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A mindfulness-based intervention to reduce stress in undergraduates.

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A Mindfulness-based Intervention to Reduce Stress in Undergraduates

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Abstract

This study piloted a mindfulness-based intervention to reduce stress in university undergraduates, and explore effects on psychological and biological indicators of stress. Mindfulness is "the awareness that emerges through paying attention on purpose, in the present moment and non-judgmentally to the unfolding of experience moment-by-moment" (Kabat-Zinn, 1994). The one week mindfulness intervention used audio-based mindfulness tracks recorded by Clinical Psychologist Paul Salmon. These tracks taught the basics of mindfulness. Participants were asked to listen to the tracks for 30 minutes a day for five days of the intervention. Perceived stress, self-reported anxiety, self-reported depression, heart rate and skin conductance were measured at baseline and follow-up. It was predicted that these measures would decrease with increased use of the mindfulness tracks. Time listened to the intervention did significantly predict changes in skin conductance during the intervention. No other predicted relationships reached significance.

Keywords: Mindfulness, Meditation, Undergraduates, Stress, MBSR, Intervention

A Meditation-based Intervention to Reduce Stress in Undergraduates

Young adults have been shown to experience high levels of stress and anxiety throughout college. Stress is a highly personalized phenomenon that is unique to a person based on their current setting and situation. In Pearlin's 1989 study, it was proposed that there are two main categories of stressors: life events and chronic strains. Life events are defined as the extent to which the accumulation of a series of experiences can create a stressful impression. Chronic strain stress is manifested in role overload: conflicting roles in an individual's life that produce competing and potentially conflicting, demands over time. Role conflict is a frequent experience throughout the college experience, putting demands on college students to find the balance between the competing demands they face (e.g., academics, creating new social connections, being responsible for their own needs, planning their future, and transitioning to financial and emotional independence) (Pearlin, 1989) (Smith & Renk, 2007). Although levels of stress fluctuate throughout a semester, increasing during midterms and finals, there is a relatively constant underlying pressure on all students (Pearlin, 1989).

College is a time where students are separated from the consistent contact with their customary support system, possibly reducing their consoling capabilities. This includes everything from their high-school friends to their families (Hudd, 2000). While a new system of support is being established, stress levels can rise. Additionally, research has been shown that certain social outing and social activities that would traditionally decrease can now increase stress

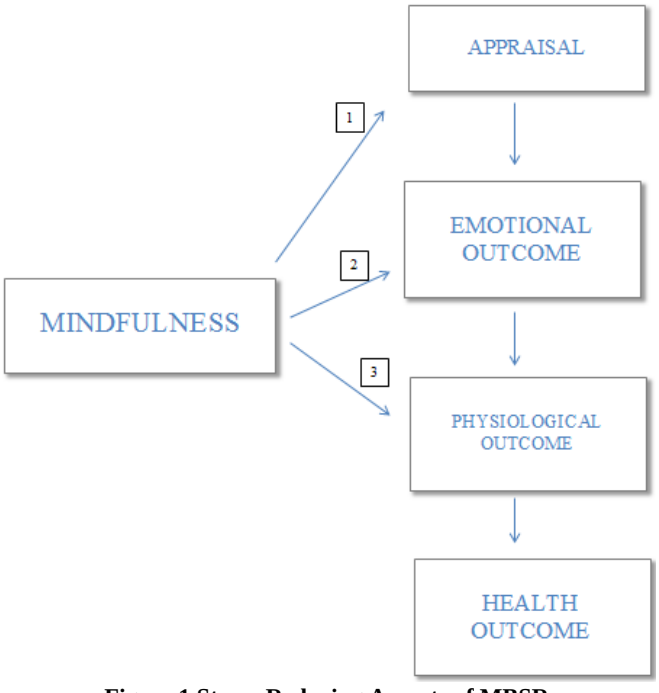

Figure 1 Stress-Reducing Aspects of MBSR

levels during this transition state (Hudd, 2000). When levels of stress become overbearing or when the stress is begun to be perceived negatively, students experience symptoms of both physical and psychological impairment (Misra & McKean, 2000). This transition to the college setting has shown that students experience a significant increase in psychological disturbances, such as depression (Dyson & Renk, 2006). Students are also reported to experience high levels of anxiety (Smith & Renk, 2007), both of which are important to keep low so that they can function at the top of their academic performance. In a chain effect, as shown in the figure 1, stress appraisal directly effects emotional outcomes such as anxiety and depression, and in turn, activates physiological stress responses such as the sympathetic nervous system, or "fight/flight" response (Salmon, Sephton, & Dreeben, 2011). These physiological outcomes show a measureable variance from the norm under stress or relaxed conditions, as evidenced by measures such as skin conductance, heart rate and blood pressure (Cacioppo, 1994). Chronic (frequent and/or repeated) activation of stress responses is linked with higher risk for disease (McEwen, 1998). In contrast, growing evidence shows that stress-reduction programs including mindfulness-based interventions have resulted in positive effects for psychological and physical health (Cavanagh et al., 2013). This suggests that a mindfulness iPod-based intervention might reduce stress and improve mental and possibly physical health in undergraduates. Mindfulness is "the awareness that emerges through paying attention on purpose, in the present moment and non-judgmentally to the unfolding of experience moment-by-moment" (Kabat-Zinn, 1994). "Mindfulness practices have been described as self-related attention in the context of a receptive orientation (Kabat-Zinn, 1996)". The use of mindfulness may change stress-health pathways that integrate emotion, cognition attention and mind-body pathways (Salmon et al., 2010). The key to the program is to suspend all judgmental and elaborative processes so that one can focus attention in a relaxed, meditative state (Mars and Abbey, 2010) (Lush et al., 2009). The hope of mindfulness practice is to reach a quality "bare attention" where all attention is focused on mental, interceptive and exteroceptive experiences (Mars & Abbey, 2010). A deeper understanding of the effects of this mindfulness based audio material on the levels of stress and anxiety would help to clarify the benefits to the mechanisms by

