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The experimental effect of social media use, treadmill walking, studying, and a control condition on positive and negative affect in college students

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Abstract
Using a within-subjects design, this study assessed the experimental effect of common activities upon positive and negative affect scores in a college student sample. All participants completed the following 30-minute activity conditions: treadmill walking, self-selected schoolwork (i.e., studying), social media use, and a control condition where participants sat in a quiet room (i.e., do nothing). Positive and negative affect scores were assessed at baseline, mid-, and post-condition. Positive affect scores increased by 26% and 10% during the treadmill and studying conditions, respectively. Conversely, positive affect decreased by 20% and 24% during the social media and "do nothing" conditions, respectively. Furthermore, negative affect was decreased by 8% in the studying condition. These changes were statistically significant ($p \leq 0.04$). This suggests that college students' everyday activities can significantly impact affect, for better and for worse. As demonstrated, studying and walking may improve affect, whereas social media use may negatively impact affect.

Keywords PANAS · Mood · Mental health · Social media · Exercise · Homework · Smartphone

Introduction

There is evidence that the ongoing COVID-19 global pandemic has negatively impacted college student's mental health (Wang et al., 2020). Furthermore, it is possible that the negative mental health consequences of the pandemic will persist for years to come (Browning et al., 2021). Yet even before the pandemic, research documented increases in college students' anxiety, depression, suicidal ideation and correspondingly, mental health services utilization (Holm-Hadulla & Koutsoukou-Argyraki, 2015; Lipson et al., 2019). In short, universities may be facing a mental health crisis for which they are potentially not well prepared (Leshner, 2021). Traditional university mental health services focus on treating acute episodes of poor mental health. Such services should be paired with complementary approaches focused on developing and maintaining good mental health (Leshner, 2021). Thus, it may be helpful to identify behaviors that cause positive emotional states while buffering against negative emotional states. Such behaviors could form the basis of future campus-wide mental health interventions and/or recommendations (Pressman et al., 2019). Towards this end, this paper presents a study which examined the influence of college students' everyday behaviors on positive and negative affect.

Briefly, positive and negative affect are distinct emotional states, rather than opposite ends of the same emotional spectrum. Positive affect is characterized by enthusiasm, energy, and pleasurable engagement. Low positive affect is then characterized by melancholy, lethargy, and disengagement. In contrast, negative affect is a distressing state characterized by anger, irritation, disgust, and fear. Low negative affect is then a state of calmness and peacefulness (Watson et al., 1988). Positive and negative affect have been of increasing interest to researchers because of growing evidence connecting these emotional states with a number of important health outcomes (Levine et al., 2021; Pressman et al., 2019). Of additional interest to college educators and administrators is

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research linking positive and negative affect with academic outcomes (Huang, 2021; Pekrun, 2006; Pekrun et al., 2009). Given this research, there is a need to better understand how widespread, everyday behaviors might influence affect in college students' daily lives.

Positive affect can be experienced when an individual engages in activities that are challenging and require skill (Csikszentmihalyi, 1975). Contributing factors include clear goals, feedback concerning progress towards goals, and intrinsic motivation (Csikszentmihalyi, 1990). In support of this, research shows that college students experience significantly greater positive affect when engaging in challenging activities that require skill than when participating in less challenging activities that require little or no skill (Rogatko, 2009). Pekrun extended these ideas, noting that activities can vary by perceived value (i.e., intrinsic or extrinsic) as well as by a match between challenge and skill (Pekrun, 2006). Different combinations of perceived value and challenge can produce different emotional states. For example, negative affect becomes more likely during activities of low intrinsic value characterized by a mismatch between challenge and skill, whereas positive affect becomes more likely during activities of high value and a match of challenge and skill.

Using these insights (Csikszentmihalyi, 1975; Pekrun, 2006) to inform our understanding, the present study examined the causal effect of four different behaviors on positive and negative affect in college students. The four behaviors examined were walking, studying, using social media, and "doing nothing." These behaviors were selected because, according to time diary studies and survey research, these are common activities that most college students engage in on a regular daily basis (Chin et al., 2017; Hanson et al., 2010; Reis et al., 2008). This is the first study to examine and compare the causal effect of these everyday behaviors on positive and negative affect under controlled conditions.

