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How Optimism Affects Stress Response and Ability to Multitask

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Abstract

Ample research has been conducted to show the inverse relationship between optimism and a physical stress response.[1] It has also been shown that cognitive task performance is limited when under stress (Olver, Pinney, Maruff & Norman, 2015).[2] Although these variables have been studied independently, very little research has attempted to link one's level of optimism to their ability on the specific cognitive task of multitasking. Participants in this study (N=26) consisted of students from Eastern Connecticut State University. Participants completed two surveys to determine their level of optimism, and one computerized assessment to determine their ability to multitask. Stress responses (heartrate and skin conductance) were monitored throughout the multitasking assessment. Results show a relation between participants' optimism and change in galvanic skin response during all three sessions of the multitasking assessment. No relation was found between optimism and heart rate or heart rate variability. There was also no relation found between optimism and multitasking ability on any of the settings of the multitasking assessment. Future research is warranted in order to better understand the extent to which the variables present in this study may be related.

Keywords: Optimism, Stress Response, Ability to Multitask

1. Introduction

Optimism is generally thought of as how positive someone's outlook on life is. According to Fernández-González, González-Hernández, and Trianes-Torres, "Optimism can be defined as the individual's predisposition to believe that he/she can achieve the pursued results without major difficulties."[3] It is a trait that some people experience more of than others, but it rarely is appreciated for its potential benefits to a person's well-being. One study found that optimism can act as a buffer during stressful situations.[4] Similar results suggest that optimism allows people to experience lower levels of acute stress.[5] Optimism is also associated with a lower risk for having long-term ailments, such as coronary heart disease.[6] One explanation for optimism having a positive long-term benefit may be that it allows for stronger immune responses such as higher T cell counts, and higher natural killer cell cytotoxicity during stressful events.[7]

It is clear from the findings described above that optimism may be associated with a person's stress response. A stress response can be thought of as a measurable true level of stress, and is defined by Fernández-González et al. as "body reactions, which can either be physiological reactions or emotional or behavioural reactions to stimuli that cause stress."[8] Fernández-González et al. were interested in the link between optimism and stress responses, and found that people with a higher level of optimism show a reduced stress response.[9] They described stress by saying, "Stress ultimately emerges when an individual assesses an event from within their environment and believes it to be threatening because it risks their well being, and because they do not have enough resources to deal with it."[10]

The physiological response to stress can be measured by using a variety of methods. Electrocardiogram equipment is used to measure stress response via heart rate (HR) in terms of the number of beats per minute. In previous research, HR has been used to measure stress level by comparing a participant's baseline measurement, or when they are at rest,

to the time at which they are dealing with a stressor.[11] For the sake of this study, HR was measured over the course of a five-minute baseline measurement, and this was compared to HR measurements taken during each of the three stages of the multitasking assessment.

Another way to measure electrocardiogram data is by looking at heart rate variability (HRV) which has been used by Shearer, Hunt, Chowdhury, and Nicol.[12] They discuss HRV stating that it is, "a physiological marker of the person's ability to regulate the stress response."[13] They define it further as, "the degree of fluctuation in the length of intervals between heartbeats."[14] Heart rate variability is a good measure of someone's ability to control their own stress response. Higher levels of heart rate variability suggest that a person is better able to regulate their reaction to a particular stressor. In effect they are able to react appropriately when stressed to increase their heart rate as necessary, and to bring their heart rate down to a healthier level more quickly in the absence of a stressor.[15] In the current study, sympathetic, vagal, and sympathetic-vagal balance were measured across the multitasking sessions for each participant.

Galvanic Skin Response (GSR) has also been used before to measure persons' physiological stress response.[16] GSR or skin conductance is a measure of the amount of sweat from a participant, where higher measurements indicate a higher stress response by the participant.[17] For the sake of this study GSR was measured over the course of a five-minute baseline measurement, and this was compared to GSR measurements taken during each of the three stages of the multitasking assessment.

