

THE FACTOR STRUCTURE OF RESILIENCE AND THE RELATIONSHIP  
BETWEEN RESILIENCE AND PHYSICAL ACTIVITY

BY

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## **Abstract**

It is not too difficult to get an individual to start a physical activity program. It is incredibly difficult to get an individual to maintain a physical activity program over time. All of life's major and minor inconveniences can become a barrier to performing physical activity, and thus lead to sedentary behavior. The construct of resilience, defined as positively adapting to adverse circumstances, may be helpful in the maintenance of physical activity. However, resilience as a construct is not entirely understood in the current literature. Some theorists suggest resilience is a single construct, while other theorists suggest that resilience is a hierarchical construct that is comprised of other traits. The first portion of this dissertation tested a hierarchical model of resilience. The results of exploratory and confirmatory factors analyses suggest six traits underlie resilience (purpose in life, self-esteem, life satisfaction, cognitive flexibility, proactive coping, and social support). The hierarchical model of resilience found in the first part of this dissertation was then used for the second portion where structural equation modeling tested if resilience mediated the relationship between barriers to physical activity and physical activity. Consistent with a mediational model, the results showed a significant negative relationship between barriers to physical activity and resilience, and a significant positive relationship between resilience and physical activity. However, there was also a significant direct negative link between barriers to physical activity and physical activity. Thus, results suggest that resilience can help mediate the relationship between barriers to activity and being active, although there is also a direct link. Future research may want to examine this relationship longitudinally, and further refine the hierarchical model

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## PREFACE

This dissertation is in the manuscript format, in accordance with the required format for the *Journal of Positive Psychology* and *Journal of Health Psychology*, using APA style 6<sup>th</sup> edition. It contains two manuscripts that will be submitted for publication upon completion of the dissertation defense and necessary edits. The first manuscript, entitled “Towards a Hierarchical Model of Resilience” will be submitted to the *Journal of Positive Psychology*. The second manuscript, entitled “Don’t Stop Now, You’re Doing Great! The Role of Resilience in Physical Activity Maintenance” will be submitted to the *Journal of Health Psychology*.

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**MANUSCRIPT – I**

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**Towards a Hierarchical Construct of Resilience**

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Towards a Hierarchical Model of Resilience

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## **Abstract**

There are several ongoing debates in resilience research (Luthar & Brown, 2007; Luthar, Cicchetti & Becker, 2000). One of these debates asks if resilience is a single construct or a hierarchical construct comprised of other psychological constructs. The current study developed and tested a hierarchical model of resilience using samples from Mechanical Turk ( $N = 500$ ) and college students ( $N = 720$ ). Using exploratory and confirmatory factor analysis (CFA), eight constructs were tested, and the results suggested six constructs (purpose in life, self-esteem, life satisfaction, cognitive flexibility, proactive coping, and social support) indicate resilience. The CFA model showed acceptable fit and configural invariance across the two samples,  $\chi^2(18) = 233.50$ ,  $p < .001$ , CFI = 0.91, RMSEA = .17, SRMR = .07. Convergent validity evidence for the resilience factor was found with the Resilience Scale,  $r = .83$ ,  $p < .001$ . Future studies should consider validating the hierarchical model using additional underlying constructs and samples.

*Keywords:* Resilience, Positive Psychology, Structural Equation Modeling

## **Towards a Hierarchical Model of Resilience**

Resilience is a construct often studied in the fields of developmental, health, and positive psychology. Whereas there is no universal definition of resilience across different fields or studies, resilience is commonly defined as positive adaptation in the face of adversity (Cleland, Ball, Salmon, Timperio & Crawford, 2010; Hegney, Buikstra, Baker, Rogers-Clark, Pearce, Ross, King & Watson-Luke, 2007; Kinsel, 2005; Masten, Cutuli, Herbers & Reed, 2009; Waite & Richardson, 2004; Zimmerman & Arunkumar, 1994). There are several unresolved issues within resilience research. Three of these issues include understanding if resilience is a trait or a process (Luthar, Cicchetti & Becker, 2000; Luthar & Brown, 2007; Rutter, 1987), if resilience is context specific or not (Fletcher & Sarkar, 2013; Luthar et al., 2000), and if resilience is a single construct, or a hierarchical construct made up of several underlying psychological constructs (Connor, 2006; Luthar et al., 2000; Luthar & Brown, 2007). These issues are crucial to resilience research, especially considering the lack of unity in findings within the field. For example, Infurna and Luthar (2016) found that demonstrating resilience was the least common outcome when coping with the loss of a spouse, divorce, or unemployment. Mancini, Bonanno and Clark (2011) and Galatzer-Levy, Bonanno and Mancini (2010) found that demonstrating resilience was the most common outcome when using the same dataset as Infurna and Luthar (2016), using only slightly adjusted analyses. Resolving these three debates may help increase replicability of findings within resilience research, leading to better understanding of resilience. It could be argued that understanding the nature of resilience is the most

pertinent of these concerns. Thus, this study examined the issue of whether resilience is a single- or a hierarchical-psychological construct.

Pangallo, Zibarras, Lewis and Flaxman (2015) highlight that resilience is often defined as a single construct in several different psychological measures. For example, when Resnick, Galik, Dorsey, and Gutkin (2011) developed the Physical Resilience Measure, their dimensionality results found one factor which suggests the scale measures a single resilience construct. Somewhat similar results were found by Connor and Davidson (2003) when they developed the Connor-Davidson Resilience Scale (CD-RISC). Factor analysis on their sample found one factor with a larger eigenvalue of 7.47, suggesting that most of the variance was explained by the first factor and that the scale measured a single construct among the 25 items in the measure. However, the factor analysis did extract three other factors which had eigenvalues ranging from 1.56 to 1.07, which could provide some evidence for multidimensionality with one main factor and several minor factors. Ahern, Kiehl, Sole, and Byers (2006) reviewed six resilience measures, including the CD-RISC, and found that the Brief Resilience Coping Scale (BRCS), developed by Sinclair and Wallston (2004), also had evidence of unidimensionality of the resilience construct. Beyond measurement, there is also some empirical evidence which uses resilience as a single construct, in the fields of coping (Bonanno, Galea, Bucciarelli, & Vlahov, 2007; Campbell-Sills, Cohan & Sills, 2006) and in heritability research (Boardman, Blalock & Button, 2007).

In contrast with the findings above, the other view of resilience is that resilience is made up of several constructs working together (e.g. purpose in life, self-

esteem, social support, positive emotions, internal locus of control, and others). This hierarchical view of resilience also has both empirical and measurement support. Starting with measurement of resilience, Ahern et al. (2006) found that five of the six resilience scales they reviewed were multidimensional. These scales included the Baruth Protective Factors Inventory (BPMI; Baruth & Carroll, 2002), the CD-RISC mentioned earlier (Connor & Davidson, 2003), the Resilience Scale for Adults (RSA; Friborg, Hjemdal, Rosenvinge & Martinussen, 2003), the Adolescent Resilience Scale (ARS; Oshio, Kaneko, Nagamine & Nakaya, 2003), and the Resilience Scale (RS; Wagnild & Young, 1993). The RS had two factors, the BPMI and ARS had three factors, and the CD-RISC and RSA each had five factors, suggesting multiple possible structures of resilience (Ahern et al., 2006; Baruth & Carroll, 2002; Connor & Davidson, 2003; Friborg et al., 2003; Oshio et al., 2003; Wagnild & Young, 1993). Other empirical work into resilience finds close to a dozen different constructs used to partially define resilience. These constructs include: purpose in life, self-esteem, cognitive flexibility, active coping style, social support, culture, personality, community, self-efficacy, internal locus of control, positive emotions, having goals, positive stress management, experience, patience, spirituality/faith, being humorous, curiosity, challenge, and self-acceptance (Bradshaw et al., 2007; Burton, Pakenham, & Brown, 2010; Connor, 2006; Hegney et al, 2007; Kinsel, 2005; Lee, Nam, Kim, Kim, Lee & Lee, 2013; Maknach, 2014; Mlinac, Sheeran, Blissmer, Lees & Martins, 2010; Rossi, Bisconti, & Bergeman, 2007; Southwick, Vythilingam, & Charney, 2005; Wagnild & Young, 1993; Waite & Richardson, 2004). This view of resilience is supported by several different research areas, such as job satisfaction (Waite &

Richardson, 2004), trauma (Connor, 2006), and in meta-analyses of resilience work (Lee et al., 2013).

Whereas there is evidence for measuring resilience as a single construct or as a hierarchical construct, most resilience measures view resilience as a single construct (Ahern et al., 2006). Even when the scale is multidimensional (e.g. ARS, BPF1, CD-RISC, RSA, RS), scoring these scales may yield one composite score of resilience. Thus, the theoretical conceptualization of resilience (Connor, 2006; Luthar et al., 2000; Luthar & Brown, 2007) may not be accurately measured using existing scales (Ahern et al., 2006). This is an issue, because if resilience is a hierarchical construct, but is measured as a single construct, then any findings may not be valid due to incorrect measurement that does not take into account the multidimensional nature.

