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The Impact of Cell Phone Functions on the Intensity and Liking of Bike Exercise

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Abstract

This study assessed the effect of cell phone use (e.g., texting, talking, and listening to music) during 30-minute bouts of bike exercise and its affects on intensity (e.g., heart rate and ratings of perceived exertion) and liking (e.g., enjoyment). Thirty college-age students participated in four, separate, 30-minute exercise conditions (texting, talking, music, and control) on a bike in a randomized order. Heart rate was significantly ($t \leq 4.54$, $p \leq 0.004$) higher when comparing the music (147.58 ± 4.19 beats·min^{-1}) to the texting (117.79 ± 3.42 beats·min^{-1}) and talking (122.89 ± 3.89 beats·min^{-1}) conditions. Ratings of perceived exertion was significantly ($t = 2.1$, $p = 0.05$) higher when comparing the texting (11.4 ± 0.45) to the control (10.06 ± 0.52) condition. Liking was significantly ($t = 3.85$, $p = 0.01$) higher when comparing the talking (7.64 ± 0.63) to the control (6.2 ± 0.71) condition. Liking was also significantly ($t = 3.09$, $p = 0.01$) higher when comparing the music (8.27 ± 0.38) to the control condition. In conclusion, using your cell phone for texting and talking instead of listening to music can interfere with bike exercise, resulting in reduced exercise intensity and enjoyment, and perceiving exercise to be more difficult than what it really is.

Keywords: Aerobic Exercise, Bike Exercise, Cell Phone, Heart Rate, Ratings of Perceived Exertion, Enjoyment.

INTRODUCTION

In today's society cell phones have become part of our everyday lives. In 2020, it was reported that there are 3.8 billion people worldwide who own a cell phone [1]. While it has become a huge part of our society, it has also continued to become more addictive during our everyday activities. People use it while driving, out at restaurants, before bed, and many other activities [2]. This excessive cell phone use takes free time away from many people, as they end up consumed in their cell phone. On average cell phone users spend more than three and a half hours every day on their phone [3]. However, this doesn't stop while in the gym as one might expect. When one enters the gym it is now common practice to see gym-goers using their cell phones while on aerobic equipment (e.g., treadmill, bike, elliptical) and even while utilizing resistance training equipment (e.g., free weights, machines) while in-between sets. While cell phone use could be dangerous while exercising [4], it could also possibly affect the intensity and liking of exercise which can impact the effectiveness of the exercise session [5, 6].

A few studies [5, 6] have already assessed how cell phone use effects treadmill exercise, which is considered the most common mode of aerobic exercise accounting for approximately 44.4% [7]. In a study conducted by Rebold and colleagues [5], 45 college-aged students were required to engage in four different 30-minute bouts of exercise on the treadmill. The four bouts consisted of: texting on a cell phone (*texting*), talking on a cell phone (*talking*), using a cell phone to listen to music (*music*), and no cell phone use (*control*) [5]. Findings from this study showed that using a cell phone for listening to *music* resulted in significant increases in the intensity (speed and heart rate) and liking of a bout of treadmill exercise when compared to *texting*, *talking*, and *control* conditions [5]. According to the researchers, other cell phone functions (*texting* and *talking*) have the potential to interfere with treadmill exercise and result in engaging in lower intensity exercise, which over time can result in minimal health and fitness benefits [5].

Another study conducted by Rebold and colleagues [6] assessed cell phone use and how it affected the time spent exercising at different intensities while on a treadmill. According to the American College of Sports Medicine (ACSM), all healthy adults aged 18-65 years old should engage in moderate (65-75% heart

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rate max)-vigorous (76-96% heart rate max) intensity exercise to have significant health benefits [7]. For this study, thirty-two college-aged students were required to engage in two different conditions (*cell phone* [for texting purposes only] and *control* [no cell phone present]). It was found that engagement in vigorous intensity exercise was significantly greater in the *control* condition when compared to the *cell phone* condition, and engagement in low intensity exercise was significantly greater in the *cell phone* condition when compared to the *control* condition [6]. This study [6], like Rebold and colleagues' [5] previously mentioned study also concluded that using your cell phone can negatively affect the intensity of exercise and over time result in minimal health and fitness benefits.