Multitasking is something that many people take part in throughout their day to day actions when they are too busy to focus on only one task at once, and elect to focus on multiple tasks all at the same time. According to Oswald, Hambrick, and Jones, "Multitasking requires (a) performing multiple tasks, (b) consciously shifting from one task to another, and (c) performing the component tasks over a relatively short time span."[18] Multitasking has been linked to stress, and can be thought of as a stressor.[19] Wetherell and Carter were able to show the relationship between multitasking and stress by measuring participants' heart rates during a multitasking assessment and found that multitasking increases stress.[20] Multitasking can be thought of as a cognitive task as well.[21] Although previous research has not specifically studied a link between multitasking and the other variables, previous research has found that stress acts as a barrier for one to complete cognitive tasks.[22]

In the present study, participants completed two surveys to determine their level of optimism. One test was the *Future Events Scale* which has been found to be reliable and valid in measuring optimism.[23] The other test used was the *Optimism-Pessimism Prescreening Questionnaire* which has been found to be a valid measure for the trait of optimism.[24]

After completing those two assessments online, participants came to the lab where they performed a third assessment designed to determine one's ability to multitask. This assessment was the Multi-Tasking Ability Test (MTAT) which has been shown to be a reliable and valid measure to determine a participant's ability to multitask.[25] While engaged in this assessment, electrocardiogram and skin conductance were monitored.

It is hypothesized that participants with a higher level of optimism will experience a lower stress response during stressful situations such as the MTAT, and because they are experiencing a lower stress response they will show better cognitive task performance. Hence, it is hypothesized that there is a relation between optimism and the cognitive task of multitasking such that participants who are more optimistic will achieve better multitasking scores.

2. Methodology

Participants**.** Twenty-six individuals took part in this study, 7 males and 19 females, with a mean age of 19.92 (range: 18 - 27). All participants gave informed consent before they were assessed, and the study was approved by our institution's ethics review board. Participants represented the following races: White (16), Black or African American (5), Asian (2), and American Indian or Alaska Native (1); two did not specify. No participants were taking beta blockers, antianxiety medications, or antihypertensive medications. No participants had a pacemaker device.

Instruments**.** Before taking part in the multitasking portion of the experiment, all participants were required to fill out an online questionnaire. This online questionnaire included two separate assessments which were intended to gauge a participant's level of optimism.

The *Future Events Scale* was the first assessment, which has 23 questions and asks the participant to rate their perceived likelihood of hypothetical future events on an 11 point Likert-type scale ranging from -5 (extremely unlikely) to +5 (extremely likely).[26] Higher scores indicated a higher level of optimism. The *Future Events Scale* was found to be reliable, with a test-retest reliability that ranged from .61 to .75 (M = .68).[27] This measure was also found to have strong convergent validity by Wichman et al. as the optimistic, or positive questions correlated positively to

other established measures of self-worth such as the Rosenberg Self-Esteem Scale (Rosenberg, 1965).[28] The pessimistic, or more negative questions on the measure were also found by Wichman et al. to positively correlate with established measures intended to determine if a person has low self-worth like the Beck Depression Inventory.[29] Wichman et al found the *Future Events Scale* to have discriminant validity as well by comparing it to a different measure of optimism: The Life Orientation Test.[30] Two separate samples were tested and found a positive correlation between the optimistic questions on the *Future Events Scale* and the Life Orientation Test. The first group showed a positive correlation of .39, and the second group showed a positive correlation of .46.[31]

The Optimism-Pessimism Prescreening Questionnaire was the second assessment intended to measure a participant's level of optimism.[32] It did so by posing 9 statements; participants indicated how "true" each statement was, or how well it described them. Answers ranged from 1 (not at all true) to 11 (very true). Higher total scores indicated a higher level of optimism. This measure was found to be valid as optimists consistently predicted higher expectations on an anagram task than did pessimists.[33]

Psychophysiological data were collected using The BioPac MP150 system (Biopac Systems Incorporated, Goleta, CA). To monitor skin conductance two EDA100c disposable electrodes were attached to the participant's palm via wire leads. Two ECG100c electrodes were attached via wire leads so that one was on each arm of the participant, in order to measure electrocardiogram data.

Experimental task. The Multi-Tasking Ability Test (MTAT) was used as the experimental task for this study.[34] This test is comprised of four separate sessions, one of which is a practice test designed to familiarize the participant with the test, and the other three are meant to actually measure the participant's ability to multitask. The test requires one to sort items into bins based upon the characteristics of size, shape, and color. When a new item appears, participants may query the item to determine which bin it should be placed in before placing it accordingly. A participant's multitasking ability was scored based upon their average time to process a single object, as this has been found to be the most valid and stable metric.[35]

Procedure. As participants came into the lab, they were asked to sign a physical version of the consent form that they had seen online. Along with this, participants were asked to give the response they had indicated online for first pet and month of birth. This was so that their results could be matched up to the online assessments at a later point, without having to know their names. Participants were briefed on the BioPac equipment and were given the opportunity to ask any questions before moving forward. After having the participants clean their hands and forearms with soap and water, sensors were attached to their palm to record GSR and to their forearm to record heart rate. Participants were instructed to sit alert and be as still as possible while a 5-minute baseline measurement was recorded.