The purpose of this study was to investigate a possible hierarchical conceptualization of resilience. Based on a review of the literature, eight constructs (purpose in life, self-esteem, life satisfaction, cognitive flexibility, proactive coping, social support, locus of control, and stress/coping) were initially identified as the most common constructs theorized to underlie resilience (Bradshaw et al., 2007; Burton et al., 2010; Connor, 2006; Hegney et al, 2007; Kinsel, 2005; Lee et al., 2013; Maknach, 2014; Mlinac et al., 2010; Rossi et al., 2007; Southwick et al., 2005; Wagnild & Young, 1993; Waite & Richardson, 2004). These eight constructs were measured in two different samples, along with a pre-existing measure of resilience (Wagnild & Young, 1993) to test for a hierarchical structure and for convergent validity with the existing measure.

## **Methods**

### *Participants*

Participants for this study were a convenience sample gathered from Mechanical Turk (MTurk) and a large, rural university in the northeastern United States. The total sample size was 1,220 with 500 participants recruited from MTurk, and receiving \$1.25 as compensation for participating, and 720 participants recruited from a college student sample and receiving one extra credit point as compensation for participating. The MTurk sample had an inclusion criteria of being 18 or older and a United States citizen, while the college student sample inclusion criteria was being 18 or older only. The MTurk sample was mostly white ( $N = 370$ , 74.0%) and about half female ( $N = 276$ , 55.2%), with an average age of 36.05 ( $SD = 11.32$ ). The college student sample was predominantly white ( $N = 561$ , 77.9%) and female ( $N = 566$ , 78.6%), with an average age of 19.23 ( $SD = 1.86$ ). Chi-square goodness of fit tests suggested the MTurk and college student samples had different distributions of gender identity,  $X^2(2) = 78.51$ ,  $p < .001$  and racial/ethnic identity,  $X^2(7) = 33.70$ ,  $p < .001$ . The MTurk sample had a more even distribution of men and women compared to the college student sample, but no specific pattern of differences in racial/ethnic identity emerged across samples. The MTurk sample ( $M = 36.06$ ,  $SD = 11.32$ ) was also older than the undergraduate sample ( $M = 19.23$ ,  $SD = 1.86$ ), Welch's  $t(515.66) = -32.87$ ,  $p < .001$ , Cohen's  $d = 33.00$  (four participants chose not to report their age). Thus, the two samples provided somewhat different characteristics from which to assess the nature of resilience.

### *Measures*



Purpose in Life. Purpose in life was measured using the Purpose in Life Test - Revised (PIL-R) (Harlow, Newcomb & Bentler, 1987). The PIL-R measures if individuals perceive their life as significant (Crumbaugh & Maholick, 1964). This scale is 20 items long and measured on a 7-point scale where 1 = Strongly Disagree and 7 = Strongly Agree. A sample item is “Life to me seems always exciting.” The PIL-R has some evidence for convergent validity with measures of happiness and for divergent validity with measures of meaningless (Harlow et al., 1987). The 17<sup>th</sup> item of this measure (i.e., “I regard my ability to find a meaning, purpose, or mission in life as very great”) was accidentally omitted from the survey and thus only the 19 remaining items were included here. Still, the slightly adjusted PIL-R had excellent internal consistency in the MTurk sample (Cronbach’s alpha = .91; coefficient omega = .92, 95% CI [.90, .93]), and college student sample (Cronbach’s alpha = .84; coefficient omega = .84, 95% CI [.82, .86]).

Self-Esteem. Self-esteem was measured using the Rosenberg Self-Esteem Scale (Rosenberg, 1965), which assesses an individual’s perception of his or her self-worth. This scale is 10 items long and uses a 4-point scale where 1 = Strongly Disagree and 4 = Strongly Agree. A sample item is “On the whole, I am satisfied with myself.” This scale showed excellent internal consistency in the MTurk sample (Cronbach’s alpha = .94; coefficient omega = .94, 95% CI [.93, .95]), and good internal consistency in the college student sample (Cronbach’s alpha = .89; coefficient omega = .89 95% CI [.88, .90]).

Satisfaction with Life. Global life satisfaction was measured using the Satisfaction with Life Scale (Diener, Emmons, Larsen & Griffin, 1985). It is 5 items long and

measured on a 7-point scale where 7 = Strongly Agree and 1 = Strongly Disagree. A sample item is “In most ways my life is close to my ideal.” This scale showed excellent internal consistency in the MTurk sample (Cronbach’s alpha = .92; coefficient omega = .92 95% CI [.90, .93]), and the college student sample (Cronbach’s alpha = .89; coefficient omega = .89 95% CI [.87, .90]).

Cognitive Flexibility. Cognitive flexibility was measured using the Cognitive Flexibility Scale (Martin & Rubin, 1995). This scale is 12 items long and designed to measure an individual’s ability to identify alternatives to a situation, their willingness to be flexible with said alternatives, and their self-efficacy for flexibility. The scale is measured on a 6-point scale where 6 = Strongly Agree and 1 = Strongly Disagree. A sample item is “I am willing to listen and consider alternatives for handling a problem.” In the MTurk sample, this scale showed acceptable internal consistency (Cronbach’s alpha = .76; coefficient omega = .79 95% CI [.76, .82]) and somewhat weak internal consistency in the college student sample (Cronbach’s alpha = .63; coefficient omega = .66 95% CI [.61, .69]). Removing item 10 from the college student sample improved the internal consistency to alpha = .72, coefficient omega = .71, 95% CI [.67, .74], so an adjusted version of the cognitive flexibility measure was used in this study to meet acceptable reliability recommendations. Removing item 10 in the MTurk sample resulted in an internal consistency of alpha = .83; coefficient omega = .84, 95% CI [.81, .86].

Proactive Coping. Proactive coping was measured using the Proactive Coping Scale (Greenglass, Schwarzer, Jakubiec, Fiksenbaum & Taubert, 1999). This scale was designed to measure regulatory behavior when there is a possible threat to that

behavior, and the ability to plan ahead of time to avoid disruption. The scale is 14 items long and measured on a 4-point scale where 1 is Not at all True and 4 is Completely True. A sample item is “Despite numerous setbacks, I usually succeed in getting what I want.” This scale showed acceptable internal consistency in the MTurk sample (Cronbach’s alpha = .75; coefficient omega = .82 95% CI [.80, .85]), and somewhat weak internal consistency in the college student sample (Cronbach’s alpha = .65; coefficient omega = .72, 95% CI [.68, .75]). Deleting item 8 from the college student sample improved the reliability to .74; coefficient omega = .86, 95% CI [.84, .88], thus an adjusted version of the proactive coping measure was used for analysis in this study to meet acceptable reliability guidelines. Removing item 8 in the MTurk sample resulted in an internal consistency of .84; coefficient omega = .77, 95% CI [.75, .80]. Convergent validity for this scale exists with self-efficacy, proactive attitude, and active coping measures (Greenglass et al., 1999).

Social Support. Social support was measured using the Multidimensional Scale of Perceived Social Support (MSPSS) (Zimet, Dahlme, Zimet & Farley, 1988). This scale was 12 items long and used a 7-point scale where 1 = Very Strongly Disagree and 7 = Very Strongly Agree. This scale has three subscales which measure perceived support from family, friends, and a significant other. Only the total scale was used for analysis. Zimet et al. (1988) found discriminant validity with a depression measure in their study. The MSPSS had excellent internal consistency in the MTurk sample (Cronbach’s alpha = .94; coefficient omega = .92 95% CI [.89, .94]), and excellent internal consistency in the college student sample (Cronbach’s alpha = .93; coefficient omega = .93 95% CI [.92, .94]).

Locus of Control. Locus of control was measured by the Health Locus of Control Scale (Wallston, Wallston, Kaplan & Maides, 1976). This scale was designed to measure both external and internal locus of control of one's individual health, or in other words, if one can control their health by their actions (internal) or if their health is determined by outside forces (external). This scale is 11 items long and measured on a 6-point scale where 1 = Strongly Disagree and 6 = Strongly Agree. A sample item is "I am directly responsible for my health." The overall scale showed poor internal consistency in the MTurk sample (Cronbach's alpha = .52; coefficient omega = .26 95% CI [.04, .43]), but the internal locus of control subscale showed acceptable reliability (Cronbach's alpha = .74; coefficient omega = .74, 95% CI [.70, .78]). In the college student sample, the overall scale showed poor internal consistency as well (Cronbach's alpha = .54; coefficient omega = .36 95% CI [.10, .52]) and weak internal consistency in the internal locus of control subscale (Cronbach's alpha = .63; coefficient omega = .63 95% CI [.58, .67]). Wallston et al. (1976) found some evidence for convergent validity with the Rotter Internal-External Locus of Control Scale, the scale was initially retained for use in the current study, but is dropped early in the analyses.

Stress Management. The Rhode Island Stress and Coping Inventory (RISCI) was used to measure stress management (Fava, Ruggiero & Grimley, 1998). This scale has 12 items designed to assess perceived stress and coping abilities. The RISCI is measured on a 5-point scale where 1 = Never and 5 = Frequently. This scale showed acceptable internal consistency in the MTurk sample (Cronbach's alpha = .73; coefficient omega = .69 95% CI [.58, .75]), and acceptable internal consistency in the college student

sample (Cronbach's alpha = .72; coefficient omega = .64 95% CI [.45, .71]). This measure also ended up being dropped during the analyses.