However, previous research, utilizing non-experimental techniques, has identified relationships between these activities and affect. This research has been largely cross-sectional and longitudinal. Research examining the relationship between exercise and affect has concluded that as exercise intensity increases so does the likelihood of experiencing positive affect (Pasco et al., 2011). Systematic reviews of this research found significant relationships between physical activity and positive affect but no relationship with negative affect (Reed & Ones, 2006; Wiese et al., 2018). Interestingly, a recent study suggested that positive affect associated with exercise persists even during stressful life events, such as the current COVID 19 pandemic (Maher et al., 2021). In a study of college students' daily activities most likely to match challenge with skill, exercise and studying were the two most frequently identified activities. For students who identified exercise or studying, researchers found that an hour of these activities was predictive of a significant increase in positive affect (Rogatko, 2009). Social media use has also been associated with affect and related constructs. Various meta-analyses and reviews have found small but significant negative relationships between social media use and subjective well-being and self-esteem; and small but significant positive associations between social media use and depressive symptoms, body dissatisfaction, and distress (Huang, 2021; Ivie et al., 2020; Keles et al., 2020). Research has also examined social media use and immediate emotional state. In a series of three studies, researchers determined that social media use was associated with a decline in positive affect. Furthermore, this decline was explained by the tendency of subjects to mistakenly overvalue the benefits of social media use. In other words, the subjectively determined value of the activity was less than expected and this dampened affect (Sagioglou & Greitemeyer, 2014). Finally, research has identified "doing nothing" as a commonly reported activity and not surprisingly, this activity is associated with boredom (Chin et al., 2017). Boredom, when thought of as disengagement, is likely an indicator of reduced positive affect (Watson et al., 1988).

Using a within-subjects experimental design (i.e., each participant was exposed to each condition), our study built upon this previous research by experimentally assessing the impact of these behaviors on positive and negative affect in a controlled laboratory setting. We asked: what is the effect of 30 min of studying, walking, social media use, and doing nothing on positive affect and negative affect? The match of challenge and skill, as well as perceived value, are important to understanding how an activity is experienced (Csikszentmihalyi, 1975; Pekrun, 2006). Given these insights, coupled with the results of previous research, we offer the following hypotheses:

1. Thirty minutes of studying self-selected schoolwork should be appropriately challenging and intrinsically rewarding (i.e., high value). Previous research has connected studying with positive affect but not negative affect (Rogatko, 2009). In the studying condition, we hypothesized that positive affect would increase, and negative affect would be unchanged.
2. Thirty minutes of continuous walking may present a mild challenge and it does have widely valued health benefits. Exercise of various intensities has been linked with positive affect but not negative affect (Reed & Ones, 2006; Wiese et al., 2018). In the walking condition, we hypothesized that positive affect would increase, and negative affect would be unchanged.
3. Thirty minutes of social media use may provide some benefits; however, research suggests that users may

overestimate the value of this activity as this activity is not very challenging (Sagioglou & Greitemeyer, 2014). Additionally, it has been linked to several negative psychological outcomes (Huang, 2021). In the social media condition, we hypothesized that positive affect would decrease, and negative affect would increase.

4. Thirty minutes of doing nothing is likely to be perceived as low challenge and of little value. Additionally, students may feel frustrated at being required to do nothing for 30 min as part of this study. In the do nothing condition, we hypothesized that positive affect would decrease and negative affect would increase.

As identified by Pressman, Jenkins and Moskowitz, there is a particular need to understand the behavioral causes of positive and negative affect (Pressman et al., 2019). Knowledge gained from this study could be useful in developing interventions and/or recommendations aimed at improving college students' mental health.

Method

Participants

The study utilized a within-subjects design and a convenience sample of 40 college students ($n = 24$ females, $n = 16$ males, age 21.7 ± 2.0 years) who each participated in four, separate 30-minute conditions (*social media use, walking on a treadmill, studying, control*). The order of the conditions was randomized across participants and each condition was completed on separate days. Participants were recruited from courses taught by research personnel and offered extra credit for their participation. Participants were screened for any contraindications (e.g., orthopedic injury) to participating in physical activity and none were identified. All participants provided written informed consent prior to enrollment in the study and all procedures were approved by the Kent State University Institutional Review Board (approval #15–616).

Procedures

Each participant reported to a private laboratory in the Exercise Science department on four separate occasions to complete the 30-minute conditions (*social media use, walking on a treadmill, studying, control*) in a random order. These conditions were all completed during weekdays (Monday-Friday) and working hours (9am-5pm). Apart from periods of data collection, participants completed all conditions in the room by themselves while research personnel supervised via closed-circuit television. Participants were made aware that they were being monitored. The closed-circuit monitoring allowed researchers to observe whether or not participants were completing the conditions as instructed. No participants deviated from the provided instructions for each condition and all participants completed all four conditions.

During the *walking on a treadmill* condition there was a treadmill (Quinton MedTrack CR60, Bothell, WA) in the laboratory. Twenty-four hours prior to this condition, participants were notified that they would be engaging in moderate-intensity physical activity and they should dress accordingly (e.g., proper footwear). During this condition participants walked at 3.1 miles/hour at a grade of zero for 30 min. This is considered a typical walking speed (Ainsworth et al., 2000). Prior to the condition, participants were instructed not to alter the speed or grade of the treadmill and they could ask any questions they may have had. Finally, participants were not allowed to bring anything into the laboratory with them.

