We hypothesized that participants would rate their enjoyment of exercise greatest when they were allowed to choose the television program. However, the primary finding of this study was that participants reported a greater level of exercise enjoyment when watching TV, regardless of the program, compared to a no TV condition. Additionally, affective responses were more positive during the self-selected TV condition vs. the no TV condition.

The result of the current study are similar to those of Overstreet et al. (2016). In both studies, TV viewing during moderate intensity exercise appears to improve ratings of exercise enjoyment compared to a no-TV condition. Interestingly, participants in the current study reported greater levels of enjoyment during the TV conditions (97.1 ± 15.2 and 92.7 ± 15.2 for self-selected and standardized TV, respectively) than those in Overstreet's study (87.0 ± 19.0 standardized condition) despite similar enjoyment rating during the no TV condition (77.5 ± 13.4 vs. 79.0 ± 16.0). This difference in enjoyment ratings could be due to the differences in the study population. College students may have different motivations to exercises (competition) or preference for a higher exercise intensity compared to adults, which might account for the overall difference in scores between the two studies. Differences might also be due to the exercise mode (walking in the current study vs. cycling in Overstreet's study). Specifically, walking is a more common activity than cycling, and there are locomotor reflexes that are activated in walking that enable participants to continue exercising with minimal input from higher brain centers, when they are distracted (Beck, 2011).

External factors can impact exercise enjoyment by serving as a distraction from internal cues (heart rate, breathing rate) and self-talk ("how long have I been exercising? How much longer do I have to go?). The parallel processing conceptualization theory of Rejeski et al. (1985) suggests that during exercise these external and internal cues compete for the individual's attention, with the most appealing cue ultimately winning out. Thus, we initially hypothesized that enjoyment scores during the self-selected TV condition would be greater than the standardized program, since participants chose their favorite program to view. However, the participants' reported "liking" of the TV program compared with their "focus" on the TV program does not support this hypothesis. It's important to note that we did not include a TV condition where the program was extremely unpleasurable.

Providing an external cue (TV) that increases enjoyment of exercise is a potential approach for improving exercise adherence. Brawley and Vallerand (1984) proposed that while extrinsic motivators can cause people to begin an exercise program, they eventually lead to reduced adherence and PA levels (mostly due to diminished feelings of enjoyment). This view is supported by the work of Wankel (1985), who argues that intrinsic motivation is the key factor in exercise adherence. Since enjoyment is strongly linked to intrinsic motivation, it is likely that interventions that succeed in increasing enjoyment of PA could lead to increased long-term adherence to PA (Wankel, 1985; 1993). Our findings suggest that watching TV improved affective experiences and exercise enjoyment, which could in turn lead to improved adherence over time. Williams, et al. (2008) demonstrated that the affect experienced during an acute bout of aerobic exercise predicted PA participation 6 and 12 months later. A subsequent study by the same group reported similar findings; with affect experienced during a 10-minute treadmill walk being associated with increased PA levels 6 and 12 months later (Williams et al., 2012a). The Tripartite Model of Exercise Prescription suggests exercise prescriptions should not focus only on improving health benefits and reducing injury risk, but also on reducing possible negative psychological effects, which in turn will promote motivation and adherence (Ekkekakis et al., 2011). Based on the results of this study it appears TV viewing is a possible avenue to control that negative affect.

There should be future exploration into the utility of TV viewing as a means of improving exercise and PA adherence. Previous research has shown that music can increase enjoyment of exercise (Karageorghis and Priest, 2012a; 2012b), yet there are limitations to its utility. People often listen to music while doing other activities, and is not typically a stand-alone sedentary activity. In other words, individuals are less likely to listen to music and do nothing else, as they often do with TV viewing. TV viewing consumes half of our leisure time (approximately 2.8 hours per day) (U.S. Department of Labor and Bureau of Labor Statistics, 2013). The negative effect of prolonged sedentary behavior on Americans' health has resulted in calls for increasing the number of interventions aimed at reducing TV watching (Keadle et al., 2015). However, although previous studies have attempted to reduce screen time (Maniccia et al., 2011; Raynor et al., 2013; Schmidt et al., 2012) an alternative, more effective approach, might be to repurpose screen time, as such an approach already shown to be effective at increasing not only exercise (Steeves et al., 2012) but exercise enjoyment (Overstreet et al., 2016; Steeves et al., 2016).

Strengths and limitations

There were several strengths within this study design. We used an identical exercise protocol for each condition as

well as the same research assistant collecting all data. Additionally, we allowed participants to self-select one of their favorite 30-minute TV programs. We also used a neutral TV program to reduce any potential gender, racial, or religious biases. The use of these two TV conditions along with a "no TV" control condition, allowed us to examine the effects to TV viewing on enjoyment, compared to a no TV condition.

A limitation of our study was that it did not seek to identify which precise component of the self-selected and standardized TV altered exercise enjoyment. TV programs contain different components (e.g. music, dialogue, laugh track, and video.) We did not separate out these various components and thus we could not determine what effect, if any, each one would have on overall enjoyment separately. Nevertheless, ecological validity is important and TV typically infuses imagery, dialogue, and music; thus, there is value in a study design that translates to real world settings. Another limitation of our study was that it restricted the types of programs participants could watch. The protocol specified 30 minutes of exercise, and thus participants were instructed to choose Netflix/Amazon Prime versions of their favorite TV shows that typically were 22.5 minutes in duration. As a result, this eliminated any one-hour programs and resulted in mainly sitcoms being selected. While it did not happen in our sample population, it is possible that an individual would end up liking the nature program more than their chosen program, reducing internal control of the experiment. Future studies may benefit from pre-emptively asking individuals to rate their perceived liking of the various shows.

Conclusion

This study found that TV viewing, regardless of whether the programming is self-selected or standardized, resulted in greater reported enjoyment of exercise. This may have occurred because TV viewing caused the participants to focus their attention more on the TV program, and less on the physiological demands of the exercise bout itself. Given the popularity of TV viewing in US adults, active TV viewing may be one approach to increasing PA. Many commercial fitness centers are already placing exercise equipment placed in front of TVs, and people are also doing this in their homes (Weed, 2010), but to date there has been limited research regarding the effects of this strategy on the psycho-physiological responses to exercise.

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Key points

- The use of TV viewing is a novel method of increasing enjoyment of exercise.
- TV viewing resulted in greater reported enjoyment of moderate intensity exercise among insufficiently active adults.
- More positive affect scores were reported when participants viewed their preferred TV program compared to a no TV control.

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