Resilience. A measure of resilience using an already established scaled was collected using the Resilience Scale (Wagnild & Young, 1993). The resilience scale is 25 items long measured where 1 = Disagree and 7 = Agree. A sample item is "In an emergency, I'm someone people generally can rely on." This scale had excellent internal consistency in the MTurk sample (Cronbach's alpha = .95; coefficient omega = .95 95% CI [.94, .95]), and excellent internal consistency in the college student sample (Cronbach's alpha = .91; coefficient omega = .91 95% CI [.90, .92]).

### *Procedure*

Participants for this study completed a set of surveys online through Google Forms. The first screen showed a consent form informing participants that this study was approved by an Institutional Review Board and asked participants to please provide their consent before continuing with the study. If the participant chose to continue, they were asked to complete the nine resilience measures, demographics, and several other measures unrelated to the current study. After completion, participants were thanked for their participation and given contact information in case they had any questions about the study.

## **Results**

Prior to any analyses, all missing data were imputed using maximum likelihood (ML) and the expectation-maximization algorithm. There was 3.28% of the data missing, falling under the conventional guidelines for using ML imputation (Gold & Bentler, 2000). The first step of analyses was to conduct assumption checks for normality and multicollinearity among the purpose in life, self-esteem, life

satisfaction, cognitive flexibility, proactive coping, social support, health locus of control, and stress/coping measures. All measures except social support showed skewness and kurtosis values within -1.00 and +1.00 in both the MTurk and college samples, indicating reasonable univariate normality. Social support was slightly skewed in the college student sample (-1.14), and the Shapiro-Wilk test was significant ( $p < .001$ ), but interpreting the Q-Q plot suggested that the slight skewness was of little concern. A correlation matrix between all eight variables showed that no variable was correlated above  $\pm .70$ , indicating no issues of multicollinearity (Harlow, 2014).

Before the main analyses, a one-way multivariate analysis of variance (MANOVA) assessed if any of the eight variables, plus the resilience measure, were significantly different across the MTurk and college student samples. The omnibus MANOVA result was significant, Pillai's Trace = .16,  $F(9, 1210) = 25.03$ ,  $p < .001$ , partial eta-squared = .16. Pillai's Trace was used because there were issues with heteroscedasticity in several variables, and Pillai's Trace is more robust against violations of homoscedasticity than Wilks' Lambda (Harlow, 2014). MTurk users scored slightly higher on cognitive flexibility (partial eta-squared = .01; Cohen's  $d = .18$ ), but college students scored slightly higher on purpose in life (partial eta-squared = .004; Cohen's  $d = .13$ ), life satisfaction (partial eta-squared = .04; Cohen's  $d = .38$ ), proactive coping (partial eta-squared = .01; Cohen's  $d = .22$ ), social support (partial eta-squared = .06; Cohen's  $d = .50$ ), and stress/coping (partial eta-squared = .04; Cohen's  $d = .38$ ). There were no statistically significant differences in resilience, self-esteem, or health locus of control. Despite a number of significant differences, all of

the effect sizes were small, or did not reach the criteria for a small effect excluding social support which reached a medium effect size (Cohen, 1988). Thus, a decision was made to merge the samples when appropriate, realizing that there may an issue with the social support variable. For all descriptive statistics, please see Table 1.

#### TABLE 1 GOES ABOUT HERE

The next step of analyses was to conduct an exploratory factor analysis (EFA), minimum average partial (MAP), and parallel analysis on the MTurk and college student samples separately. A random subset of 200 participants from each sample was used for this step, and the remaining participants were saved for use in the confirmatory step.

When analyzing the MTurk sample, all eight composite scores were put into an unrestricted EFA, using principal axis factoring with promax rotation. The number of eigenvalues greater than 1.0 suggested a three-factor solution, explaining 75.87% of the variance. However, EFA tends to over or under extract factors (Velicer, 1976), so a MAP test and parallel analysis (Horn, 1965) were also conducted to assess further the number of factors to extract. Both the MAP test and parallel analysis suggested a one-factor solution. As it made theoretical sense for there to be only one hierarchical factor of resilience, the EFA was re-conducted restricting the number of factors extracted to one.

The restricted EFA used principal axis factoring for extracting the single factor that explained 47.22% of the variance in the eight composites. No rotation was done because only one factor was extracted. The loadings are shown in Table 2.

As health locus of control and stress and coping did not load greater than  $|\cdot 29|$ , these variables were dropped from further analysis (Harlow, 2014). The MAP test and parallel analysis were re-conducted with health locus of control and stress and coping removed, and both tests still suggested a one-factor solution. The restricted EFA was also re-conducted, with the single factor explaining 62.88% of the variance in the six retained composites for the MTurk sample. The loadings are shown in Table 3.

The same analyses were conducted on the college student sample separate from the MTurk sample. The unrestricted results suggested a 3-factor solution, explaining 72.78% of the variance. However, the MAP test and parallel analyses suggested a one-factor solution, so the EFA was re-conducted restricting the number of factors extracted to 1. The single factor from the restricted EFA explained 42.62% of the variance in the composites in the college sample; loadings are shown in Table 2.

Health locus of control and stress and coping did not load greater than  $|\cdot 29|$  in this sample as well, so it was dropped from further analyses (Harlow, 2014). When re-conducting the MAP test and parallel analysis still suggested one factor, which explained 55.35% of the variance in the six composites in the college sample. The loadings are shown in Table 3.

#### TABLES 2 AND 3 GO ABOUT HERE

Based on the results of the EFA in the MTurk and college student samples, the next step was to conduct confirmatory factor analyses (CFA). The CFA was conducted with data from the remaining 300 participants in the MTurk sample, and the remaining 520 participants in the college student sample. Three nested models were built in both samples: a perfect model where all loadings were fixed to 1.0, an estimated model



where the factor variance was fixed at 1.0 to identify the metric used for the estimated constructs loading onto the factor, and a restricted model where loadings were restricted to be equal across the six constructs. If the perfect model fit well, it would imply that there was a single factor of resilience and each scale was a perfect indicator. This model was not expected to hold. If the estimated model fit well, it would suggest there was a single factor and each scale was an indicator of resilience but in different amounts. If the restricted model fit well, it would imply a single factor of resilience and each scale was equally similar in assessing resilience. The restricted model was not expected to hold either. A chi-square test, the comparative fit index (CFI), root mean square error of approximation (RMSEA), and standardized root mean square residual (SRMR) were used as fit indices for these models, where a CFI greater than .90/.95 shows good and great fit, an RMSEA lower than .10/.08/.05 shows acceptable, good, and great fit, respectively, and an SRMR of .08 or less indicated acceptable fit (Hu & Bentler, 1999; Steiger & Lind, 1982). A non-significant chi-square test indicates good fit, but the chi-square test is extremely sensitive and a significant result is not necessarily indicative of poor fit (Harlow, 2014; Kline, 2015).

In the MTurk sample, the perfect loadings model showed poor fit,  $\chi^2(14) = 430.11, p < .001, CFI = 0.63, RMSEA = .32, SRMR = .29$ . The estimated model, with factor variance fixed at 1.0, showed good fit with the CFI (0.92) and an SRMR of .06. However, there was a significant chi-square,  $\chi^2(9) = 99.85, p < .001$  and an RMSEA = .18. Given the evidence, it was decided that the estimated model showed acceptable fit, based on the reasonable CFI and SRMR values. The constrained equal loadings model showed poor fit,  $\chi^2(14) = 430.11, p < .001, CFI = 0.63, RMSEA = .32, SRMR$

= .29. Based on the results of the three models, the estimated model showed the best fit with the data based on two of the four fit indices used. Thus, the estimated model was retained for further analysis.

When analyzing the loadings of the estimated model, z-tests were used to identify which loadings were significant (Harlow, 2014). The loadings were interpreted as an effect size measure where .1-.29 was small, .3-.49 was medium, and .5 or above was large (Cohen, 1988). The  $R^2$  values for how much each variable added to the model were also interpreted using guidelines of .02-.13 were small, .14-.25 were medium, and .26 or above were large (Cohen, 1988). The results showed that each loading was significant, and all showed a large effect size when interpreting the loadings and  $R^2$  values. The full results are shown in Table 4, and depicted in Figure 1.

#### FIGURE 1 GOES ABOUT HERE

The same sets of models were assessed in the college student sample. The perfect loading model showed poor fit,  $\chi^2(14) = 588.82, p < .001, CFI = 0.54, RMSEA = .28, SRMR = .31$ . The estimated CFA, with the factor variance fixed at 1.0, showed acceptable fit,  $\chi^2(9) = 130.49, CFI = .90, RMSEA = .16, SRMR = .07$ . Finally, the CFA that constrained loadings to be equal showed poor fit,  $\chi^2(14) = 588.79, p < .001, CFI = 0.54, RMSEA = .28, SRMR = .31$ . Similar to the MTurk sample, the estimated model was the only model which showed a reasonable fit to the data using two out of four fit indices in the college student sample. Thus, the estimated model was again retained for further analysis.

The significance of the individual loadings were interpreted using z-tests, and loadings and  $R^2$  were interpreted as effect sizes. All loadings were significant, and most of the effect sizes were large. Detailed results are shown in Table 4 and Figure 2.

#### FIGURE 2 GOES ABOUT HERE

Based on the results of the MTurk and college student samples, three additional steps were taken in the analyses. First, a multiple sample analysis (MSA) assessed if the model was invariant across samples. The MSA was conducted with purpose in life fixed at 1.0 to identify the metric for the remaining loadings as it was in the estimated CFA model. The MSA showed configural invariance, meaning the same model fit reasonably well across both samples,  $\chi^2(18) = 230.34, p < .001, CFI = 0.91, RMSEA = .17, SRMR = .07$ . Once the loadings were restricted to be equal in both samples, the MSA did not fit quite as well,  $\chi^2(18) = 254.66, p < .001, CFI = 0.90, RMSEA = .16, SRMR = .09$ .