During the other three conditions the treadmill was removed and replaced with a desk and a chair. During the *social media use* condition, participants were read the following script: "For the next 30 min you will be required to remain seated and pass the time using your smartphone to access any social media platform of your choosing. You may switch between as many or as few as you would like in the provided time period. Use the social media as you would normally, you are not required to post on any site. You must stay on social media for the entire time period. Please do not listen to music, earbuds and headphones are not allowed in this condition." Participants were then allowed to ask questions prior to initiating the 30-minute *social media use* condition.

Twenty-four hours prior to the *studying* condition participants were instructed to bring materials with them then to the laboratory so they could participate in schoolwork. They were instructed to only bring materials (e.g., textbooks, homework) that did not require internet use and smartphones were not allowed. Participants were instructed to remain seated and participate in schoolwork of their choosing for 30-minutes. They were allowed to ask questions prior to beginning the condition.

For the *control* condition participants were instructed to remain seated in the chair for 30 min and to "do nothing." They were not allowed to bring anything (e.g., smartphone, books, pen and paper) with them into the room. They were allowed to ask questions before initiating the condition.

At the beginning of each condition (T1), students were assessed for positive affect and negative affect using the Positive and Negative Affect Scale (PANAS) (Watson et al., 1988). Each condition was briefly paused and PANAS was reassessed after 15 min (T2). Finally, PANAS was assessed

Table 1 Repeated measures ANOVA with post hoc analysis demonstrating effect of time on positive affect for each condition (N = 40)

Condition	Time	Mean*	Std. Dev.	df+	F	Sig.	partial η^2
Control	1	19.8	7.8		24.2	$p < 0.001$	
	2	15.0[a]	5.3	(2, 80)			0.38
	3	14.9 [a]	5.8				
Treadmill	1	21.8	8.4		13.5	$p < 0.001$	
	2	24.8 [a]	8.6	(2, 80)			0.26
	3	27.4 [ab]	9.9				
Studying	1	21.8	7.7		3.5	$p = 0.048$	
	2	24.2 [a]	7.8	(2, 80)			0.08
	3	23.0	8.2				
Social media	1	21.5	8.1		12.4	$p < 0.001$	
	2	18.3 [a]	6.4	(2, 80)			0.23
	3	17.2 [ab]	6.7				

a = significantly different from corresponding value at baseline ($p \leq 0.05$)

b = Significantly different from corresponding value at 15 min ($p \leq 0.05$)

* Mean positive affect scores could range from 10 to 50 (Watson et al., 1988)

+ (between groups, within groups)

at the conclusion of each 30 min condition (T3). The scale consisted of 10 items assessing positive affect and 10 items assessing negative affect. We used the instructions suggested by the original scale developers to assess affect in the moment. Thus, instructions asked participants to indicate how they "feel right now, that is, at the present moment" (Watson et al., 1988). Participants then indicated the extent to which the items in the scale described their feelings using a five-point likert scale ranging from 1 = "very slightly or not at all" to "extremely." The ten items assessing positive affect were: interested, excited, strong, enthusiastic, proud, alert, inspired, determined, attentive, and active. Within this sample, these items demonstrated good internal reliability ($\alpha = 0.88$). The ten items assessing negative affect were: distressed, upset, guilty, scared, hostile, irritable, ashamed, nervous, jittery, and afraid. Within this sample, these items demonstrated good internal reliability ($\alpha = 0.70$).

Analytic plan

Four condition (*social media use, walking on a treadmill, studying, control*) by three time point (0, 15, 30 min), two-way repeated-measure analyses of variance (ANOVAs) were used to examine differences in both the positive and negative affect scale scores. Across the many cells in the study, some data were normally distributed and some were not. ANOVA has proven to be a robust analytic approach under such circumstances (Blanca et al., 2017). Additionally, Mauchly's Test of Sphericity indicated that the assumption of sphericity had not been met ($\chi 2 \geq 28.8$, $p \leq 0.001$). Therefore, the Greenhouse-Geisser correction was used to calculate a more conservative comparison of means at each time point for each condition. Significant main effects of condition from the initial two-way ANOVAs were teased apart via paired samples t-tests. There were no significant main effects of time in the initial two-way ANOVAs. Significant condition by time interactions were post hoc tested using a planned comparisons approach as we had specific hypotheses for each condition (Castañeda et al., 1993). To that end, we performed one-way ANOVAs to assess changes across time in positive and negative affect scores in each condition separately. For any significant main effects of time in these post-hoc ANOVAs, paired samples t-tests were then utilized to compare changes across time points. All p values for post-hoc analyses were adjusted using the Benjamini and Hochberg False Discovery Rate correction (Benjamini & Hochberg, 1995). Finally, if two or more conditions influenced affect, the influence was compared. A comparison was made by calculating change scores in affect from 0 to 15 and then from 0 to 30 min for the conditions of interest. The change scores were then compared using paired samples t-test to determine if changes in affect were different. Data were analyzed using SPSS version 26 (SPSS Incorporated, Chicago, IL).