Cell phone use (e.g., texting and talking) has been shown in several recent studies to have a negative impact on treadmill exercise [5, 6]. However, to the best of our knowledge there is no research that has investigated the effects cell phone use (e.g., texting, talking, and listening to music) and its affects on bike exercise. Investigating the effects of cell phone use on bike exercise was the next logical step since bike exercise is another popular mode of aerobic exercise (accounting for approximately 31.5%) due to its low-impact and multi-tasking capabilities (e.g., watching television, talking on the cell phone) while exercising on it [7]. Therefore, the purpose of this study was to assess the effects of cell phone use on a bout of 30-minutes of bike exercise. This study utilized a between-subjects design to compare the intensity (average heart rate and ratings of perceived exertion [RPE]) and enjoyment (i.e., liking) of 30-minute bouts of self-selected bike exercise during the following conditions: texting on a cell phone (*texting*), talking on a cell phone (*talking*), using a cell phone to listen to music (*music*), and no cell phone use (*control*). The following hypotheses were made: the *music* condition would result in greater heart rate and liking; the *texting* condition would result in greater RPE; and the *control* condition would result in lower liking.

METHODS

Participants

Thirty college-aged students (*n* = 14 males, *n* = 16 females, age 21 ± 0.2 years, Table 1) each participated in four, separate, 30-minute aerobic conditions (*texting*, *talking*, *music*, and *control*) on a bike on separate days. The order of the four conditions on the bike was randomized. Participants were excluded if they did not own a cell phone or if they had any contraindications to exercise (i.e., orthopedic injuries). One-week prior to participation in the study participants were instructed on the benefits and risks, to refrain from strenuous exercise at least twenty-four hours prior to their visit, and to also refrain from caffeinated related-substances (e.g., drinks, foods, supplements) at least two-hours prior to their visit, completed medical history forms, and signed an informed consent form. This study was approved by the Hiram College Institutional Review Board.

Table 1: Average height, weight, and age of the participants.

	Males (*n* = 14)	Females (*n* = 16)
Height (cm)	176.68±3.78 cm*	163.32±1.37 cm
Weight (kg)	87.38±4.51 kg*	60.7±1.08 kg
Age (years)	21.22±0.32 years	20.8±0.25 years

All data are means ± SD
*males significantly greater than females for height and weight
$p < 0.05$ for all

Protocol

For each of the four conditions (*texting*, *talking*, *music*, and *control*) the participants reported to the fitness center located in the Coleman Center at Hiram College. The procedures for this study that will be explained below were similar to the procedures that Rebold and colleagues [5] implemented when investigating the impact of cell phone use on the intensity and liking of treadmill exercise. This study was designed this way so that findings from this study could also be compared to findings from that previous study [5]. Prior to initiating each 30-minute condition, participants were familiarized with the bike (Precor c846i, Seattle, Washington, USA) and research personnel placed an RPE scale over the display screen on the bike. This was done so the participants could not see the time elapsed, distance, or calories burned which could have influenced how they performed. Participants were instructed that they could alter their pedal rate (i.e., RPM) at any time during the 30-minute session. In other words, if participants wished to increase or decrease their pedal rate at any point, they were free to do so as often as they wished. It was necessary to allow participants to alter their pedal rate as assessing the effect of cell phone use on bike performance was a primary purpose of this study. Participants were also instructed not to change the resistance setting during the 30-minute session. This was to ensure that the same muscle groups were being recruited and utilized from all participants during each condition. Lastly, before being allowed to engage in the 30-minute session, participants were informed which condition (*texting*, *talking*, *music*, or *control*) they would be engaging in for that day. These procedures were repeated for all four conditions (*texting*, *talking*, *music*, and *control*).

Heart rate was measured every five-minutes through the use of a Polar H10 Heart Rate Monitor (Polar, Kempele, Findland) and the Polar Beat App (Kempele, Findland). Average heart rate was reported in beats•min^{-1}. Ratings of perceived exertion was also assessed every 5-minutes by having participants look at the 6-20 Borg Rating of Perceived Exertion Scale [8] on the display screen on the bike while being asked how they felt. Immediately at the end of each condition, participants liking was assessed by having them simply place a mark on a 10 cm visual analog scale (VAS), which had "do not like it at all" on the left-hand side and "like it very much" on the right-hand side [9].

Control Condition

During the *control* condition, participants were instructed to leave their cell phone and other electronic devices in their bag or the locker room. If they were wearing an Apple watch they were instructed to turn off all notifications. In addition, all televisions were turned off. Participants engaged in the bout of aerobic exercise in a distraction-free room with no access to any electronic devices nor interactions with other individuals. Research personnel did not interact with participants except only to record heart rate every five-minutes and then record liking and RPE at the end of the 30-minute session.