The second additional step was to assess the estimated CFA using the merged MTurk and college student samples. The estimated model was analyzed using the entire sample ( $N = 1,220$ ), and the loading for purpose in life was still fixed at 1.0 to identify the metric for remaining loadings. The estimated CFA showed acceptable fit,  $\chi^2(9) = 362.53, p < .001, CFI = 0.90, RMSEA = .18, SRMR = .07$ . Z-tests, loadings, and  $R^2$  values were interpreted, and all loadings were significant with large effect sizes. Detailed results are in Table 4 and Figure 3.

#### TABLE 4 AND FIGURE 3 GO ABOUT HERE

The third additional step was to explore some apparent residual variance between the cognitive flexibility and proactive coping in both samples. In the MTurk sample, there was some residual variance between cognitive flexibility and proactive

coping (.22), and about the same amount of residual variance in the undergraduate student sample (.25). Two approaches were taken to explore this additional variance. First, a correlated error term was added between cognitive flexibility and proactive coping. This resulted in improved model fit in the MTurk sample  $\chi^2(8) = 39.21, p < .001, CFI = 0.97, RMSEA = .11, SRMR = .04$  and undergraduate student sample,  $\chi^2(8) = 69.14, p < .001, CFI = 0.95, RMSEA = .12, SRMR = .05$ . Second, a correlated two-factor model was built with purpose in life (fixed at 1.0), self-esteem, life satisfaction, and social support loading on the first factor and cognitive flexibility (fixed at 1.0) and proactive coping loading on the second factor. The two factor model showed improved fit in the MTurk  $\chi^2(8) = 39.21, p < .001, CFI = 0.97, RMSEA = .11, SRMR = .04$  and undergraduate student sample as well,  $\chi^2(8) = 69.14, p < .001, CFI = 0.95, RMSEA = .12, SRMR = .05$ . These post hoc models were not interpreted further because they may well only fit these two samples, but future research may want to keep this finding in mind in replication or other studies.

The last step in the analyses was testing a correlated CFA model to look for convergent validity between the hierarchical resilience factor and the resilience scale. The hierarchical resilience factor was built using the estimated model as described above, and the resilience scale was created as a separate factor where the composite score had a fixed perfect loading. Finally, the correlation between the two factors was estimated. This model showed acceptable fit,  $\chi^2(13) = 519.57, p < .001, CFI = 0.90, RMSEA = .18, SRMR = .07$ , and found a strong, positive correlation between the hierarchical resilience factor and the resilience scale,  $r = .84, p < .001, R^2 = .71$ .

## **Discussion**

The purpose of this study was to examine a hierarchical construct of resilience, where resilience was initially measured using eight underlying constructs (purpose in life, self-esteem, life satisfaction, cognitive flexibility, proactive coping, social support, locus of control, and stress/coping). Initial testing suggested a single global resilience factor could be identified using the eight separate constructs with the current sample(s) (Connor, 2006; Luthar et al., 2000). Exploratory factor analyses showed that locus of control and stress/coping did not load well onto the resilience construct, and so were removed from further analysis. Confirmatory factor analyses showed that the hierarchical model fit reasonably well in the MTurk and college student samples, and a multiple sample analysis showed reasonable model fit across samples. A two-factor correlated CFA found a strong, positive correlation between the hierarchical construct and the resilience scale, further validating the hierarchical model.

The results of this study further support viewing resilience as a hierarchical multi-faceted construct rather than a single construct (Cleland et al., 2010; Connor, 2006; Hegney et al., 2007; Luthar et al., 2000; Luthar & Brown, 2007). The implications of these results could lead to significant developments within the field of resilience research. If using the hierarchical construct in future studies, it will be necessary to use multiple measures to identify the resilience factor, which makes measurement much more difficult due to increased participant burden. This will also lead to increased difficulties with missing data, and may impact attrition rates in any longitudinal studies. Despite these issues, the results also provide a solid foundation for examining other possible constructs which may underlie resilience (Connor, 2006; Luthar et al., 2000; Luthar & Brown, 2007). These findings could also help inform

future studies examining if resilience is a trait or process and if resilience is context specific or not. Additionally, these results further validate the Resilience Scale (Wagnild & Young, 1993), as a strong positive correlation was found between both the hierarchical and single factor conceptualizations of resilience.

There are several limitations to the current study. First, the health locus of control scale (Wallston et al., 1976) may not have been the best measure of locus of control to use since it is specific to health, and did not include all facets of locus of control. Second, eight constructs were initially examined to measure resilience in this study, but other researchers have theorized even more than the eight constructs used in this study as possible components of resilience; perhaps up to 17 different constructs (Bradshaw et al., 2007; Burton et al., 2010; Connor, 2006; Hegney et al, 2007; Kinsel, 2005; Lee et al., 2013; Maknach, 2014; Mlinac et al., 2010; Rossi et al., 2007; Southwick et al., 2005; Wagnild & Young, 1993; Waite & Richardson, 2004). Whereas it may well be that more constructs are needed to fully define the hierarchical construct, this study is an informative first step in that direction. Third, the cognitive flexibility, proactive coping, and locus of control measures did not reach acceptable levels of internal consistency in the college student sample, which could be one explanation of why the estimated college student sample CFA did not fully achieve desired CFI levels for good model fit (Hu & Bentler, 1999). Another reason may be that college samples may need a slightly different conceptualization for resilience than may be the case for the older, more diverse MTurk sample, suggesting there may be developmental differences in resilience throughout the lifespan. Additionally, the

omitted items in the PIL-R, cognitive flexibility, and proactive coping measures may limit the amount of information available to completely identify these constructs.

There are several directions for future research based on the results of this study. The hierarchical construct could be replicated using the technique of constructive replication (Lykken, 1968), to verify the nature of resilience in various samples and conditions. It also may be that fewer constructs are needed to replicate the hierarchical resilience factor, particularly if some of the six constructs examined here could be dropped with little loss in validity evidence (e.g., R-squared values). This would make future studies easier to conduct since participants may not have to complete six or more measures to assess resilience. Other research could be done to further validate other measures of resilience with the hierarchical model, lending further validity to these measures (Ahern et al., 2006). Research could also be conducted using the hierarchical factor and behavior, and testing could be done to see if resilience acts differently in different contexts. For example, it may well be that social support is more crucial than self-esteem or cognitive flexibility when recovering from trauma, but self-esteem and cognitive flexibility may be utilized more when facing a difficult situation at work or at home. Additionally, based on the residual variance between cognitive flexibility and proactive coping, both of which are cognitive/behavioral in nature, there may well be psychosocial (e.g. purpose in life, social support, life satisfaction, self-esteem) and cognitive (e.g. proactive coping and cognitive flexibility) components to resilience which merit further investigation. Future research could consider each of these and other areas, to gain a better understanding of the process and manifestation of resilience.

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Table 1

*Mean and Standard Deviations by MTurk and College Student Samples*

	Mean	S.D.	Mean	S.D.
Variable	(MTurk)	(MTurk)	(College)	(College)
Resilience Scale	5.43	.96	5.44	.74
Purpose in Life	4.92	1.02	5.04	.71
Self-Esteem	4.01	.72	4.01	.59
Life Satisfaction	3.24	1.11	3.63	.88
Cognitive Flexibility	4.50	.60	4.40	.51
Proactive Coping	2.88	.40	2.96	.32
Social Support	5.24	1.42	5.86	1.11
Health Locus of Control	3.43	.57	3.48	.54
Stress and Coping	3.24	.58	2.45	.51

*Note: MTurk is short for Mechanical Turk.*

Table 2

*MTurk and College Student EFA Initial Results*

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Construct	MTurk	College Student
	Loadings	Loadings
Purpose in Life	.93	.83
Self-Esteem	.89	.81
Life Satisfaction	.72	.77
Cognitive Flexibility	.65	.55
Proactive Coping	.64	.49
Social Support	.62	.62
Health Locus of Control	-.01	-.05
Stress and Coping	.06	.26

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Table 3

*MTurk and College Student EFA Final Results*

Construct	MTurk	College Student
	Loading	Loadings
Purpose in Life	.93	.83
Self-Esteem	.89	.83
Life Satisfaction	.72	.78
Cognitive Flexibility	.65	.53
Proactive Coping	.64	.46
Social Support	.62	.63

*Note: MTurk is shortened for Mechanical Turk and EFA is shortened for Exploratory Factor Analysis.*

Table 4

*Estimated Confirmatory Factor Analysis Results*

Variable	Parameters			R <sup>2</sup>
	Loading	z-value	p-value	
<i>MTurk</i>				
Purpose in Life	.94	21.28	<.001	.89
Self-Esteem	.88	23.81	<.001	.78
Life Satisfaction	.73	16.23	<.001	.54
Cognitive Flexibility	.64	13.01	<.001	.45
Proactive Coping	.64	13.19	<.001	.47
Social Support	.63	12.94	<.001	.41
<i>College Student</i>				
Purpose in Life	.87	23.43	<.001	.75
Self-Esteem	.83	24.76	<.001	.69
Life Satisfaction	.68	20.46	<.001	.46
Cognitive Flexibility	.53	13.20	<.001	.28
Proactive Coping	.45	11.75	<.001	.20
Social Support	.67	18.65	<.001	.45
<i>Merged Sample</i>				
Purpose in Life	.91	39.41	<.001	.82
Self-Esteem	.85	38.52	<.001	.73
Life Satisfaction	.71	29.26	<.001	.50
Cognitive Flexibility	.58	20.29	<.001	.34
Proactive Coping	.57	20.37	<.001	.32
Social Support	.64	24.91	<.001	.40