Results

Positive affect

The condition by time two-way repeated measures ANOVA revealed a significant interaction ($F(6, 234) = 19.5$, $p < 0.001$, partial $\eta^2 = 0.33$) for positive affect scores. The interaction was teased apart with subsequent one-way ANOVAs (see Table 1; Fig. 1), The first one-way ANOVA found a significant main effect of time for the control condition. In this condition, positive affect scores were significantly lower at 15 ($t = 5.8$, $p < 0.001$) and 30 ($t = 4.6$, $p < 0.001$) minutes,

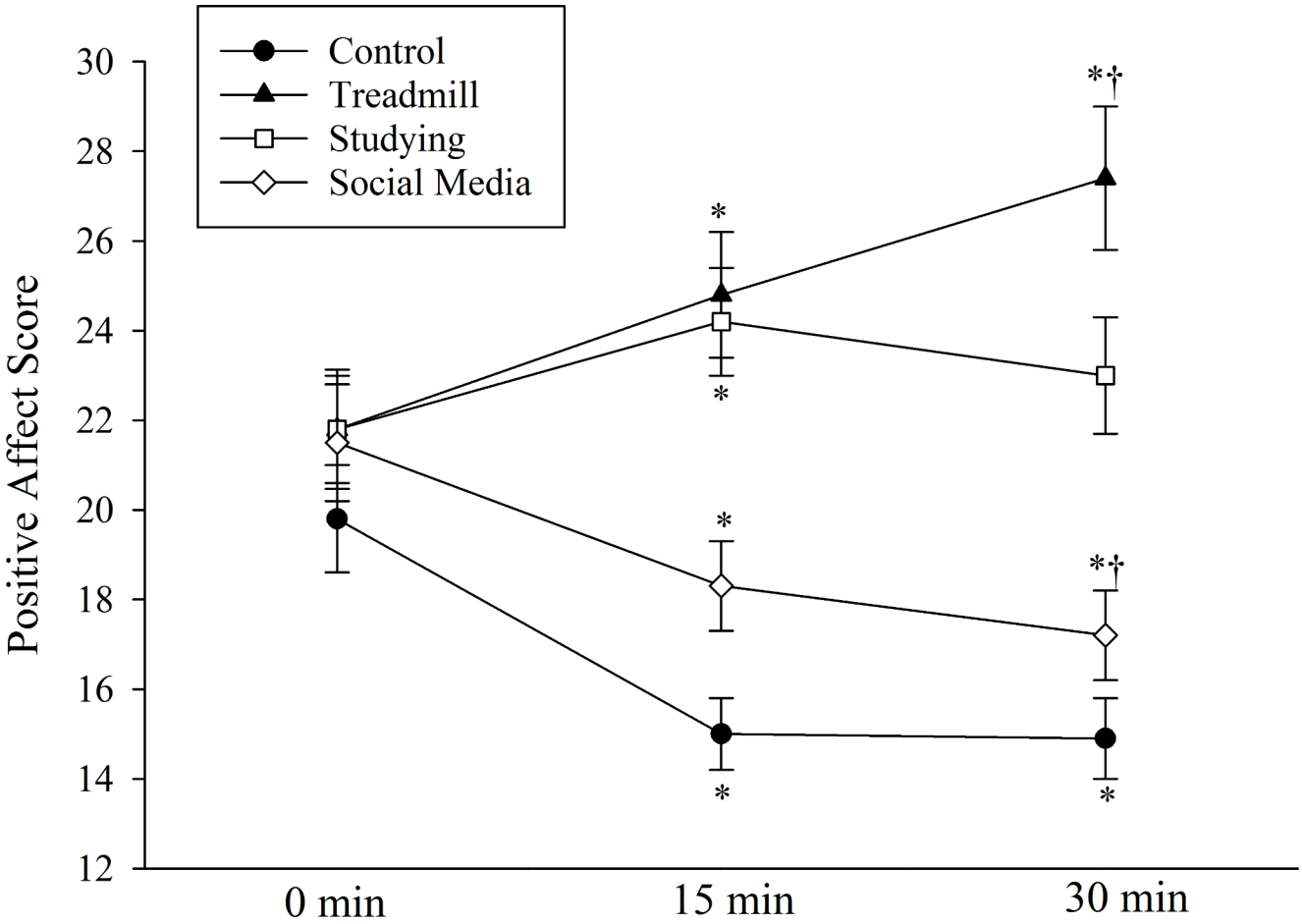

Fig. 1 Illustrates the significant ($p < 0.001$) condition (control, studying, treadmill, social media) by time (0 min, 15 min, 30 min) interaction for positive affect scores. *Significantly different score than the corresponding baseline value. †Significantly different score from the corresponding 15 min value. ($p < 0.05$ for all)