which such a therapy would be beneficial to undergraduates. In the current study, we asked undergraduate students to listen to and reflect on audio-based mindfulness tracks recorded by Clinical Psychologist Paul Salmon to examine the affects that they have on their stress, anxiety and depression levels. It was hypothesized that the Mindfulness based audio tracks would be associated with a reduction of self-reported perceived stress, anxiety and depressive symptoms along with a decrease in skin conductance and heart rate.

Methods

Hypotheses set: based on associations represented by arrows 1, 2, and 3 in the figure, as follows:

Hypothesis 1: Greater time spent listening to the mindfulness audio tracks will be associated with a reduction in stress appraisal ratings from baseline to follow-up.

Hypothesis 2: Greater time spent listening to the mindfulness audio tracks will be associated with a reduction in anxiety and depression ratings form baseline to follow-up.

Hypothesis 3: Greater time spent listening to the mindfulness audio tracks will be associated with a reduction in the physiological stress responses from baseline to follow-up.

Participants

Thirty-two students participated in this study from the SONA online research system between September 2013 and March 2013. The SONA online research system is used to recruit students who are enrolled in a course that requires the completion of a research requirement. The pool of SONA participants were mostly from Psychology 201, a course with a majority of freshman (usually ages 18 to 19). Participants must have been between the ages of 18-30 and must be fluent in English. SONA required that the student select their name from the class in which they are enrolled, therefore their college enrollment will be verified through the SONA system. SONA allowed the student to make an appointment with the research team.

Procedure

Participants were sent a reminder email of their research participation appointment. Factors of the Model in Figure 1 were assessed at baseline. Students were provided with the mindfulness program (on audio tracks) loaded on an iPod, and asked to listen to the tracks 30 minutes a day, 5 days per week for one week. At

the conclusion of this period, all model factors were reassessed. Table 1 describes the variables assessed at baseline and one-week follow up.

Baseline data collection- Questionnaires measured psychosocial variables including stress appraisal and emotional outcome (anxiety, and depressive symptoms). Physiological stress responses were assessed during a laboratory visit. Psychophysiological recording equipment was positioned to record skin conductance and heart rate. Recordings were gathered during a 3-minute acclimation period, a 10-minute meditation session, and 2-minute rest period. The 10-minute meditation session was used in the later analyses.

Intervention- All participants were introduced to Mindfulness as a stress-reducing technique, in this case, meditation using iPods containing mindfulness audio tracks. They were asked to listen to the tracks for thirty minutes a day, five times a week for one week. They were also asked to record what they listened to in a log. The iPod-based mindfulness tracks to be used in this study were provided in a file at the lab. The tracks were recorded by Clinical Psychologist co-investigator Paul Salmon. They are based on the Mindfulness-Based Stress Reduction (MBSR) program, which was started by Jon Kabat-Zinn at the University of Massachusetts in 1979. The MBSR program is centered around the concept of mindfulness and the purposeful directing and focusing of attention on the body and breath. Some of the tracks provide instructional narratives about the foundations of mindfulness, while others provide guided mindfulness practices, including meditations on eating, breathing, listening, thinking, feeling, and the body as a whole. For example, meditation on breathing asks the listener to sit either in a chair or cross-legged on the floor and focus their attention on some quality of the breath as it flows in and out. The meditation on the body as a whole (a.k.a. the body scan) asks the listener to lie on the floor as they are guided to slowly and progressively shift the attention throughout the body, all the way from their feet to their head.

One-week follow-up data collection- After the one-week intervention, students were asked to bring their home-based data collection materials (saliva samples, meditation logs) to the laboratory. All baseline measures were repeated at a follow-up visit one week later. Usage data was downloaded from iPods to provide

objective data consisting of tracks used and total time used.

Measures

Questionnaires were administered at the pre-intervention baseline and 1-week follow-up to measure perceived stress, self-reported anxiety and self-reported depression. They included the Perceived Stress Scale, Beck Anxiety Inventory and Beck Depression Inventory. Additionally at both baseline and follow-up, physiological recordings were made while the participants listened to the bell track. The independent variable for these measures was the total time in seconds spent listening to the provided mindfulness tracks as calculated using the play count. Control variables recorded in the background questionnaire include age and GPA. A description of the measures used follows.

The Perceived Stress Scale (PSS) is a 10-item self-report measure that assesses perceived stress over the last month (e.g. "how often have you felt that you were unable to control the important things in your life?") based on a 5-point Likert scale, ranging from 0 "never" to 4 "very often" (Cohen et al, 1983). A summary score is obtained by adding up all of the items.