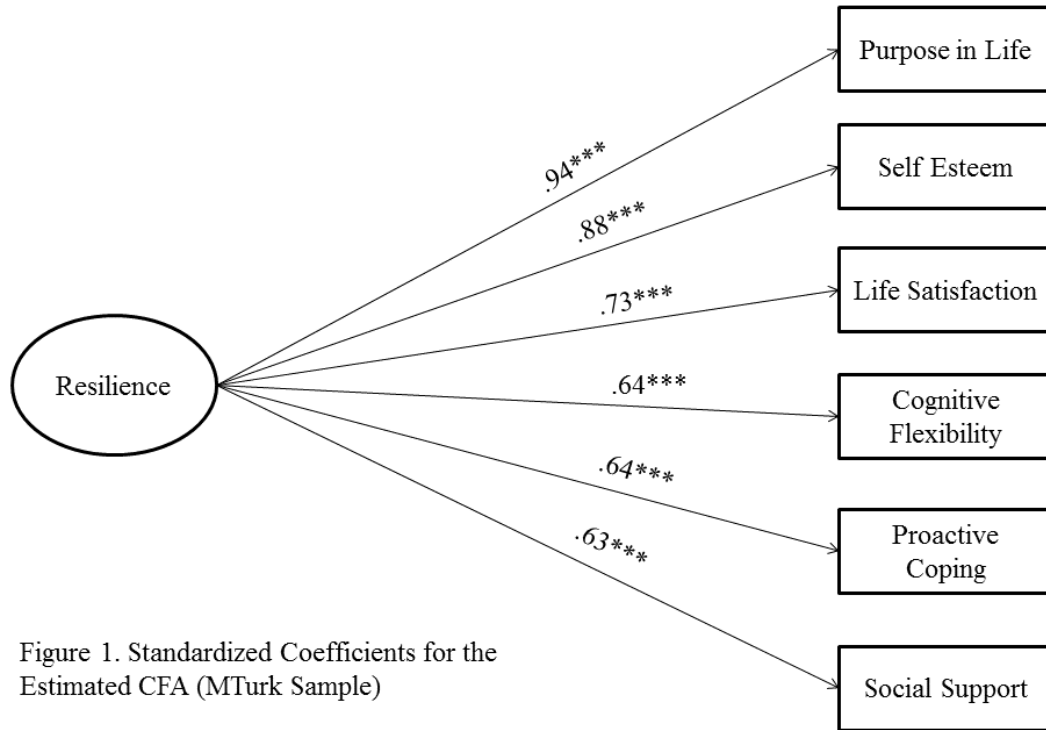


Figure 1. Standardized Coefficients for the Estimated CFA (MTurk Sample)

p < .001 = \*\*\*



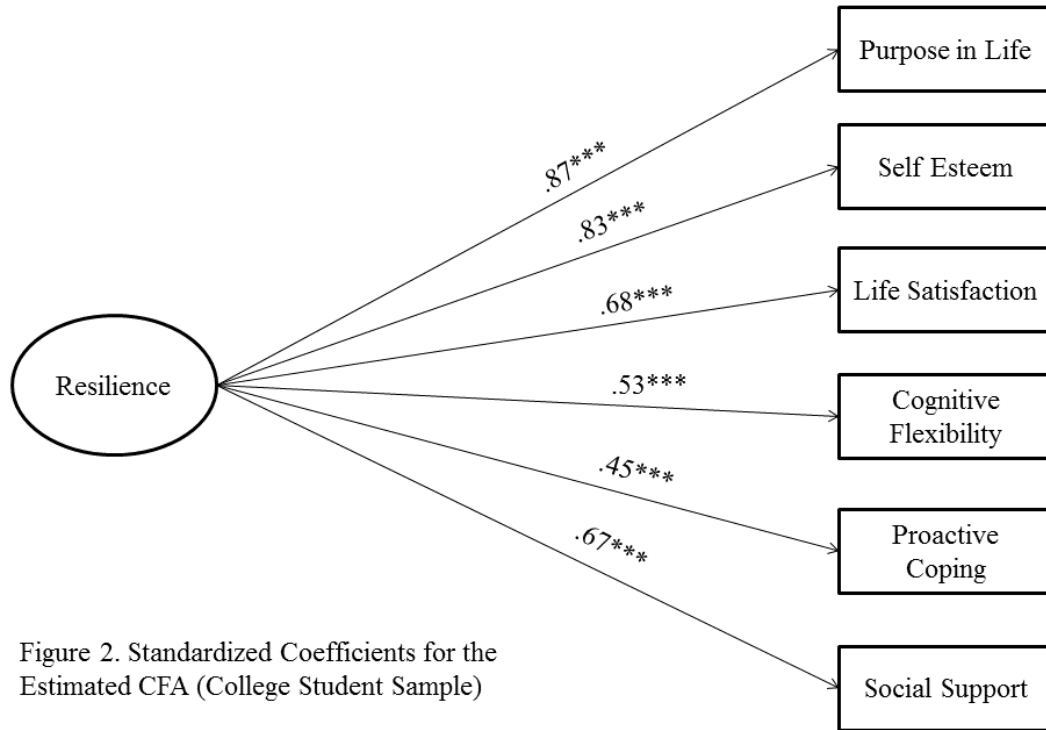


Figure 2. Standardized Coefficients for the Estimated CFA (College Student Sample)

$p < .001 = ***$

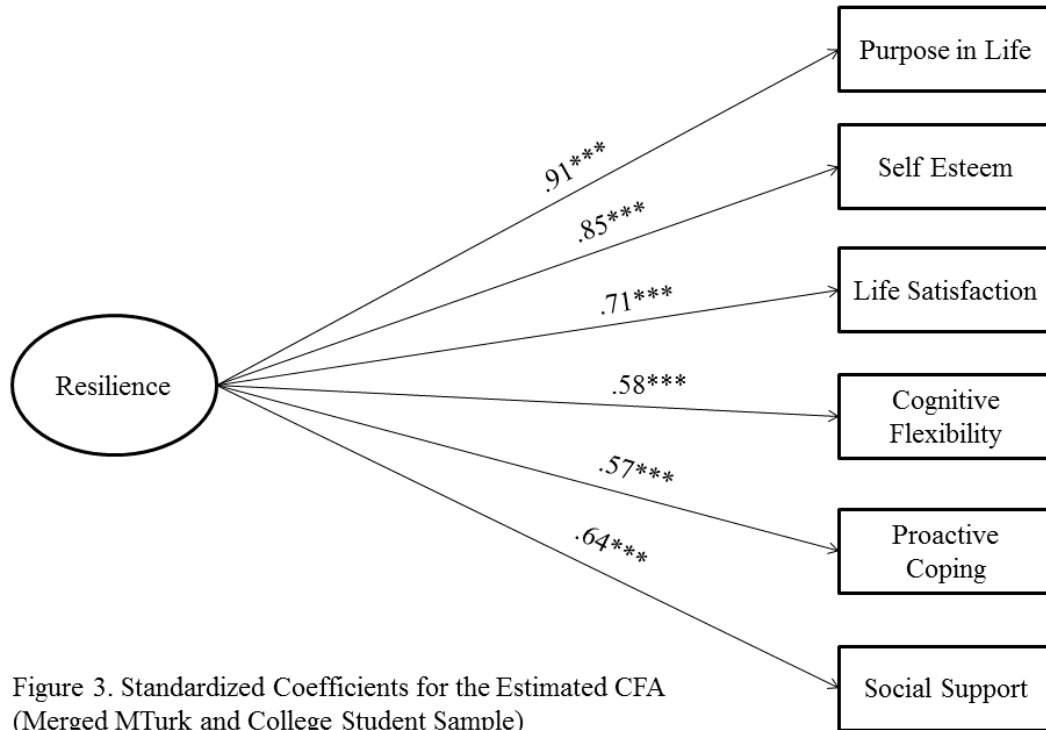


Figure 3. Standardized Coefficients for the Estimated CFA (Merged MTurk and College Student Sample)

$p < .001 = ***$

**MANUSCRIPT – 2**

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Don't Stop Now, You're Doing Great! Resilience as a Mediator of Barriers to  
Physical Activity

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Don't Stop Now, You're Doing Great! Resilience as a Mediator of Barriers to  
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## Abstract

Many individuals face barriers to performing recommended levels of physical activity. Resilience, commonly defined as positively adapting to adverse circumstances, is a psychological construct which may help individuals overcome barriers to physical activity but has rarely been studied in this context. This study used samples from Mechanical Turk ( $n = 500$ ) and college students ( $N = 720$ ) and structural equation models to examine if resilience was a mediator of the relationship between barriers to physical activity and physical activity. A full model with both mediating and direct paths was the best fitting, ( $\chi^2 (18) = 333.48, p < .001, CFI = .90, RMSEA = .12, SRMR = .06$ ). Standardized coefficients showed that barriers to physical activity was negatively related to the mediator, resilience, which in turn was positively related to physical activity. However, there was also a significant direct, negative relationship between barriers to physical activity and physical activity using metabolic equivalents and exercise frequency measures. These results suggest that resilience is a partial mediator between barriers to physical activity and physical activity, but other factors may also explain this relationship. Future research should consider examining the relationship between resilience and physical activity over time, or in at-risk samples.