relative to baseline. There was no difference ($t = 0.4, p = 0.73$) between the 15 and 30-minute time points. There was a significant main effect of time for the treadmill condition. In this condition, positive affect scores significantly increased from baseline to 15 ($t = 2.7$, $p = 0.01$) minutes and again from 15 to 30 ($t = 3.9$, $p < 0.001$) minutes. There was also a significant main effect of time for the studying condition. This was due to a significant increase ($t = 2.6$, $p = 0.045$) in positive affect from baseline to 15 min. There were no additional differences ($t \leq 1.7, p \geq 0.15$) across time points during the studying condition. There was also a significant main effect of time for the social media condition. In this condition, positive affect scores significantly decreased from baseline to 15 ($t = 3.4$, $p = 0.003$) minutes and again from 15 to 30 ($t = 2.2$, $p = 0.04$) minutes. Finally, the beneficial changes in positive affect caused by the treadmill and studying conditions were compared. From time point 0 to 15 min, the treadmill condition caused a change in mean positive affect score of 3.0 (SD = 7.0) and the studying condition caused a change of 2.3 (SD = 5.7). These changes were not significantly different from each other (t = 0.49, p = 0.63). However, from time point 0 to 30 min, the treadmill condition caused a change in mean positive affect score of 5.6 (SD = 8.5) and the studying condition caused a change of 1.3 (SD = 6.7). These changes were significantly different from each other (t = 2.6, p = 0.014).

In addition to the significant interaction described above there was also a significant main effect of condition (F(3, 117) = 21.8, p < 0.001, partial $\eta^2 = 0.36$) in the condition by time ANOVA examining positive affect scores. Average positive affect scores were significantly lower in the control condition (M = 16.7, SD = 5.6) than the treadmill condition (M = 24.7, SD = 8.1; t = 6.9, p < 0.001), the studying condition (M = 22.9, SD = 7.3; t = 6.1, p < 0.001), and the social media condition (M = 19.0, SD = 6.3; t = 2.9, p = 0.007). Positive affect was also significantly lower in the social media condition relative to the treadmill ($t = 4.8$, $p < 0.001$) and studying conditions ($t = 3.5$, $p = 0.002$). The treadmill and studying conditions were not different ($t = 1.3$, $p = 0.20$) from one another.

Table 2 Repeated measures ANOVA with post hoc analysis demonstrating effect of time on negative affect for each condition (N = 40)

Condition	Time	Mean*	Std. Dev.	df+	F	Sig.	partial η^2
Control	1	12.6	3.6		2.7	$p = 0.09$	
	2	13.8	4.0	(2, 80)			0.066
	3	13.7	4.1				
Treadmill	1	12.3	3.6		1.5	$p = 0.23$	
	2	11.5	2.2	(2, 80)			0.037
	3	11.8	2.7				
Studying	1	13.4	3.3		5.6	$p = 0.013$	
	2	12.3[a]	3.8	(2, 80)			0.12
	3	12.5[a]	4.1				
Social media	1	12.5	3.3		0.11	$p = 0.84$	
	2	12.3	2.6	(2, 80)			0.003
	3	12.4	2.6				

a = significantly different from corresponding value at baseline ($p \leq 0.05$)

* Mean negative affect scores could range from 10 to 50 (Watson et al., 1988)

+ (between groups, within groups)

Lastly, in the condition by time ANOVA there was not a significant main effect of time ($F(2, 80) = 0.90$, $p = 0.40$, partial $\eta^2 = 0.02$) for differences in positive affect score.

Negative affect

The condition by time two-way repeated measures ANOVA revealed a significant interaction ($F(6, 234) = 3.1$, $p = 0.019$, partial $\eta^2 = 0.073$) for negative affect scores. In the subsequent one-way ANOVAs (see Table 2; Fig. 2), there was a significant main effect of time for the studying condition only. Participants reported significant reductions in negative affect at the 15 ($t = 2.7$, $p = 0.03$) and 30-minute ($t = 2.2$, $p = 0.05$) time points relative to baseline. There was no significant difference ($t = 0.7$, $p = 0.49$) between the 15 and 30-minute time points. There was not a main effect of time for any of the remaining conditions.

In addition to the interaction, the condition by time ANOVA also revealed a significant main effect of condition ($F(3, 117) = 3.0$, $p = 0.04$, partial $\eta^2 = 0.072$) for negative affect scores. This effect was due to a significantly lower ($t = 2.8$, $p = 0.042$) average negative affect score in the treadmill condition ($M = 11.9$, $SD = 2.4$) relative to the control condition ($M = 13.4$, $SD = 3.3$). There were no other differences ($t \leq 1.9$, $p \geq 0.18$) across conditions (studying $M = 12.7$, $SD = 3.9$; social media $M = 12.4$, $SD = 2.3$). There was not a significant main effect of time ($F(2, 80) = 0.40$, $p = 0.67$, partial $\eta^2 = 0.01$).