The Beck Anxiety Inventory (BAI) is a 21-item questionnaire measure that assesses symptoms of anxiety over the past week on a Likert scale from 1 "not at all" to 4 "severely" (Beck et al, 1988). A summary score is calculated by summing all items and ranges from 0 to 63. This inventory demonstrates high internal consistency ($\alpha = .92$) and adequate test-retest reliability ($r = .75$) (Beck at al, 1988).

The Beck Depression Inventory (BDI) is a 21-item self-report measure that assesses the severity of depressive symptoms over the past week based on a four-point scale (Beck et al, 1988). A summary score is obtained by summing across all items. This instrument has been used extensively in clinical research with various populations and demonstrates high internal consistency (alpha of .86) and adequate test-retest reliability (>.60) (Beck et al, 1988).

The psychophysiological recording includes listening to the bell track while sitting in a chair and being hooked up to several leads measuring skin conductance level (SCL) and heart rate (HR). The 15 minute bell

track started with a brief set of directions which lead into a track with two bell chimes at 3 minutes and 13 minutes. The 10 minute recording period between the bells was used for analyses. SCL was measured in microsiemens (μS). A normal SCL reading is <5 μS. Resting HR was measured in beats per minute (bpm) with 60-100 bpm considered normal for adults (Schwartz & Associates, 1987).

Statistical Analyses

All data were double entered and check for accuracy prior to calculation of summary measures for each variable in our model. Summary scores were calculated. Descriptive analyses were used to determine the fit of the data with regard to assumptions of normality.

Hypotheses 1, 2 and 3 were tested using univariate ANCOVAs. These hypotheses test the predictive value of listening to meditation tracks (total time over one week) with regard to change from baseline to follow up in perceived stress (as measured by the PSS), anxiety (BAI) depressive symptoms (BDI) and psychophysiological measures of heart rate and skin conductance. Mean skin conductance and heart rate data were obtained for each participant by averaging the measurement values obtained throughout the 10-minute meditation session. A one-way between-subjects analysis of covariance was conducted to compare the effectiveness of the mindfulness based audio intervention designed to reduce participants' stress. The independent variable was the use of the meditation tracks (total seconds during which iPod meditation tracks were used). The dependent variables included the follow-up score on the outcome variables, with the baseline score being used as the covariate in these analyses. Control variables (age and current GPA) were entered simultaneously with baseline values in a series of univariate ANCOVAS predicting stress, psychopathology, and physiology at follow-up.

Results

Sample Demographics

The sample was predominantly female, Caucasian with GPA between a 3.0 and 4.0 and living with roommates. The hours of paid employment per week were not normally distributed and contained several outliers. The median number of hours per week was 15.00 hrs. and the mode was 0.00 hrs.

Table A: Demographic Data for the Sample, Summarizing Age, Hours of Paid Employment per Week, GPA, Gender, Race and Living Situation.

Variable	**Min.**	**Max.**	**Mean**	**SD**	**N**
Age	**18.63**	**24.61**	**21.17**	**1.67**	**32**
Hours of Work per Week	**0**	**40**	**15.19**	**10.01**	**31**
	Frequency		**Percentage**		**N**
GPA					32
Below 2.0	0		0%		
2 – 2.4	3		9.4%		
2.5 – 2.9	9		28.1%		
3.0 – 3.4	10		31.3%		
3.5 – 4.0	10		31.3%		
Gender					32
Total Male	3		9.4%		
Total Female	29		90.6%		
– Female on Contraception	14		43.8%		
– Female not on Contraception	15		46.8%		
Race					32
Asian	2		6.3%		
Black	5		15.6%		
Hispanic	0		0%		
Native American	0		0%		
White/Caucasian	25		78.1%		
Other	0		0%		
Living Situation					31
Live Alone	2		6.5%		
Live with Spouse/Partner only	1		3.1%		
Live with Spouse/Partner and Child or Children only	1		3.1%		
Live with other Relatives	7		21.9%		
Live with Roommates/Non-relatives	16		50.0%		
Other	4		12.5%		

Table B: Descriptive statistics of the measures used in baseline and follow-up

Measure	Baseline Mean (SD)	N	Follow-up Mean (SD)	N
Questionnaires				
PSS	17.9 (6.4)	32	15.8 (5.8)	32
BAI	13.0 (5.3)	30	7.5 (6.7)	32
BDI	8.5 (5.3)	32	5.5625 (4.9)	32
Psychophysiological				
Skin Conductance (μS)	4.26 (4.93)	32	3.34 (4.07)	31
Heart Rate (bpm)	83.91 (12.40)	32	81.04 (13.48)	32

The average time in minutes listened to the mindfulness intervention was 106.76 minutes, with a standard deviation of 119.46 minutes. The median was 83.33 minutes and the mode was 0.00 minutes. The minimum and maximum were 0 minutes and 391.48 minutes respectively.

Histograms were constructed to visualize normality of meditation track use, age and GPA. As shown in Figure 2, meditation track use was not normally distributed amongst participants. A majority of the participants did not use the tracks much, with total listening time less than 42 minutes. Age was distributed normally as shown in Figure 3. The participant pool ranged from 18.63 to 24.61 years with an average of 21.17 years of age. Figure 4 presents GPAs for the participant sample as having had a left skew. GPA ranged from 2.0 to 4.0 with an average GPA between a 2.5 and 3.4. The results did not change in secondary analyses using log transformed versions of the control variables.