Music Condition

During the *music* condition, participants were instructed that they could only use their cell phone to listen to music. They were also instructed to turn off notifications from all other apps. Research personnel allowed participants to self-select the type of music they wanted to listen to. Research personnel allowed participants to self-select the type of music they wanted to listen to because it was believed that if participants were "forced" to listen to a specific type of music this could have possibly affected their liking (i.e., enjoyment) in a negative way due to them possibly not liking that specific type of music [10, 11, 12].

Texting and Talking Conditions

During the *texting* and *talking* conditions, participants were instructed that they could only use their cell phone for texting or talking purposes only. They were also instructed to turn off notifications from all other apps except for texting-related notifications during the *texting* condition and talking-related notifications during the *talking* condition. During the entirety of the *texting* and *talking* conditions, research

personnel were texting or talking to participants to simulate a texting or talking conversation. The texting and talking prompt consisted of having participants reflect on the following topics: movies, songs, food, places to go on vacation, college school classes, hobbies, and favorite things to do with friends. Responses to these questions were not recorded as these responses were considered inconsequential to the purpose of this study.

Statistical Analysis

All data were analyzed with SPSS version 20.0 (SPSS Incorporated, Chicago, IL) with an a-priori α level of ≤ 0.05. Males and females physical characteristics (height, weight, age) were compared using independent samples-t-tests. Because there were no hypotheses based upon sex, it was not included as an independent variable in all subsequent analysis of variance (ANOVA) models. Four condition (*texting*, *talking*, *music*, *control*) repeated-measures ANOVAs were utilized to examine differences in average heart rate, average RPE, and liking. Post-hoc analyses for all significant main effects were completed using paired samples t-tests with the Benjamini and Hochberg False Discovery Rate correction [13].

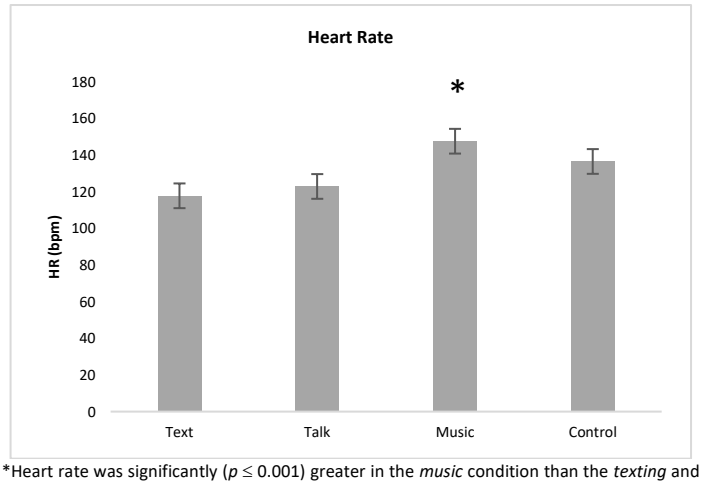
RESULTS

Physical characteristics

Independent samples-t-tests revealed significant differences in males and females physical characteristics for height and weight (Table 1).

Heart Rate

There was a significant ($F = 18.56$, $p \leq 0.001$) main effect of condition for heart rate. Heart rate was significantly ($t \leq 4.54$, $p \leq 0.004$) greater when comparing the *music* (147.58 ± 4.19 beats·min^{-1}) to the *texting* (117.79 ± 3.42 beats·min^{-1}) and *talking* (122.89 ± 3.89 beats·min^{-1}) conditions. Heart rate from the *texting* to the *music* condition increased by 25.29%. Heart rate from the *talking* to the *music* condition increased by 20.09%. Heart rate was not significantly ($t = 1.98$, $p = 0.06$) different between the *music* and *control* (136.53 ± 3.73 beats·min^{-1}) conditions. Heart rate was not significantly ($t \leq 1.94$, $p \leq 0.06$) different between any of the other conditions.