After this measurement was complete, participants were introduced to the MTAT assessment. The initial part of the MTAT consists of a directions page informing the test taker how to complete a session of the assessment. This is directly followed by a practice session of the test before the participant completes three true 5 minute sessions of the MTAT. Physiological readings were taken during the entirety of the assessment.

3. Results

The present study examined how the variables of optimism, stress response, and multitasking might be related. Optimism was measured using two different scales. The *Future Events Scale* showed a mean score of 5.04 (range: -32 - 27), and the Optimism-Pessimism Prescreening Questionnaire showed a mean score of 11.38 (range: -8 - 38).

Stress response was measured in three different ways (heart rate, heart rate variability, and change in galvanic skin response). Heart rate and galvanic skin response were measured across three settings to account for the three settings of the multitasking assessment, and heart rate variability measurements were conducted for sympathetic, vagal, and sympathetic-vagal balance. The mean heart rate change for the three settings were -2.60 for the first setting, -2.68 for the second setting, and -3.28 for the third setting. The mean GSR changes from baseline were the following: -.16 for the first setting, -.17 for the second setting, and -.18 for the third setting. For heart rate variability the mean sympathetic score was .06, the mean vagal was .14, and the mean sympathetic-vagal balance was 1.18. The mean response time for the Multi-Tasking Ability Test was 116.40 seconds for the first setting, 109.92 seconds for the second setting, and 76.38 seconds for the third setting, resulting in an aggregate mean response time of 95.64 seconds.

Positive correlations were found between the *Future Events Scale* scores and all three GSR settings. The correlations were ($r(24) = .54$, $p < .05$) for the first setting, ($r(24) = .63$, $p < .05$) for the second setting, and ($r(24) = .59$, $p < .05$) for the third setting. Each finding is depicted in Figure 1. These three findings suggest a negative correlation between optimism and GSR reactivity such that participants who reported higher levels of optimism showed a lower galvanic skin response. No relation was found between the following: Optimism-Pessimism Prescreening Questionnaire and

GSR, either optimism measure and all other measures of stress response, multitasking scores and all levels of stress response, and either optimism measure and multitasking scores.