Hypothesis 1: Listening time did not significantly predict changes in perceived stress during the intervention, $F(24,3)=0.767$, $p=0.704$, partial eta squared= 0.86. None of the control variables significantly predicted changes in perceived stress, and the overall model was not significant.

Hypothesis 2: Listening time did not significantly predict changes in anxiety (as measured by the BAI) during the intervention, $F(24,2)=1.731$, $p=0.441$, partial eta squared= 0.954. None of the control variables significantly predicted changes in anxiety, and the overall model was not significant.

Listening time did not significantly predict changes in depression (as measured by the BDI) during the intervention, $F(24,3)=5.360$, $p=0.096$, partial eta squared= 0.977. The BDI pre-intervention score significantly

predicted changes in depression, F(1,3)=36.087, p=0.009, partial eta squared=0.923. The overall model was significant F(27,3)=13.413, p=0.027, partial eta squared=0.992

Hypothesis 3: Listening time did not significantly predict changes in Heart Rate during the intervention, F(24,2)=0.683, p=0.749, partial eta squared= 0.891. None of the control variables significantly predicted changes in heart rate, and the overall model was not significant.

Listening time did significantly predict changes in Skin Conductance during the intervention, F(24,2)= 190.929, p=0.001, partial eta squared= 0.999. The baseline skin conductance score significantly predicted changes in skin conductance, F(1,3)=1185.252, p=.000, partial eta squared=0.997. Age also significantly predicted changes in skin conductance, F(1,3)=23.972, p=.016, partial eta squared=0.889. The overall model was significant F(27,3)=343.471, p=0.000, partial eta squared=1.00.

Figure 6 graphs the mean and range of skin conductance scores throughout the 10 minute recording period at baseline and follow-up for participants who had low use of the tracks. Figure 7 and Figure 8 graph the same variables with the group that had moderate use of the tracks and high use of the tracks respectively. Analysis of the SC data reveals significantly reduced SC scores for the 10 minute recording phase, providing a physiological indication that by the end of the mindfulness intervention, participants reduced autonomic activation during the meditative state.

Discussion

A significant relationship was found between skin conductance and time listened to the meditation tracks provided during the intervention. This suggeststhat after the participants used the mindfulness tracks for the week period, their skin conductance values decreased demonstrating a reduction in sympathetic arousal. This could be the result of decreased stress. Similar to Lush et al., 2009, skin conductance was shown to decrease after a mindfulness intervention. This study however used a much shorter period than Lush et al's standard 8-week group-based format Mindfulness-based Stress-Reduction (MBSR) intervention. Most MBSR

interventions have been costly and time consuming to implement. However, this iPod based mindfulness intervention is relatively inexpensive and a lot less time consuming. This method is more easily managed and distributed to participants than the 8-week group session led by a clinical psychologist with extensive MBSR experience. This more efficient iPod intervention, if having the same positive outcome as other MBSR interventions, could have significant potential in other samples including clinical samples. Other MBSR interventions have shown positive MBSR effects on all kinds of clinical samples such as fibromyalgia (Lush et al., 2009) and breast cancer (Monti et al, 2013). It is possible that these mindfulness tracks could produce the same desirable outcome as the current more resource costly MBSR interventions.

Contrary to the hypotheses, no significant relationships were found between perceived stress, self-reported anxiety, self-reported depression and heart rate with use of the mindfulness based audio tracks. It is possible that the intervention duration was not long enough to show significant enough results. Across all variables, the scores trended in the hypothesized direction, but none reached significance. Continuing the study to increase sample size could help to strengthen these results and trends.

None of the psychological effects of the intervention produced significant results. This may be because the tracks, through their mindfulness education, instruct the listener to focus on their breathing. If the breath modulation techniques in the tracks directly affect vagal tone, it is possible that physiological effects are more proximal than psychological effects. This would mean that the physiological effects of the intervention are shown before the psychological effects. It might be possible that if the intervention were longer, these psychological effects could reach significance.

Audio-based mindfulness intervention may not be sufficient to teach mindfulness techniques in such a way that provides psychological benefit. It could be beneficial to add additional elements to the study to aid in the intervention.

Limitations

This study did not employ a control group; rather, hypotheses were tested by exploring associations between objective (iPod time stamp) measures of time spent listening to the mindfulness audio tracks, and pre-to-post intervention change in the subjects levels of perceived stress, depression/anxiety, and autonomic arousal. None of the inferences that would be permitted in a randomized controlled trial, such as correlations, can be done with this study. The study in its design and power lacks the ability to show whether or not the changes in stress, anxiety and the various other measures used are caused by meditation, elapsed time, attention from the research team or some other factor. This pilot study can only test for associations between the use of the mediation tracks and the potential change of outcomes, and will be useful in terms of generating hypotheses for future studies that may employ a more rigorous design.

This study also employed the mindfulness intervention for a concise time period of one week. Most other studies employ these interventions for longer periods of time such as 8 weeks in Lush et al., 2009 and 2 weeks in Cavanagh et al., 2013. This one-week period may not have been a sufficient period for the intervention to have effects on the psychological outcomes. However, at least one other study has shown significant results after a slightly longer two week intervention (Cavanagh et al., 2013).