Discussion

This was the first study that we are aware of to experimentally compare the effects of social media use, treadmill walking, studying, and a control condition (i.e., doing nothing) on positive and negative affect. Relative to baseline, social media use caused a 15% reduction in positive affect after 15 min and a 20% reduction after 30 min. This was similar to the 24% reduction seen in the control condition. Conversely, relative to baseline, positive affect increased by 14% after 15 min and 26% after 30 min during the treadmill condition. Positive affect also increased by as much as 10% during the studying condition. While both caused an improvement in positive affect, treadmill use in comparison to studying caused a significantly greater change over the 30 min experimental condition. Furthermore, average positive affect scores across time points in the social media condition were 17% and 23% lower than the studying and treadmill conditions, respectively. Regarding negative affect, relative to baseline, participants reported significant reductions of 7–8% during the studying condition only. Average negative affect scores across time points during the treadmill condition were 11% percent lower than the control conditions. Taken together, these results demonstrated that walking on a treadmill and studying can cause a significant increase in positive affect. Also, social media use can cause a significant decrease in positive affect. Except for studying, the effect of these activities on negative affect over time was negligible.

Complementing these results, prior work from our group experimentally compared the impact of these same conditions upon three measures of state boredom: disengagement, inattention, and altered perception of time (Barkley & Lepp, 2021). In that prior work, studying decreased all measures of boredom and walking on a treadmill prevented against an increase in disengagement. Conversely, social media use and the "do nothing" control significantly increased all measures of boredom. Given that positive affect is characterized by "full concentration and pleasant engagement" (Watson et al., 1988) these previous findings support our present