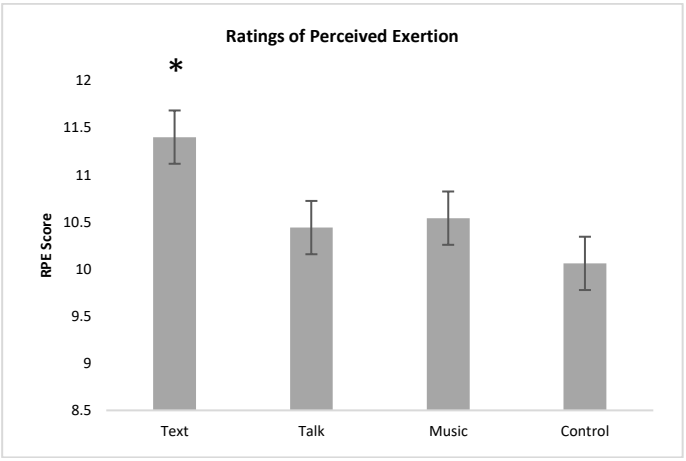


*Heart rate was significantly ($p \leq 0.001$) greater in the *music* condition than the *texting* and *talking* conditions.

Figure 1: Heart rate between the *texting*, *talking*, *music*, and *control* conditions.

RPE

There was a significant ($F = 2.46$, $p = 0.04$) main effect of condition for RPE. Ratings of perceived exertion was significantly ($t = 2.1$, $p = 0.05$) greater when comparing the *texting* (11.4 ± 0.45) to the *control* (10.06 ± 0.52) condition. Ratings of perceived exertion from the *control* to the *texting* condition increased by 13.32%. Ratings of perceived exertion was not significantly ($t \leq 1.66$, $p \leq 0.25$) different when comparing the *texting* to the *talking* (10.44 ± 0.49) and *music* (10.54 ± 0.58) conditions. Ratings of perceived exertion was not significantly ($t \leq 0.94$, $p \leq 0.6$) different between any of the other conditions.

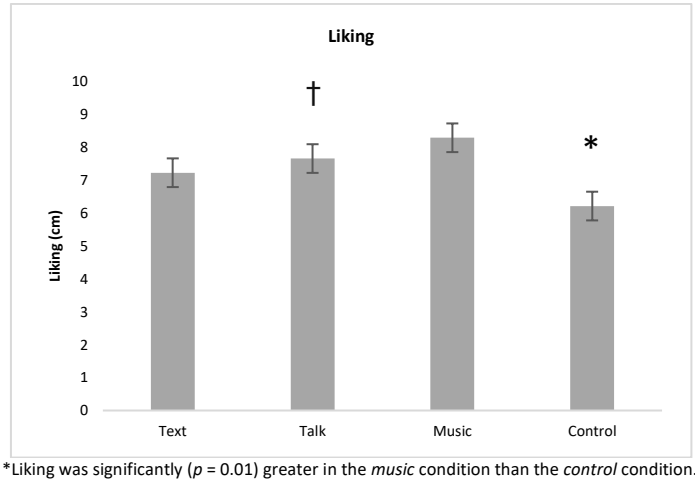


*Ratings of perceived exertion was significantly ($p = 0.05$) greater in the *texting* condition than the *control* condition.

Figure 2: Ratings of perceived exertion between the *texting*, *talking*, *music*, and *control* conditions.

Liking

There was a significant ($F = 4.14$, $p = 0.02$) main effect of condition for liking. Liking was significantly ($t = 3.85$, $p = 0.01$) greater when comparing the *talking* (7.64 ± 0.63) to the *control* (6.2 ± 0.71) condition. Liking from the *control* to the *talking* condition increased by 23.06%. Liking was significantly ($t = 3.09$, $p = 0.01$) greater when comparing the *music* (8.27 ± 0.38) to the *control* condition. Liking from the *control* to the *music* condition increased by 33.39%. Liking was not significantly ($t \leq 0.99$, $p \leq 0.42$) different when comparing the *texting* (7.21 ± 0.54) to the *talking*, *control*, and *music* conditions. Liking was not significantly ($t \leq 1.09$, $p \leq 0.33$) different between the *talking* and *music* conditions.



*Liking was significantly ($p = 0.01$) greater in the *music* condition than the *control* condition.
†Liking was significantly ($p = 0.01$) greater in the *talking* condition than the *control* condition.

Figure 3: Liking between the *texting*, *talking*, *music*, and *control* conditions.