Other group-based mindfulness interventions such as the one described by Lush et al., 2009, could have a potential advantage. In the group setting, the participants would have a supportive environment to discuss the mindfulness practices in MBSR. The study we performed did not have this feature. This environment could have aided in the MBSR effects for a portion of the sample.

Additionally, some of the sample pool had significant deviations between the play counts on the iPods and their self-reported logs. Only the iPod play count was used in these analyses since it was a more objective and reliable data source. Each individual track had a rather long pause after it and before the next track started. It had come to our attention that some participants skipped those long pauses after the track by clicking the skip button on the iPod. When they used the skip button, the iPod didn't record that time they spent listening to

the track on the play count since a track must be listened to entirely to show up there. It is possible that this flaw could have skewed our time listened to the tracks to be less than they actually were.

Additionally, the sample size for this study is relatively small. The baseline scores to follow-up scores trend appeared to be headed in the desired direction for a mindfulness intervention as shown in table B. It is possible that with a larger sample size and more statistical power that more of the hypotheses would have reached significance.

Future Research

More research could be done on mindfulness and its effects on an undergraduate population. Many mindfulness-based studies have overlooked this portion of the population, but instead focused on medical populations (Lush et al., 2009; Mars and Abbey, 2010). These studies could also implement the interventions for longer periods of time to investigate what time frame is appropriately required for an intervention to be effective. Studies could also implement different types of mindfulness interventions (e.g. yoga, group, etc.) to see if this population experiences greater effects from one intervention over another. Studies could also use differing treatment groups to examine between group effects. More than one participant noted how hard it was to pay attention to the tracks alone. Future studies could even investigate administering the study in different forms of media (e.g. in person, over the internet, etc.) to see any possible effects.

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Figure 2: Track Use Distribution