### Keywords

Resilience, Physical Activity, Barriers to Physical Activity

## Don't Stop Now, You're Doing Great! Resilience as a Mediator of Barriers to Physical Activity

### **Introduction**

It is well known that most people in the United States do not meet the recommended guidelines for physical activity (CDC, 2014). In fact, some studies show that fewer than 10% of adults reach these recommendations (Tucker, Welk & Beyler, 2011). It is perhaps equally well known that many successful physical activity interventions exist, but that the gains made in these programs are rarely maintained after its conclusion (Nigg, Borrelli, Maddock & Dishman, 2008). In other words, these programs help individuals start being active, but are not effective at keeping individuals active once the program ends. Once the participant loses the structure provided by the intervention, it is common for many participants to relapse into their previously sedentary behavior (Nigg et al., 2008). This is not to say that current interventions do not entail high-quality research. A recent review of Lemon and her colleagues (2016) found that many weight-loss interventions, including studies with both diet and exercise components, are methodologically rigorous. However, of the 90 articles Lemon et al. reviewed, close to half (47.4%) showed no effect (Cohen's  $d < .2$ ) at the final follow-up time point post-intervention. These findings suggest the end of the intervention is an adverse event for participants, who can either thrive (i.e. continue their activity) or decline to ceasing his or her activity entirely. Similar patterns are seen outside the context of intervention programs such as when an individual starts an activity program on his or her own or with friends and family (Marcus, Forsyth, Stone, Dubbert, McKenzie, Dunn & Blair, 2000). This issue of physical activity maintenance,

or exercise adherence, has been studied consistently for over 40 years (Dishman, 1994; Dishman, 1982), but merits continual investigation since maintaining physical activity is difficult for many individuals. One construct which has not often been studied in the context of physical activity maintenance, but may be helpful in sustaining physical activity, is resilience.

Resilience has multiple definitions, but is commonly defined as positive adaptation in the face of adversity (Cleland, Ball, Salmon, Timperio & Crawford, 2010; Hegney, Buikstra, Baker, Rogers-Clark, Pearce, Ross, King & Watson-Luke, 2007; Kinsel, 2005; Masten, Cutuli, Herbers & Reed, 2009; Waite & Richardson, 2004). In the context of physical activity, adversity could come in many different forms. As stated above, it could be at the conclusion of a physical activity intervention when the individual loses the routine that he or she was previously following. Other possible adverse events could be life events such as vacations, moving, changing jobs, having children, holidays, or injuries (Allender, Cowburn & Foster, 2006; Allender, Hutchinson & Foster, 2008; Brown, Heesch, & Miller, 2009). Changes in social support for exercise or decreased motivation for exercise in general could be other adverse events that could also have a negative impact on physical activity (Wallace & Buckworth, 2003). Regardless of the event, most adults experience some sort of decrease in physical activity participation throughout their life (Nigg et al., 2008), suggesting that many events besides the ones listed here could adversely impact physical activity. The issue then becomes aiding individuals to positively adapt towards whatever adverse circumstances arise and remain physically active. Thus,

increasing resilience to these events may be one way to help individuals maintain physical activity (Southwick & Charney, 2012).

There are two main conceptualizations of resilience in the current literature. The first view sees resilience as a single construct, or one global idea unto itself (Ahern, Kiehl, Sole & Byers, 2006; Boardman, Blalock & Button, 2007; Bonanno, Galea, Bucciarelli, & Vlahov, 2007; Campbell-Sills, Cohan & Sills, 2006). The second view suggests that resilience is a hierarchical construct, made up of other psychological constructs (Ahern et al., 2006; Connor, 2006; Kunicki & Harlow, 2017). Some of the constructs theorized to underlie resilience have been previously studied in relation to physical activity. Examples include self-esteem (Fox, 2000; Sonstroem, Harlow & Josephs, 1994; Sonstroem & Morgan, 1989), cognitive flexibility (Masley, Roetzheim & Gualtieri, 2009), and social support (Duncan, Duncan & Strycker, 2005; Hohepa, Scragg, Schofield, Kolt & Schaaf, 2007; Prochaska, Rodgers & Sallis, 2002).

One example of resilience and physical activity comes from an intervention designed to increase resilience among type II diabetes patients (Bradshaw, Richardson, Kumpfer, Carlson, Stanchfield, Overall, Brooks & Kulkarni, 2007). This study took place over six months, and participants were either given standard treatment or treatment with resiliency classes. Resilience was measured by purpose in life, self-efficacy, social support, and locus of control. This intervention was effective at increasing resilience, and participants in the intervention group also increased physical activity at three months compared to the control group. However, at the six-month time point there were no differences in physical activity between the two groups. This is likely explained by the goal of this intervention to increase resiliency,



not physical activity, although one of the goals of the intervention was to mitigate risk factors of diabetes as well.

Cleland and colleagues (2010) examined the relationships between resilience and physical activity in a population of low SES women in an Australian city. Resilience was measured by enjoyment, self-efficacy, and having a routine for physical activity. Physical activity was measured using the International Physical Activity Questionnaire, and categorized as either meeting or missing the recommended activity guidelines. The results showed that women with higher self-efficacy for walking (Prevalence Ratio [PR] = 2.05, 95% CI = 1.19 - 3.53), who enjoyed walking more (PR = 1.97, 95% CI = 1.12 - 3.45), and who had set routines (PR = 1.91, 95% CI = 1.18-3.09) were associated with meeting the activity guidelines. These results are encouraging, as they show a direct link between resilience constructs and physical activity. However, the cross-sectional design means no direction of effects can be made, and these measures of resilience did not use a resilience scale or take into account several other possible measures of resilience (e.g. social support, locus of control, positive emotions).

A qualitative study of rheumatoid arthritis patients from Denmark explored the experience of physical activity maintenance, and found themes similar to some resilience traits (Loeppenthin, Esbensen, Ostergaard, Jennum, Thomsen & Midtgaard, 2014). A sample of 16 physically active patients were interviewed, asking questions about challenges to being active, support systems for staying active, and important experience for being active among other questions. The results revealed themes of joyful sense of being, experiencing a community with others, taking responsibility for

life, and several others. These themes map onto several resilience themes, (e.g. joyful sense of being is similar to positive emotions, experiencing a community with others is similar to social support, and taking responsibility for life is similar to internal locus of control). These results also lend support to the idea that physical activity and resilience may be related, even if the idea was not directly explored within this study.

At a national level, a study of resilience and physical activity is being conducted as part of the Resilience and Activity for Every Day (READY) program in Australia, which is designed to increase resilience and physical activity levels in coronary heart disease patients (Burton, Pakenham & Brown, 2009). While results from the full intervention are not yet available, results from a pilot study were published by Burton, Pakenham, and Brown (2010). The intervention targets five resilience measures: positive emotions, cognitive flexibility, social support, meaning in life, and active coping. Physical activity was measured by self-report items and then calculated into total minutes active. Participants also wore a pedometer for one week and recorded their number of steps daily. The pilot study was conducted over the course of 13 weeks, where participants attended 11 two hour long sessions designed to increase resilience. Measures were taken at the beginning and end of the study. Paired-sample *t*-tests showed significant differences in self-acceptance, valued living, and positive emotions. Several other significant results were found in other psychosocial variables, such as autonomy, mastery, personal growth, stress, and mindfulness. No other significant results were found, including the two measures of physical activity. Despite the lack of significant results in some key areas, the purpose of this pilot study was to see if a larger scale study was feasible. Since there were significant

improvements in several resilience variables, the larger study was started and results should be forthcoming in the future.

Another study on resilience and physical activity was conducted by Resnick and D'Adamo (2011) in a sample of older adults living in a retirement community. Resilience was defined by the Resilience Scale (Wagnild & Young, 1993), and Resnick and D'Adamo (2008) also gathered data on self-efficacy and positive outcome expectations. Physical activity was defined by minutes per week of moderate-level activity using a subscale of the Yale Physical Activity Survey. Resnick and D'Adamo conducted a path analysis which modeled resilience, physical activity, several demographics (e.g. marital status, comorbid illness), and other factors (e.g., health, pain, fear, negative outcome expectations). The overall model showed somewhat acceptable fit:  $\chi^2 = 45.56$ ,  $df = 25$ ,  $p = .01$ , Normed Fit Index (NFI) = .78, and root mean square error of approximation (RMSEA) = .06, but not every pathway was significant. There was a direct effect between self-efficacy and exercise ( $\beta = .35$ ), but no direct effect between resilience and exercise. Further, there was an indirect effect between resilience and exercise through negative outcome expectations. A negative relationship was found between resilience and negative outcome expectations ( $\beta = -.16$ ), and a positive relationship between negative outcome expectations and exercise ( $\beta = .14$ ). These results show a direct effect of one resilience construct (self-efficacy) on physical activity. The indirect relationship between resilience and physical activity through negative outcome expectations suggests there may be a possible mediational relationship.