DISCUSSION

This study utilized a between-subjects design to compare the intensity (average heart rate and average RPE) and liking of 30-minute bouts of bike exercise during four conditions: texting on a cell phone (*texting*), talking on a cell phone (*talking*), using a cell phone to listen to music (*music*), and no cell phone use (*control*). There have been a few studies

that have assessed cell phone use and its affects on treadmill exercise, but to the best of our knowledge there were no studies that have assessed cell phone use and its affects on bike exercise. Both studies [5, 6] that investigated the effects of cell phone use on treadmill exercise came to the same conclusion stating that the participants engaged in lower intensity exercise when using their cell phone for texting and talking purposes. This current study also came to the same conclusion as those previously mentioned studies and found that the participants engaged in lower intensity exercise while using their cell phone for texting and talking purposes. These findings may come as a surprise because one may think that maintaining a higher exercise intensity may seem like a simpler task while multi-tasking on the bike, but the results from this study prove differently. Heart rate from the *texting* to the *music* condition increased by 25.29%, while heart rate from the *talking* to the *music* condition increased by 20.09%. This percent increase in heart rate during bike exercise from the *texting* and *talking* conditions to the *music* condition confirms that participants engaged in more moderate-high intensity exercise throughout the entirety of the *music* condition when compared to both the *texting* and *talking* conditions. These findings were also much more impressive when compared to the findings from Rebold and colleague's [5, 6] previous studies that examined treadmill exercise. Heart rate from the *texting* to the *music* condition increased by 11.28%, while heart rate from the *talking* to the *music* condition increased by 8.61%. This percent increase in heart rate during treadmill exercise from the *texting* and *talking* conditions to the *music* condition also confirmed that participants engaged in more moderate-high intensity exercise throughout the entirety of the *music* condition when compared to both the *texting* and *talking* conditions.

The Borg RPE scale was used in conjunction with heart rate monitoring in the current study to assess the intensity throughout all conditions. It was imperative that we also assessed RPE because the Borg RPE scale has been proven to be a valid and reliable predictor of heart rate and a strong correlation exists between RPE scores and heart rate [8, 14]. However, by assessing both heart rate and RPE we could also possibly suggest that it is important for the health professional to also take into consideration what their athlete, client, or patient is doing in conjunction while during exercise as using one's cell phone to talk, text, or listen to music can possibly influence one's RPE. In the current study, RPE from the *control* to the *texting* condition increased by 13.32%. This finding was different from what we observed for heart rate responses between the different conditions. The highest heart rate was observed for the *music* condition, while the highest RPE score was observed for the *texting* condition. Therefore, a strong correlation between heart rate and RPE was not observed in the current study and we can possibly suggest that multi-tasking (e.g., texting or listening to music on a cell phone) while engaging in bike exercise can influence RPE scores differently when compared to exercise attempted alone. According to the findings, it seems as if using a cell phone to listen to music has the potential to distract the "exerciser" from the task-at-hand (e.g., exercise) and result in lower RPE scores (i.e., perceiving the bout of exercise to be less demanding than what it really is). It is possible that while listening to music during a bout of bike exercise distracted the "exerciser" from the often not so liked physiological responses (e.g., increased sweating, ventilation, and muscle fatigue) that happens during exercise, therefore, resulting in the lower RPE scores [15]. While on the other hand, using a cell phone for texting purposes has the opposite effect and causes the "exerciser" to have higher RPE scores (i.e., perceive the bout of exercise to be more demanding than what it really is). It is possible that the higher RPE scores while engaging in a texting conversation during a bout of bike exercise could have been a result of uncoordinated movements and improper motor unit recruitment patterns.

Our findings for liking were somewhat similar to what was found in the previously mentioned study conducted by Rebold and colleagues [5] with the *music* condition being the most liked. Liking from the *control* to the *talking* condition increased by 23.06%, while liking from the *control* to the *music* condition increased by 33.39%. This percent increase in liking from the *talking* and *music* conditions to the *control* condition confirms that participants prefer to only use certain cell phone functions (e.g., talking and listening to music) and not others (e.g., texting) during bike exercise. However, these findings were not as robust when compared to the findings from Rebold and colleague's [5] previous study that examined treadmill exercise. Liking from the *talking* to the *control* condition increased by 25.58%, while liking from the *music* to the *control* condition increased by 74.42%. This percent increase in liking during treadmill exercise from the *talking* and *music* conditions to the *control* condition also confirmed that participants preferred to only use certain cell phone functions (e.g., talking and listening to music) and not others (e.g., texting). These are important findings because if one finds something, such as exercise to be more enjoyable, then they are probably more likely to engage in it, accumulate more bouts of it, and achieve greater health and fitness results [9].