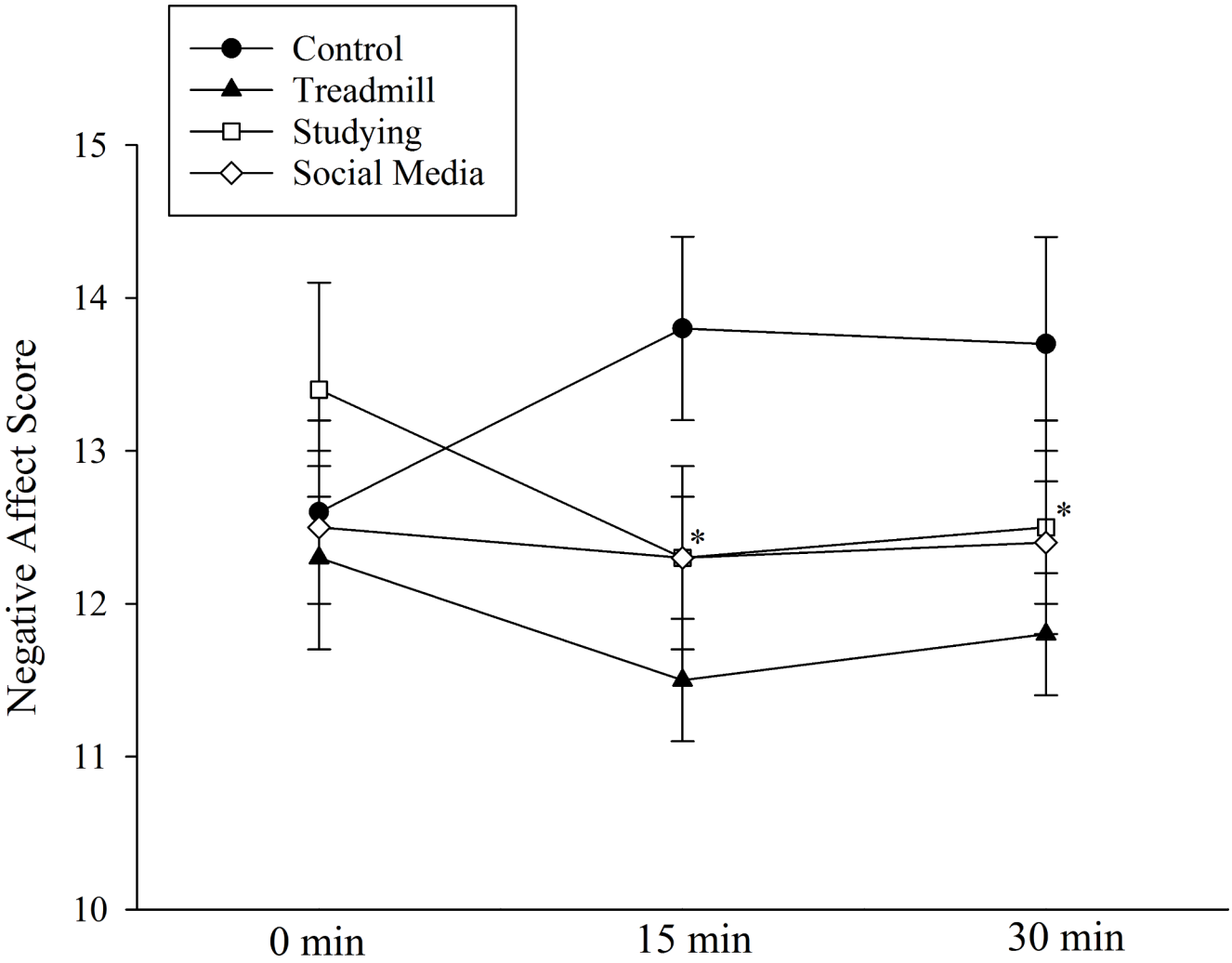

Fig. 2 Illustrates the significant ($p = 0.019$) condition (control, studying, treadmill, social media) by time (0 min, 15 min, 30 min) interaction for negative affect scores. *Significantly different score than the corresponding baseline value for the studying condition only. ($p < 0.05$ for all)

findings. Specifically, an increase in positive affect should correspond with a decrease in boredom, particularly the disengagement dimension of boredom. We see that when comparing the present study to Barkley & Lepp (2021). Similarly, a decrease in positive affect should correspond with an increase in boredom, particularly the disengagement dimension. Again, we see that when comparing our two studies.

The work of Csikszentmihalyi (1975) and Pekrun (2006) offers a reasonable explanation of these results. Accordingly, it may be that participants found studying and treadmill walking to be intrinsically meaningful activities that adequately matched challenge and skill. Previous research examining college students' perceptions of daily activities found that studying and exercise were the most likely of all daily activities examined to match challenge and skill; furthermore, regular participation in these activities was associated with positive affect (Rogatko, 2009). Activities which match challenge and skill absorb attention, focus it on the task at hand, and allow for feelings of competence as progress towards completing the challenge is recognized. As described by Csikszentmihalyi (1975), this seems to be a recipe for meaningful and enjoyable engagement characterized by positive affect. This may explain why exercise and studying produced positive affect and reduced or prevented against disengagement in our studies. In contrast, activities which are not challenging are associated with disengagement, decreased positive affect, and boredom (Lepp, Li & Barkley, 2017). In our study, participants may not have been challenged by social media use. Additionally, and as suggested by Sagioglou and Greitemeyer (2014), participants in our study may have overestimated the value of social media use. If so, the mismatch of challenge and skill coupled with low value may explain why social media use decreased positive affect and increased boredom in our experimental studies.

While our hypotheses regarding positive affect were supported, our hypotheses regarding negative affect were not entirely supported. Negative affect is characterized by unpleasant and even aversive mood states such as anger, hostility, fear, and nervousness. None of the activities investigated here caused an increase in negative affect, although we hypothesized that social media use and also "doing nothing" would do so. Triggering negative affect with social media use may depend on very specific social media uses, such as engaging in political debate or unique social comparisons such as body image (Barfar, 2019; Saiphoo & Vahedi, 2019). In alignment with previous research, walking did not increase or decrease negative affect over time (Wiese et al., 2018). Studying, however, did cause a significant decrease in negative affect over the 30-minute condition. This is a novel finding. Perhaps this is because at baseline, students were a bit anxious at the prospect of studying for thirty minutes during their free time yet their fears were allayed as they made progress towards their study goals, hence the reductions in negative affect. It should be noted that negative affect was low at baseline for each condition, including studying. An interesting question for future research regarding negative affect is "how effective are different activities at reducing negative affect once it is being experienced?" Such a study would need to first elicit negative affect and then experimentally assess the efficacy of different activities at reducing it. However, our present results suggest that the daily activities examined herein influence positive affect to a much greater degree than negative affect.

These findings may have implications for college student health and well-being. Two comprehensive reviews have recently summarized the research investigating associations between positive affect and health (Levine et al., 2021; Pressman et al., 2019). These reviews connect positive affect to an increased likelihood of adhering to important health behaviors such as healthy eating, regular exercise, and sufficient sleep. High positive affect scores are also associated with improved immune system functioning. These reviews also suggest that positive affect may buffer unhealthy stress and lower stress hormone levels. As such, positive affect has been linked to improved cardiovascular function and reduced risk of cardiovascular disease. Additionally, positive affect is predictive of academic achievement (Huang, 2021; Pekrun et al., 2009). This would provide yet another potential pathway for positive affect to interact with college student well-being (Lepp et al., 2014). This would suggest that promoting activities which increase positive affect (e.g., studying, walking) and decrease negative affect (e.g., studying) while discouraging activities that may decrease positive affect (e.g., social media, doing noting) may serve as effective aspects of university-based interventions and/or recommendations designed to support students' psychological and physical health. As advocated by Leshner (2021) writing in the journal Science, universities must do a better job promoting student health and well-being. Indeed, this is a key tenet of universities' obligation to develop the whole student.