Whereas the results of previous studies suggest there is a relationship between resilience, or aspects of resilience, and being physically active (Bradshaw et al., 2007; Burton et al., 2009; Burton et al., 2010; Cleland et al., 2010; Loeppenthin et al., 2014; Resnick & D'Adamo, 2008), there is no study directly testing the relationship between resilience and physical activity. Additionally, no known study has examined if resilience is related to overcoming barriers to physical activity that most individuals encounter. Thus, the purpose of this study was to examine the relationships between resilience and physical activity, and to assess if resilience acts as a mediator between barriers to physical activity and physical activity.

## **Methods**

### *Participants*

Participants for this study were a convenience sample gathered from Mechanical Turk (MTurk) and a large, rural university in the northeastern United States. The total sample size was 1,220 where 500 participants were recruited from MTurk, and received \$1.25 as compensation for participating, and 720 participants were recruited from the college student sample and received one point extra credit as compensation for participating. A set of 51 participants was removed due to answering a written instead of numerical response to the physical activity questions (e.g. "I walk around campus almost every day,") bringing the final sample size to 1,169. The MTurk sample was mostly white ( $N = 370$ , 74.0%) and about half female ( $N = 276$ , 55.2%), with an average age of 36.05 ( $SD = 11.32$ ). The college student sample was predominantly white ( $N = 561$ , 77.9%) and female ( $N = 566$ , 78.6%), with an average age of 19.23 ( $SD = 1.86$ ).

## *Measures*

Resilience. Resilience was conceptualized using a procedure developed by Kunicki and Harlow (2017). Six constructs (purpose in life, self-esteem, life satisfaction, cognitive flexibility, proactive coping, and social support) were measured, and used to construct a hierarchical model of resilience. This model of resilience was validated using classical test theory, and demonstrated some evidence for convergent validity with the Resilience Scale (Kunicki & Harlow, 2017). Please see table 1 for construct names and internal consistency values used in this model.

TABLE 1 GOES ABOUT HERE.

Barriers to Physical Activity. Barriers to physical activity were measured using a procedure developed by Salmon, Owen, Crawford, Bauman and Sallis (2003). Participants were asked to rate 13 different barriers on a 1 to 5 scale where 1 = Not a Barrier and 5 = Very Much a Barrier. Good internal consistency was found for this scale in the MTurk (Cronbach's alpha = .81; coefficient omega = .80 95% CI [.78, .83]) and college student samples (Cronbach's alpha = .84; coefficient omega = .84 95% CI [.82, .86]).

Physical Activity. Physical activity was measured using the Godin Leisure-Time Exercise Questionnaire (Godin & Shepard, 1985). This scale has two items. Question 1 asks for participants to indicate how frequently they perform strenuous, moderate, and mild exercise activities in 15 minutes bouts per week. Question 2 asks how often participants engage in any activity long enough to work up a sweat, where 1 = Never/Rarely, 2 = Sometimes, and 3 = Often. The answers to question 1 in this scale were converted into metabolic equivalents (METs) for analysis. This scale has good

test-retest reliability for the total scale of question 1 ( $r = .74$ ) and for just the strenuous activity portion ( $r = .94$ ), but it is not reliable for light ( $r = .48$ ) or moderate ( $r = .46$ ) activity. Question 2 also has good test-retest reliability ( $r = .80$ ). This scale has also been validated using maximum oxygen consumption and body fat percentage.

Cronbach's alpha for MET variable in the MTurk sample was .97 and coefficient omega was .98, 95% CI [.62, .99], while in the college student sample alpha was .90 and coefficient omega was .91, 95% CI [.44, .98].

Demographics. A demographic questionnaire asked participants to provide their gender identity, racial/ethnic identity, age, and if they have attempted to start a physical activity program in the past six months. It also asked if s/he considers him/herself to be regularly active.

#### *Procedure*

Participants for this study completed a set of surveys online. The first screen showed a consent form and asked participants to please provide their consent before continuing with the study. If participants chose to continue, they were asked to complete the resilience, physical activity, and demographic questionnaires. After completion, participants were thanked for their completing the study and given contact information in case they had any questions.

#### **Results**

Prior to any analysis, all scales were scored and checked for normality violations. The Godin MET variable was highly skewed (17.69) and kurtotic (360.12), and was transformed by adding 1 to the variable to remove any zeros, and then

performing a log10 transformation (Maxwell & Delaney, 2003). This resolved the non-normality issue of the MET variable. No other violations of normality emerged.

The first step in analyses was testing if it was reasonable to merge the MTurk and undergraduate student samples. Independent sample t-tests revealed the undergraduate student sample ( $M = 1.69$ ,  $SD = 0.29$ ) were significantly more active than the MTurk sample ( $M = 1.57$ ,  $SD = 0.34$ ) when using the MET variable, Welch's  $t(875.91) = 6.53$ ,  $p < .001$ , Cohen's  $d = .38$ , which indicates a small-to-medium effect size. The undergraduate student sample ( $M = 2.25$ ,  $SD = .68$ ) was also more active than the MTurk sample ( $M = 2.09$ ,  $SD = 0.69$ ) when using the frequency of exercise variable, Welch's  $t(1069.08) = 3.99$ ,  $p < .001$ , Cohen's  $d = .23$ , which indicates a small effect size. There were no significant differences between the two samples on barriers to physical activity,  $t(1218) = .08$ ,  $p = .08$ . Since there were significant differences on both measures of physical activity, the two samples were not merged and analyses were conducted separately.

This second part of this study used nested structural equation models to examine the relationship between barriers to physical activity, resilience, and physical activity. Several versions of a model were tested to adequately assess the nature of the relationships. Thus, full, mediational, and direct models were considered. The full model had regression pathways between barriers to physical activity and resilience, resilience and physical activity, and barriers to physical activity and physical activity. If this model fit the data best, it would imply that resilience is not a pure, but rather a partial mediator. The mediational model removed the direct pathway between barriers to physical activity and physical activity from the full model. If this model fit as well

as the full model, it would imply that greater resilience was an important buffer between perceived barriers to physical exercise and greater physical activity, such that perceiving barriers would not have to be a stopping point. The direct model removed the pathways to and from resilience and only retained a direct path between barriers to physical activity and physical activity. If this model fit as well as the full model, it would suggest that individuals who perceived barriers would be less apt to engage in physical activity, and resilience would not necessarily make a difference.

To assess the plausibility of the three models, several fit indices were examined with preferred values as follows. A non-significant small value for a chi-square would reveal that the model was a reasonable representation of the data, particularly if accompanied by a comparative fit index (CFI) at or above .90 or .95, a root mean square error of approximation (RMSEA) at or below .10 (or even better at .08 or .05), and a standardized root mean residual (SRMR) of .08 or less (Hu & Bentler, 1999; Steiger & Lind, 1980). In addition z-tests assessed the significance of each parameter (e.g., factor loading or path coefficient), and  $R^2$  values were used as an overall effect size to show the proportion of explained outcome variance for a model.

The first set of models were built on the MTurk sample, and included both the MET and exercise frequency variable as outcomes. However, these two variables shared a large amount of residual variance (.41), so the models were reconstructed using only one outcome variable at a time. Starting with the MET variable, the full model showed acceptable fit,  $\chi^2(19) = 162.28, p < .001, CFI = .91, RMSEA = .13, SRMR = .06$ . The mediational model showed relatively similar fit,  $\chi^2(20) = 168.45, p < .001, CFI = .91, RMSEA = .13, SRMR = .06$ , and the direct model showed poorer



fit,  $\chi^2 (21) = 190.06, p < .001, CFI = .89, RMSEA = .13, SRMR = .10$ . Acceptable fit levels were not achieved in the undergraduate student sample using the full ( $\chi^2 (19) = 216.88, p < .001, CFI = .88, RMSEA = .12, SRMR = .06$ ), mediational ( $\chi^2 (20) = 244.28, p < .001, CFI = .87, RMSEA = .13, SRMR = .07$ ), or direct models ( $\chi^2 (21) = 228.39, p < .001, CFI = .88, RMSEA = .12, SRMR = .08$ ). It may well be the poor fit was due to the high amount of residual variance between the cognitive flexibility and proactive coping variables (.28).

The same set of models were built in the MTurk and undergraduate student samples, but using the exercise frequency variable as the outcome. Starting with the MTurk sample, only the full model showed acceptable fit ( $\chi^2 (19) = 212.41, p < .001, CFI = .90, RMSEA = .14, SRMR = .06$ ), and both the mediational and direct models did not achieve acceptable fit criteria. When building these models, there was also a large amount of residual variance between cognitive flexibility and proactive coping (.27). In the undergraduate student sample, none of the models achieved acceptable fit criteria, but there was still a persistent amount of residual variance between cognitive flexibility and proactive coping (.27). While it is generally inadvisable to add in extra parameters post hoc to improve model fit (Harlow, 2014), since there was a large amount of residual variance between the same two variables in two separate samples, these models were rebuilt adding a correlated error term between cognitive flexibility and proactive coping. Adding the correlated error term resulted in acceptable model fit for the full model in the MTurk ( $\chi^2 (18) = 114.36, p < .001, CFI = .95, RMSEA = .10, SRMR = .04$ ) and undergraduate student samples ( $\chi^2 (18) = 132.56, p < .001, CFI = .94, RMSEA = .09, SRMR = .04$ ). A multiple sample analysis of the same full model

with the correlated error term across both samples also achieved acceptable fit,  $\chi^2 (36) = 246.92, p < .001, CFI = .94, RMSEA = .10, SRMR = .04$ , further justifying the inclusion of the extra parameter. The multiple sample analysis also fit across both samples when using the MET variable as the outcome,  $\chi^2 (36) = 211.64, p < .001, CFI = .95, RMSEA = .09, SRMR = .04$ . Based on these analyses, the full models with the correlated error term were retained as the best fitting models and interpretation of the path coefficients were conducted.