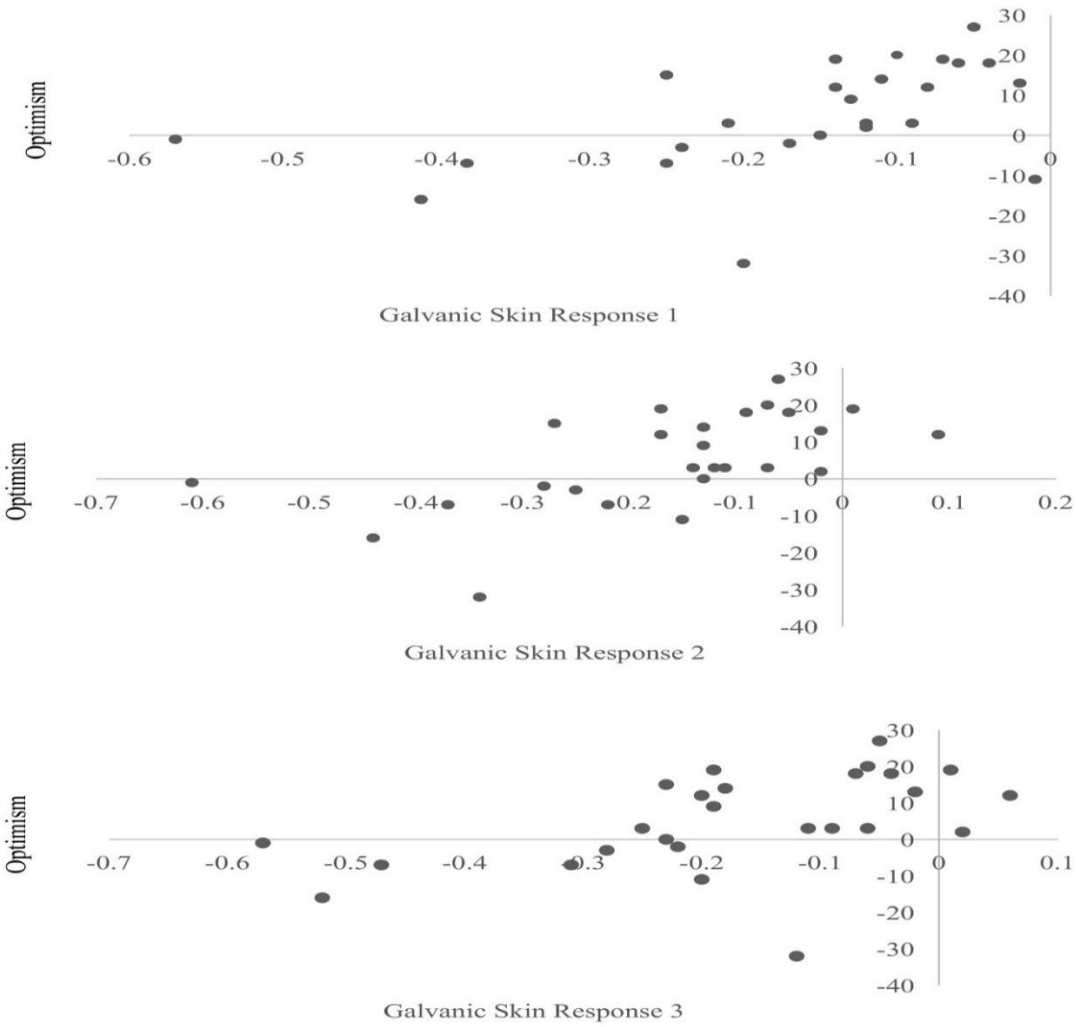

Figure 1. Top: Optimism scores compared to stress response in the first test setting as measured by GSR. Middle: Optimism scores compared to stress response in the second test setting as measured by GSR. Bottom: Optimism scores compared to stress response in the third test setting as measured by GSR.

4. Conclusion

This study was intended to test the hypothesis that participants with a higher level of optimism will experience a lower stress response during stressful situations such as the MTAT, and because they are experiencing a lower stress response they will show better cognitive task performance. Hence, it was hypothesized that there would be a relation between optimism and the cognitive task of multitasking such that participants who were more optimistic would achieve better multitasking scores. Beyond the one significant finding of a relation between scores on the *Future Events Scale* and each of the three GSR settings, results of the present study do not support the hypothesis.

Other interpretations of the results of this study may lie outside of the fact that the hypothesis was largely not supported, though. As a consequence of having a relatively small sample size it is imperative to consider some possibilities as to why the correlations between the *Future Events Scale* and the GSR settings emerged. It may be true that GSR is a more sensitive or accurate measure of a given person's stress response. In a similar manner, it may be true that the *Future Events Scale* is a more sensitive measure of small differences in a person's level of optimism. This may be a result of the measures greater length, or its focus, which tends to consider more generic experiences in life than does the Optimism-Pessimism Prescreening Questionnaire. There also exists the possibility that this particular manifestation of optimism, as measured by the *Future Events Scale,* is somehow unique, and has a greater impact on a person's response to stress.

Although this study was not able to find many significant results, the relation between optimism and GSR should still be considered. This is in line with the findings of Kimhi, Eshel & Shahar (2013) and Ai, Tice, Huang, Rodgers & Bolling (2008) who suggest that higher levels of optimism may lead to a lower stress response.[36] If this is true it may help to further explain the findings of other research, which suggest that higher levels of optimism not only lead to better long term health but may actually improve the immune system.[37] Showing a lesser GSR response may be a small window into how acute stress response impacts long-term health.

The lack of findings in this study does not align with the expectations of the hypothesis and with previous research, which suggests that participants with a higher level of optimism would show a lesser stress response.[38] The lack of findings also does not align with the expectation based on the research of Wetherell & Carter (2014) and Olver et al. (2015) that these individuals would be better able to multitask, so this calls into question potential limitations of the study.[39] Such limitations may include the sample of participants which was comprised solely of college students who were relatively young with a mean age of 19.92. Other key limitations include various levels of self-reporting that were essential in gathering data. Participants answered all survey measures online, and may have had some incentive to portray themselves in a desirable manner even though they were aware that their responses would remain anonymous. Self-reporting was also an issue in the lab setting where participants had to report which section of the multitasking assessment they were working on. Participants were not always good at indicating which section they were on, and so some assumptions had to be made in this respect. In the future, studies using this assessment may benefit from the ability to see the assessment as the participant is completing it so that the participants' progress can be monitored more closely as it occurs.