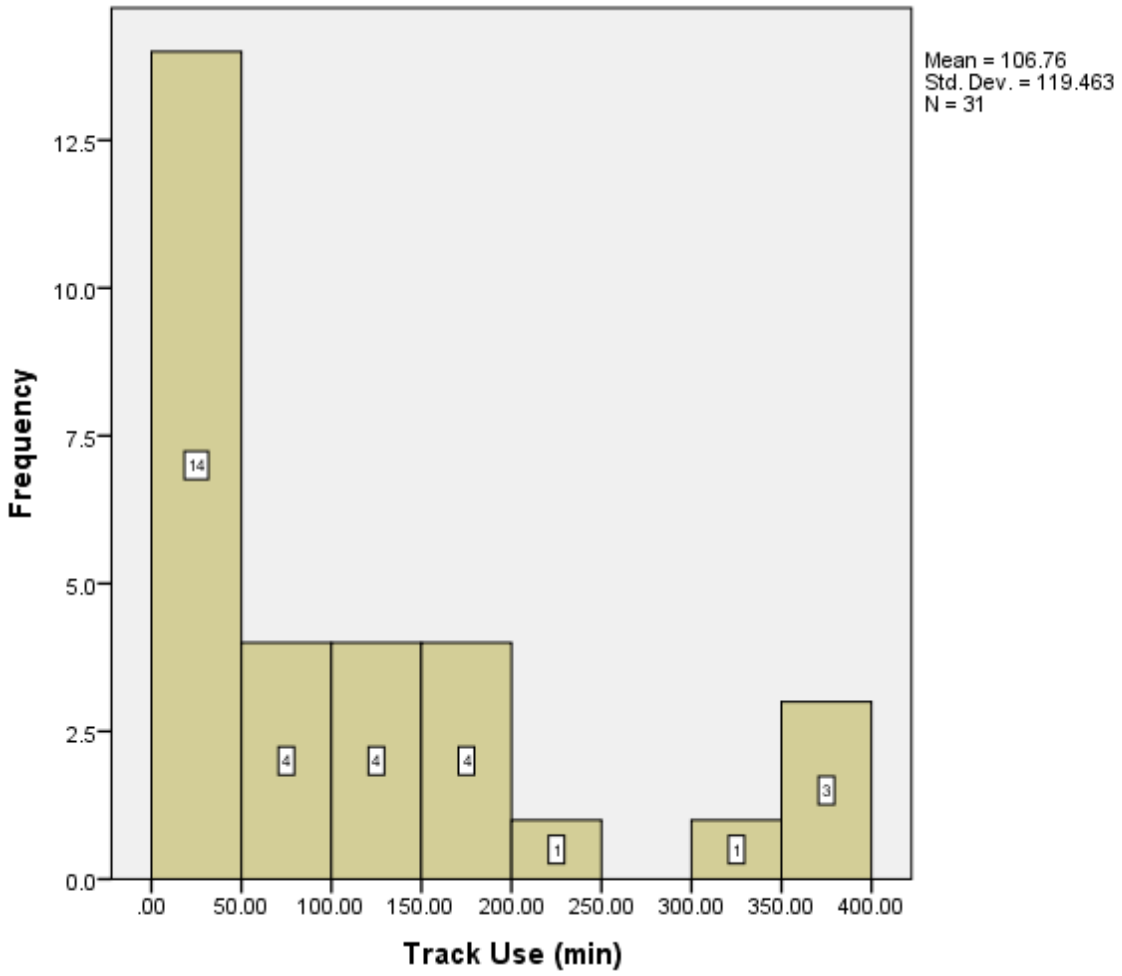

Figure 3: Age Distribution

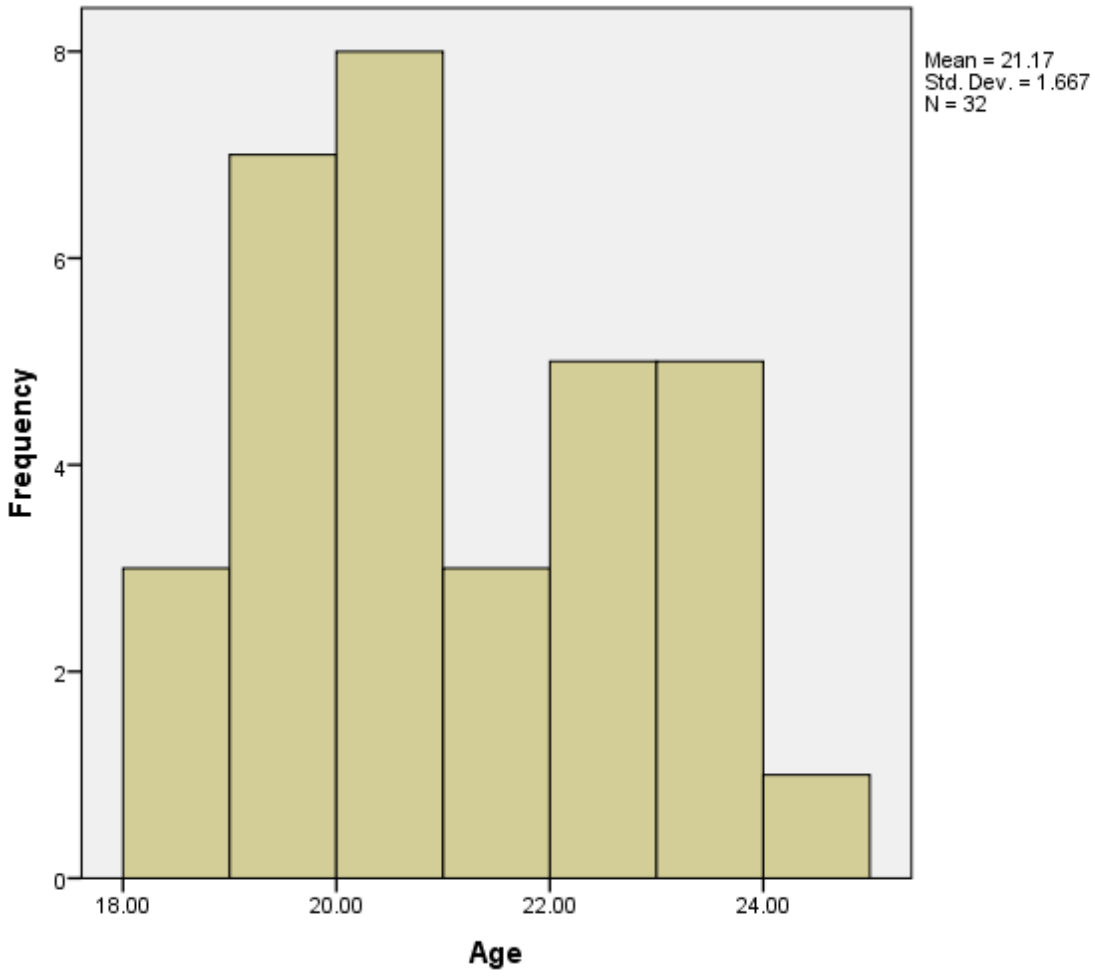

Figure 4: GPA Distribution