To this end, our study suggests that simple everyday activities can have significant effects on positive affect and, to a lesser extent, negative affect. It should be recognized that students' daily habits and routines matter. Activities which can increase positive affect and/or decrease negative affect should be promoted. Additionally, students should learn temperance with regards to activities that can potentially decrease positive affect. Education and deliberate reflection may be necessary to help students realize what kinds of activities are likely to produce positive affect. Generally speaking, these are intrinsically meaningful activities that match challenge and skill. Understanding this, students might better appreciate the potential for self-selected studying (i.e., learning) to increase positive affect. Likewise, they might better appreciate how simple activities that present little challenge like social media use might lower positive affect. Especially when such activities consume multiple hours of a student's day, as smartphone use and social media use presently do (Lepp et al., 2014, 2017). Certainly, most students understand the value of exercise. Our study was enlightening in that it demonstrated that even mild exercise in an empty room can increase positive affect. It is reasonable to conclude that the benefits of walking outside would be even greater (Miller & Krizan, 2016). Generally speaking, interventions promoting regular physical activity of any intensity should be encouraged (Miller & Krizan, 2016; Wiese et al., 2018). Especially as sedentary behavior is on the rise among college students (Barkley & Lepp, 2016). As such interventions are developed, it will be important to determine how regular fluctuations in positive affect influence depressive symptoms, anxiety and overall health and well-being. This is an area for future research.

This is the first study we are aware of to assess the effects of these different conditions upon positive and negative affect; however, it is not without limitations. While the focus of the study was upon college students, we only examined a small convenience sample of this population from a single university. This limits our ability to generalize these results. Additionally, all conditions were conducted in a controlled laboratory environment. Results may be different if these conditions were completed in a free-living environment (e.g., campus fitness centers, libraries) with fewer controls (e.g., using smartphones for activities other than social media). Also, we did not attempt to control for differences in the enjoyment of each condition across participants. However, the study used a within-subjects design to assess differences in positive and negative affect across these conditions

and time points. Therefore, each participant sets their own baseline score which is then compared to subsequent scores. Still, we acknowledge the fact that we did not control for potential participant differences in the enjoyment of the four conditions as a limitation. Additionally, participants were provided 24-hour notification of their condition for only the treadmill and studying conditions. While this was done for practical reasons (e.g., to ensure that participants brought schoolwork for the studying condition) it may have been advisable to provide these notifications for all four conditions to be consistent and eliminate the potential differential impact such notifications or a lack thereof may have had across conditions. Also, our study was designed to identify the effect of condition on positive and negative affect. We used the insights of Csikszentmihalyi (1975) and Pekrun (2006) to explain that effect. We acknowledge that complementary or competing explanations may exist. Identifying the precise mechanism behind the effect identified here requires additional research. Finally, negative affect scores were low at baseline thus limiting the ability of any condition to reduce these values. Subsequent research that creates a negative affectual state and then subsequently attempts to reduce it via the activities used herein (e.g., studying, walking) may be warranted.

Conclusion

In conclusion, the current study utilized a within-subjects experimental design which allowed for a comparison of the effects of each activity as well as determinations about causality. Results demonstrated that social media use for 30 min caused a significant decrease in positive affect. This was similar to the "do nothing" control condition. In contrast, walking on a treadmill and studying for 30 min both caused a significant increase in positive affect. Furthermore, studying significantly reduced negative affect scores. These findings support and add causal evidence of the impact of these behaviors upon affect to the existing literature which has typically relied upon cross-sectional and longitudinal research designs. Based upon our current experimental results, coupled with the existing nonexperimental findings, it is possible that doing schoolwork and taking a brief walk during a college student's free time may promote positive mood states, while social media use may have the opposite effect. Given the important link between affective state and health it is our recommendation that college students be encouraged to critically reflect on the intrinsic value of studying, physical activity, and social media use as well as the time they regularly allocate to each activity. It may be that consistently incorporating bouts of studying and physical activity into their daily routine, while minimizing social media use, will improve mood - especially when faced with the choice of otherwise doing nothing.

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Conflict of interest The authors have no conflicts of interest to declare that are relevant to the content of this article.Data availability All data available upon request.

Code availability N/A.

Declarations

Ethics approval All procedures were approved by the authors' University Institutional Review Board.

Informed consent All participants provided written informed consent prior to enrollment in the study.

Ethics in publishing This manuscript has not been submitted to, nor is under review at, another journal or other publishing venue.

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