Future research should work to refine the shortcomings of this work in order to better understand how these variables may impact one another. One avenue for this might be exploring other similar assessments to determine if optimism shows any connection to stress response in settings that are similar while still remaining uniquely different from the MTAT. While replication of all variables could work to strengthen the validity of these findings, emphasis should be placed on the relation between GSR and optimism. Although the link between acute stress response and a person's level of optimism may seem like a small thing in a given moment, it appears to have the potential for long term health benefits, and this is something that is worth further attention.

This research was intended to determine if the variables of optimism, stress response, and ability to multitask are related. All participants completed two surveys and a lab portion where their multitasking ability was assessed. The findings suggest a relation between optimism as measured by the *Future Events Scale*, and a facet of a person's stress response, GSR. In order to better understand the interaction of these variables further research should be conducted, building off of the findings of this research, as well as other research that has worked to answer similar questions. Implications may appear to be small, but such future research may shed more light on strategies to mitigate responses to stressors, and possibly greater long term health as well.

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6. References

1. S. Kimhi, Y. Eshel, and E. Shahar, "Optimism as a predictor of the effects of laboratory-induced stress on fears and hope," *International Journal of Psychology* 48, no. 4 (2013): 641-648, doi:10.1080/00207594.2012.676181.

2. J. S. Olver, M. Pinney, P. Maruff, and T.R. Norman, "Impairments of spatial working memory and attention following acute psychosocial stress," *Stress and Health: Journal of The International Society For The Investigation of Stress* 31, no. 2 (2015): 115-123, doi:10.1002/smi.2533.

3. L. Fernández-González, A. González-Hernández, and M.V. Trianes-Torres, "Relationships between academic stress, social support, optimism-pessimism and self-esteem in college students," *Electronic Journal of Research in Educational Psychology* 13, no. 1 (2015): 116, doi:10.14204/ejrep.35.14053.

4. Kimhi, Eshel, and Shahar, "Optimism as a predictor of the effects of laboratory-induced stress on fears and hope," 2013, 641-648.

5. A.L. Ai, T. N. Tice, B. Huang, W. Rodgers, and S.F. Bolling, "Types of prayer, optimism, and well-being of middle-aged and older patients undergoing open-heart surgery," *Mental Health, Religion & Culture* 11, no. 1 (2008): 131-150, doi:10.1080/13674670701324798.

6. L. S. Richman, G. G. Bennett, J. Pek, I. Siegler, and R. B. Williams, Jr., "Discrimination, dispositions, and cardiovascular responses to stress," *Health Psychology* 26, no. 6 (2007): 675-683, http://dx.doi.org/10.1037/0278-6133.26.6.675.

7. S. C. Segerstrom, S. E. Taylor, M. E. Kemeny, and J. L. Fahey, "Optimism is associated with mood, coping, and immune change in response to stress," *Journal of Personality And Social Psychology*, 74, no. 6 (1998): 1646-1655, doi:10.1037/0022-3514.74.6.1646.

8. Fernández-González et al., "Relationships between academic stress, social support, optimism-pessimism and self-esteem in college students," 2015, 116.

9. Ibid., 111-130.

10. Ibid., 114.

11. Z. Yao, Y. Yuan, T. W. Buchanan, K. Zhang, L. Zhang, and J. Wu, "Greater heart rate responses to acute stress are associated with better post-error adjustment in special police cadets," *Plos ONE*, 11, no. 7 (2016).

12. A. Shearer, M. Hunt, M. Chowdhury, and L. Nicol, "Effects of a brief mindfulness meditation intervention on student stress and heart rate variability," *International Journal of Stress Management*, 23, no. 2 (2016): 232-254.

13. Ibid., 236.

14. Ibid.

15. Ibid., 232-254.

16. H. Storm, K. Myre, M. Rostrup, O. Stokland, M.D. Lien, and J.C. Raeder, "Skin conductance correlates with perioperative stress," *Acta Anaesthesiol Scand 2002* 46 (2002): 887–895.