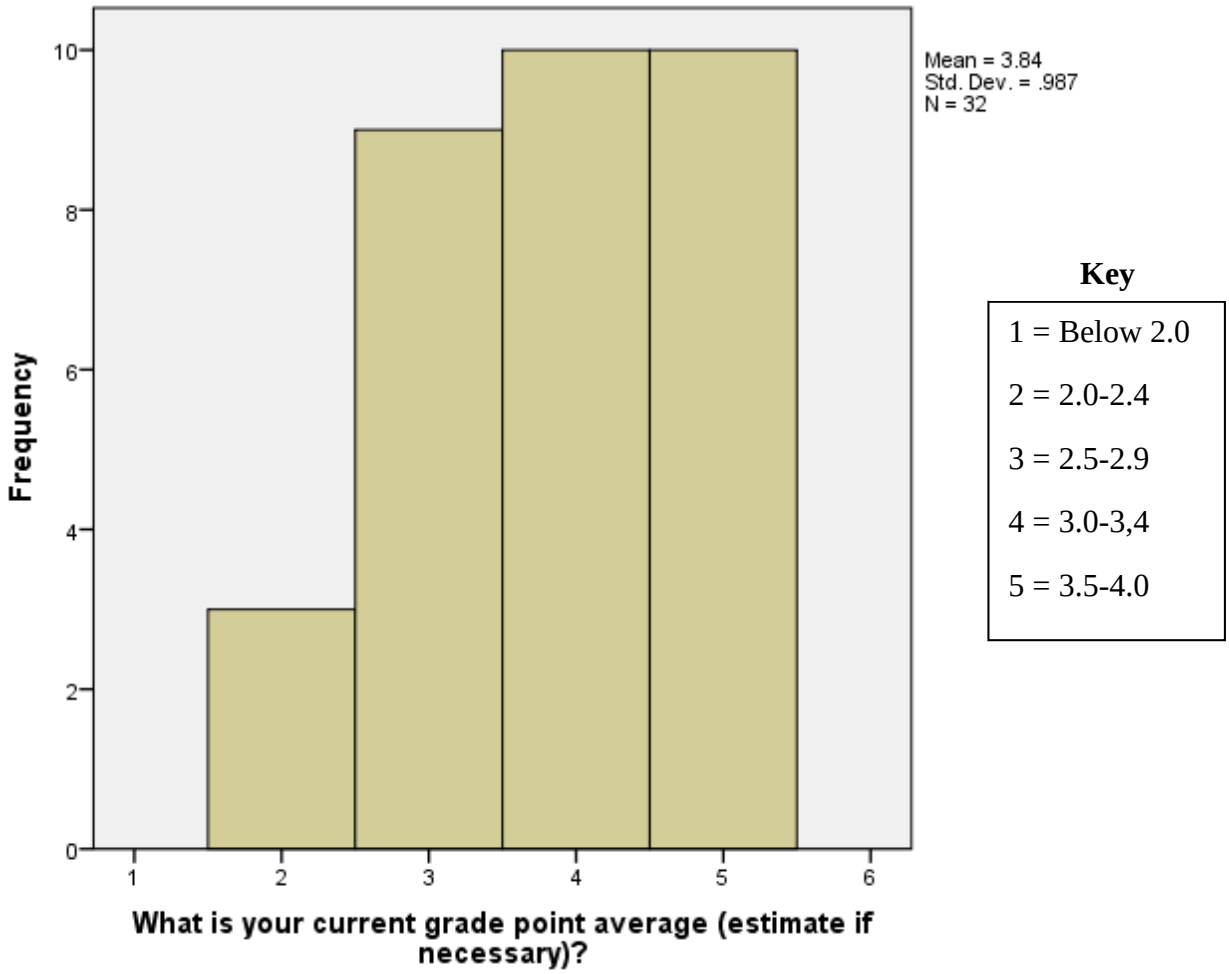

Figure 5: Skin Conductance for Low use of Tracks

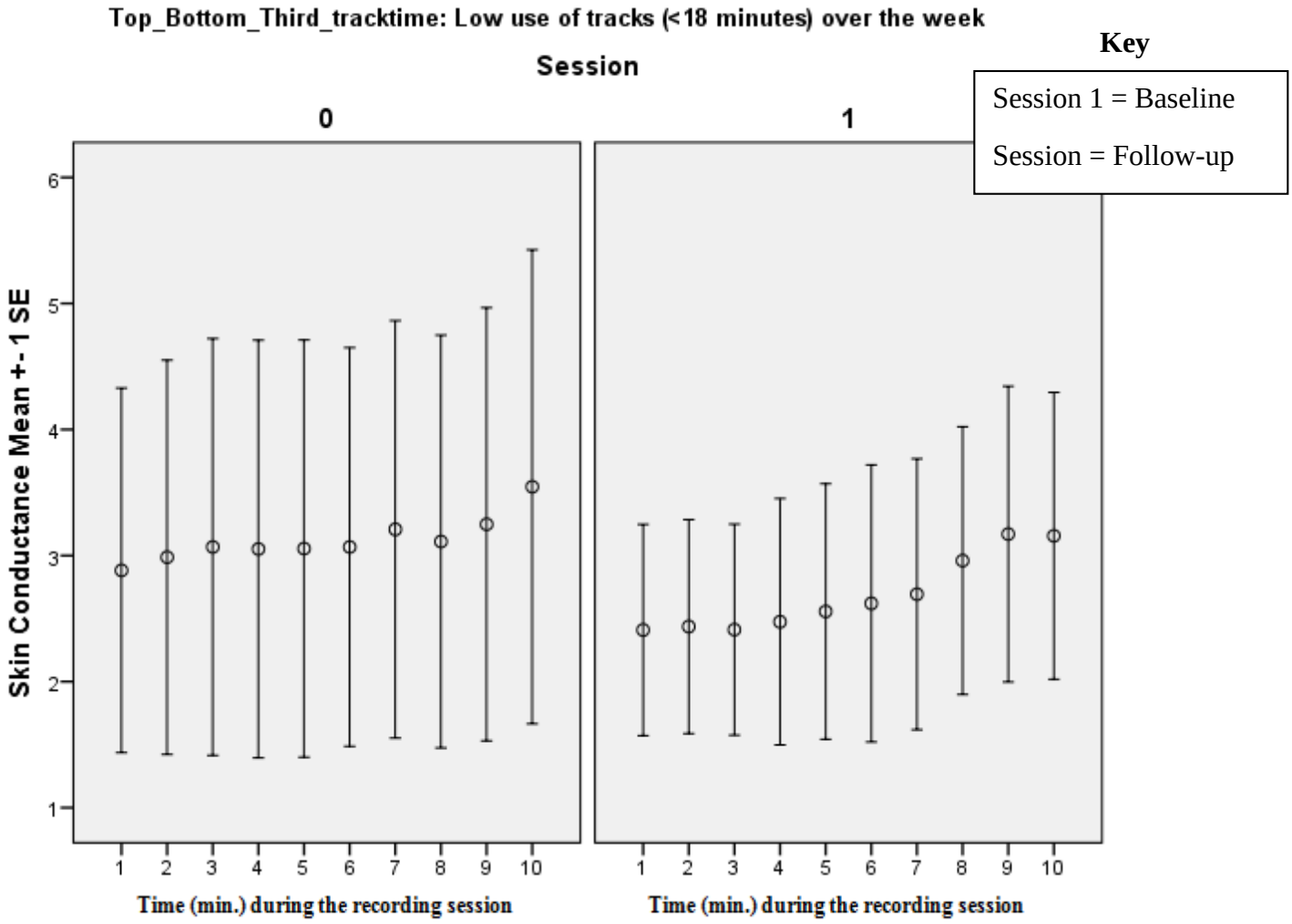