It was hypothesized that the *music* condition would result in greater heart rate and liking (e.g., enjoyment). Additionally, it was also hypothesized that the *texting* condition would result in greater RPE. Finally, it was also hypothesized that the *control* condition would result in lower liking. Our first hypothesis was supported. The *music* condition did result in a significantly greater average heart rate when compared to both the *texting* and *talking* conditions, and significantly greater liking when compared to only the *control* condition. Additionally, our second hypothesis was also supported. The *texting* condition did result in a significantly greater average RPE when compared to all other conditions. Finally, our third hypothesis was also supported. The *control* condition did result in a significantly lower liking when compared to both the *music* and *talking* conditions.

While the current study does provide useful information, it is not without limitations. The first limitation was that the participants were all college-aged students. Since the current study only focused on college-aged students, we cannot generalize our findings to other populations (e.g., middle- and older-aged adults). Future research should consider focusing on older adult populations so we can better understand how cell phone use would affect aerobic exercise, which is a common type of exercise for them to engage in. In addition, older adult populations were not raised entirely in the digital age, so the ability of them to multi-task, or engage in two activities simultaneously (e.g., use their cell phone while exercising), would possibly result in more negative affects on their exercise performance and ultimately their health and fitness [16]. Another limitation was the script that was used for the *texting* and *talking* conditions. This may not have represented a normal conversation that participants would have with their friends and/or family members and could have possibly affected the liking scores. Rebold and colleagues [6] did address this limitation in a previous study that involved recruiting participant's friends to also take part in the study. The friends of the participants in the study were asked to start either a texting or talking conversation (depending on the condition) with their friend to simulate a realistic conversation [6]. Another limitation was that the participants were allowed to self-select the type of music they wanted to listen to. This decision best mimics a real-world exercise environment, but the type of music (genre, tempo, and loudness) participants listened to may have had an affect on exercise intensity [10, 11, 12]. The above-mentioned limitations were known while going into this study, however, the researchers in the current study wanted to replicate Rebold and colleagues [5] previous treadmill study so comparisons could be made between two common modes of aerobic exercise (treadmill and bike).

CONCLUSIONS

The findings from our current study are helpful when making comparisons to the previous studies conducted by Rebold and

colleagues [5, 6] who assessed the effects of cell phone use during treadmill exercise. With the information known from our current study and those previous treadmill studies [5, 6], we now can make conclusions on which mode of aerobic exercise is affected the most while using common cell phone functions (*texting*, *talking*, listening to *music*). This study provided new insights about how another common mode of aerobic exercise (bike) is affected by cell phone use. Presently, we demonstrated that the intensity of bike exercise was affected more while using a cell phone to listen to music. Average heart rate while using a cell phone to listen to *music* was 147.58 beats·min^{-1}, while average heart rate while using a cell phone for *texting* and *talking* was 117.79 beats·min^{-1} and 122.89 beats·min^{-1}, respectively. However, according to our findings the way in which one perceives how intense or difficult a bout of bike exercise is dependent on what else they may be doing while engaging in that bout of bike exercise (multi-tasking). Using a cell phone for *texting* purposes resulted in the greatest average RPE score of 11.4, while other cell phone functions such as *talking* and listening to *music* resulted in RPE scores of 10.44 and 10.54, respectively. Finally, using a cell phone to listen to *music* resulted in the greatest liking score of 8.27. Using a cell phone for *talking* also resulted in a high liking score of 7.64, while using a cell phone for *texting* resulted in a low liking score of 7.21.

CONCLUSION

In conclusion, it appears that different cell phone functions have the ability to affect bike exercise behavior differently. The relationship between cell phone use and exercise intensity and liking appears to be specific to the cell phone function that is being utilized. It is imperative to take into consideration what one's health and fitness goals are. If one wants to maximize caloric expenditure for weight loss purposes and their cardiorespiratory fitness, then it is recommended that you only use your cell phone for listening to music. This will allow one to exercise at a higher intensity resulting in greater caloric expenditure and greater improvements in cardiorespiratory fitness (e.g., decreased risk of morbidity and premature mortality, increased VO_2) [7]. Additionally, if you are working with a client or patient who does not enjoy exercising, you may initially suggest to them that they may want to use their cell phone for listening to music or talking purposes only as this was shown to increase the liking of a bout of bike exercise. As that client or patient begins to enjoy exercise you may then slowly start transitioning them to only using their cell phone for listening to music as that will then help them increase their exercise intensity and enjoy greater health benefits and fitness improvements.

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