17. M. Pedrotti, M.A. Mirzaei, A. Tedesco, J. Chardonnet, F. Mérienne, S. Benedetto, and T. Baccino, "Automatic stress classification with pupil diameter analysis," *International Journal of Human-Computer Interaction* 30, no. 3 (2014): 220-236, doi:10.1080/10447318.2013.848320.

18. Thomas S. Redick, Zach Shipstead, Matthew E. Meier, Janelle J. Montroy, Kenny L. Hicks, Nash Unsworth, Michael J. Kane, and D. Zachary Hambrick, "Cognitive predictors of a common multitasking ability: Contributions from working memory, attention control, and fluid intelligence," *Journal of Experimental Psychology: General* 145, no. 11 (2016): 1474; citing research from F. L. Oswald, D. Z. Hambrick, and L. A. Jones, "Keeping all the plates spinning: Understanding and predicting multitasking performance," in *Learning to solve complex scientific problems*, ed. D. H. Jonassen (Mahwah, NJ: Erlbaum, 2007), 77-97.

19. M. A. Wetherell and K. Carter, "The multitasking framework: The effects of increasing workload on acute psychobiological stress reactivity," *Stress and Health: Journal of The International Society for The Investigation of Stress* 30, no. 2 (2014): 103-109, doi:10.1002/smi.2496.

20. Ibid.

21. Ibid.

22. Olver et al, "Impairments of spatial working memory and attention following acute psychosocial stress," 2015, 115-123.

23. S. M. Andersen, "The inevitability of future suffering: The role of depressive predictive certainty in depression," *Social Cognition* 8 (1990): 203– 228; A. L. Wichman, D. A. Reich, and G. Weary, "Perceived likelihood as a measure of optimism and pessimism: Support for the Future Events Scale," *Psychological Assessment* 18, no. 2 (2006): 215-219, doi:10.1037/1040-3590.18.2.215.

24. J. K. Norem and N. Cantor, "Anticipatory and post hoc cushioning strategies: Optimism and defensive pessimism in 'risky' situations," *Cognitive therapy and research* 10, no. 3 (1986): 347-362.

25. C. Flink, H. van Oostendorp, P. Wouters, I. J. Modderman, and A. Serlie, "The Skill to Handle Information Overload," 2008.

26. Andersen, "The inevitability of future suffering," 1990, 203-228.

27. Wichman et al., "Perceived likelihood as a measure of optimism and pessimism," 2006, 215-219.

28. Ibid; M. Rosenberg, *Society and the adolescent self-image* (Princeton, NJ: Princeton University Press, 1965).

29. Wichman et al., 2006; A. T. Beck, *Depression: Clinical, experimental, and theoretical aspects* (New York: Hoeber, 1967).

30. Wichman et al., 2006; M. F. Scheier and C. S. Carver, "Optimism, coping, and health: Assessment and implication of generalized outcome expectancies," *Health Psychology* 4 (1985): 219–247.

31. Wichman et al., 2006.

32. Norem and Cantor, "Anticipatory and post hoc cushioning strategies," 1986, 347-362.

33. Ibid.

34. S. C. Fischer, V. Alan Spiker, P. D. Mautone, and E. W. Holder, "Predictive validity of the Multi-tasking Ability Test *(MTAT)* for three real-world environments," *Anacapa Sciences, Inc.*, n.d., 1-125.

35. Ibid.

36. Kimhi, Eshel, and Shahar, "Optimism as a predictor of the effects of laboratory-induced stress on fears and hope," 2013, 641-648; Ai, Tice, Huang, Rodgers, and Bolling, "Types of prayer, optimism, and well-being of middle-aged and older patients undergoing open-heart surgery," 2008, 131-150.

37. Richman, Bennett, Pek, Siegler, and Williams, "Discrimination, dispositions, and cardiovascular responses to stress," 2007, 675-683; Segerstrom, Taylor, Kemeny, and Fahey, "Optimism is associated with mood, coping, and immune change in response to stress," 1998, 1646-1655.

38. Fernández-González et al, "Relationships between academic stress, social support, optimism-pessimism and self-esteem in college students," 2015, 111-130.

39. Wetherell and Carter, "The multitasking framework," 2014, 103-109; Olver et al, "Impairments of spatial working memory and attention following acute psychosocial stress," 2015, 115-123.