Figure 6: Skin Conductance for Moderate use of Tracks

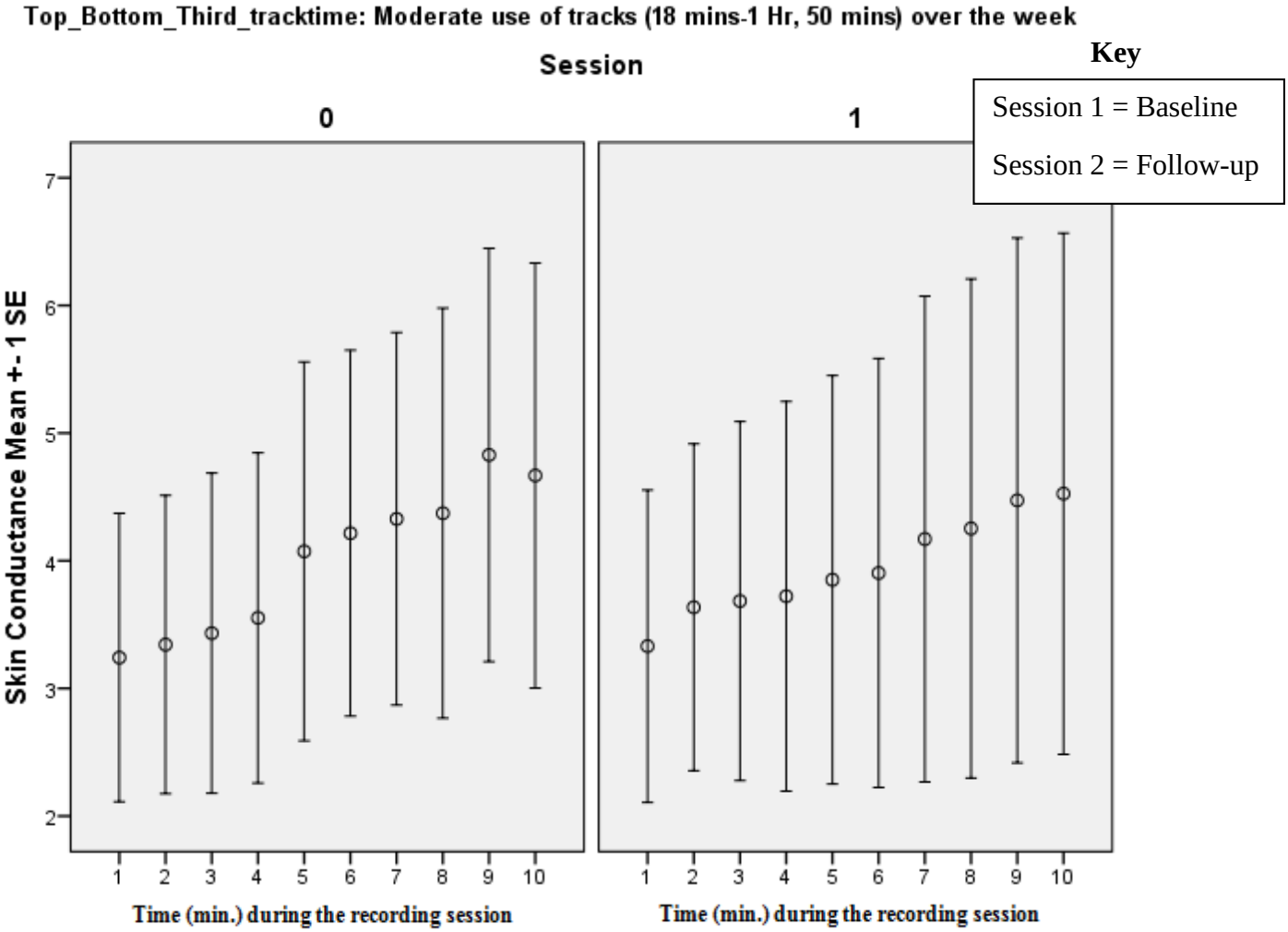

Figure 7: Skin Conductance for Low use of Tracks