Beginning with the MTurk model and the MET outcome variable, there was a significant negative relationship between barriers to physical activity and the resilience factor,  $\beta = -.16, z = -3.25, p < .01, R^2 = .03$ . There was also a significant negative relationship between barriers to physical activity and the MET variable,  $\beta = -.12, z = -2.49, p < .01$ . There was a positive relationship between the resilience factor and the MET variable,  $\beta = .20, z = 4.17, p < .001$ , and the overall  $R^2$  value for the MET variable equation was .06. All loadings on the resilience factor were significant, and are displayed in Table 2. In the undergraduate student model, the pathways from barriers to physical activity to MET ( $\beta = -.20, z = -5.31, p < .001$ ) and barriers to physical activity to the resilience factor ( $\beta = -.12, z = -3.03, p < .01, R^2 = .02$ ) were significant, but the pathway from the resilience factor to MET was not significant,  $\beta = .05, z = 1.31, p > .05$ . All loadings on the resilience factor were significant, and are displayed in Table 2 below. Figure 1 depicts the MTurk and undergraduate student model.

TABLE 2 AND FIGURE 1 GO ABOUT HERE.

Transitioning to the MTurk model and the exercise frequency outcome variable, there was a significant negative relationship between barriers to physical activity and the resilience factor,  $\beta = -.20$ ,  $z = -4.42$ ,  $p < .001$ ,  $R^2 = .04$ . There was also a significant negative relationship between barriers to physical activity and the MET variable,  $\beta = -.14$ ,  $z = -3.16$ ,  $p < .001$ . There was a positive relationship between the resilience factor and the MET variable,  $\beta = .26$ ,  $z = 5.66$ ,  $p < .001$ , and the overall  $R^2$  value for the MET variable equation was .10. All loadings on the resilience factor were significant, and are displayed in Table 3 below. In the undergraduate student sample, there was a significant negative relationship between barriers to physical activity and the resilience factor,  $\beta = -.13$ ,  $z = -3.35$ ,  $p < .001$ ,  $R^2 = .02$ . There was also a significant negative relationship between barriers to physical activity and the MET variable,  $\beta = -.20$ ,  $z = -5.42$ ,  $p < .001$ . There was a positive relationship between the resilience factor and the MET variable,  $\beta = .12$ ,  $z = 3.18$ ,  $p < .001$ , and the overall  $R^2$  value for the MET variable equation was .06. All loadings on the resilience factor were significant, and are displayed in Table 3. Figure 2 depicts the MTurk and undergraduate student models.

TABLE 3 AND FIGURE 2 GO ABOUT HERE.

## **Discussion**

The purpose of this study was to examine if resilience mediated the relationship between barriers to physical activity and physical activity. Whereas there was partial support for resilience serving as a mediator between barriers to physical activity and actual physical activity, there was also a direct relationship from barriers

and actual physical activity. In three of the four models tested, all of the expected relationships were found to suggest that resilience is a partial mediator between perceived barriers to physical activity and reported physical activity.

Interpreting the specific pattern of results suggests that whereas barriers to physical activity are related to less physical activity and lower resilience, resilience is still related to more physical activity. Thus, the results of this study support the initial hypothesis that resilience acts as at least a partial mediator between barriers to activity and being active. Since the effect sizes found in this study were all small, it may well be that there are other factors that were not controlled for within this study that explain the relationships between barriers, activity, and resilience. Still, despite these other possible factors, a small yet meaningful effect of resilience was found with these data. The only exception to this case was in the undergraduate student sample when using the MET variable as the measure of physical activity, as there was not a significant association between resilience and the MET variable. This may be due to the issues with self-reporting physical activity (Prince, Adamo, Hamel, Hardt, Gorber & Tremblay, 2008), or due to the number of students who gave an uninterpretable response to the Godin MET questions (e.g. “I walk around campus almost every day”) who were removed from these analyses.

The results of the current study help support the body of literature suggesting that there is a relationship between resilience, or aspects of resilience, and overcoming adversity. The results of this study are perhaps most similar to the results of Resnick and D’Adamo (2008), except that this study found a direct relationship between physical activity and resilience instead of an indirect relationship. Similar to Bradshaw

et al. (2007) and Cleland et al. (2010), this study found a positive relationship between resilience and physical activity, suggesting that higher levels of resilience, or aspects of resilience, are related to being physically active. Thus, results support that encouraging exercisers to be resilient and keep moving despite perceived barriers will be related to greater physical activity. However, it may also well be that there is a dynamic relationship between resilience and physical activity (Southwick & Charney, 2012). Thus, resilience may help individuals maintain physical activity programs, which in turn, could lead to increased resilience. Future studies may want to explore this possibility.

There are several limitations to the current study. First, the RMSEA results for several of the models did not reach conventional cut off criteria of .10 or less for acceptable fit (Hu & Bentler, 1999). However, this may be due to the use of item parceling when measuring the resilience factor (Kunicki & Harlow, 2017), and since the SRMR reached conventional fit criteria this may not be of large concern. Second, the cross-sectional design of this study does not allow for inference of direction of effects. A longitudinal study is needed to examine if resilience helps maintain physical activity levels over time. Third, the use of a self-report measure of physical activity can result in either over-reporting or under-reporting activity levels (Prince, et al., 2008). Fourth, the correlated error term between cognitive flexibility and proactive coping may prevent the results of this study to generalize beyond these two samples. However, it also may well be that in the context of physical activity, cognitive flexibility and proactive coping are skills utilized in tandem to be resilient. There is some evidence in stress and physical health literature suggests that cognitive flexibility

and coping style are related (Cheng, 2003; Schwartz, Peng, Lester, Daltroy, & Goldberger, 1998), so the association found in this study may have some validity. However, future studies may want to directly test this hypothesis before this claim can be made with more certainty.

The results of the current study suggest that there is a small yet meaningful relationship between resilience and physical activity which merits further investigation. Future research should consider using a more objective measure of physical activity (e.g. pedometers or accelerometers), and studying the relationship between resilience and physical activity over time. Other research may want to examine this research in at-risk populations, such as those recovering from cardiovascular disease or in obese individuals who are beginning an activity program.

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Table 1  
*Resilience Factor Measures and Coefficient Alpha and Omega*

Name	MTurk $\alpha/\omega$	Undergraduate $\alpha/\omega$	Citation
Purpose in Life	.91/.92	.84/.84	Harlow, Newcomb & Bentler, 1987
Self-Esteem	.94/.94	.89/.89	Rosenberg, 1965
Life Satisfaction	.92/.92	.89/.89	Diener, Emmons, Larsen & Griffin, 1985
Cognitive Flexibility	.84/.84	.72/.71	Martin & Rubin, 1995
Proactive Coping	.83/.86	.74/.77	Greenglass, Schwarzer, Jakubiec, Fiksenbaum & Taubert, 1999
Social Support	.94/.92	.93/.93	Zimet, Dahlme, Zimet & Farley, 1988

*Note: Please see Kunicki & Harlow (2017) for a full description of the creation of this model.*

Table 2

*Resilience Standardized Factor Loadings for MET Outcome Variable*

	Parameters			
	Loading	z-value	p-value	R <sup>2</sup>
<i>Mechanical Turk</i>				
Purpose in Life	.93	-	-	.86
Self-Esteem	.88	27.34	<.001	.78
Life Satisfaction	.71	18.68	<.001	.51
Cognitive Flexibility	.66	16.50	<.001	.43
Proactive Coping	.62	15.11	<.001	.38
Social Support	.61	14.76	<.001	.37
<i>Undergraduate Student</i>				
Purpose in Life	.86	-	-	.72
Self-Esteem	.84	24.13	<.001	.70
Life Satisfaction	.73	20.43	<.001	.53
Cognitive Flexibility	.50	12.90	<.001	.25
Proactive Coping	.42	10.63	<.001	.18
Social Support	.66	17.97	<.001	.43

Table 3

*Resilience Standardized Factor Loadings for Exercise Frequency*

<i>Outcome Variable</i>	Parameters			
	Loading	z-value	p-value	R <sup>2</sup>
<i>Mechanical Turk</i>				
Purpose in Life	.94	-	-	.89
Self-Esteem	.89	30.83	<.001	.79
Life Satisfaction	.72	20.58	<.001	.52
Cognitive Flexibility	.64	16.70	<.001	.40
Proactive Coping	.62	16.01	<.001	.38
Social Support	.62	16.26	<.001	.39
<i>Undergraduate Student</i>				
Purpose in Life	.85	-	-	.72
Self-Esteem	.84	24.67	<.001	.70
Life Satisfaction	.72	20.68	<.001	.52
Cognitive Flexibility	.49	12.96	<.001	.24
Proactive Coping	.42	11.01	<.001	.18
Social Support	.66	18.74	<.001	.44

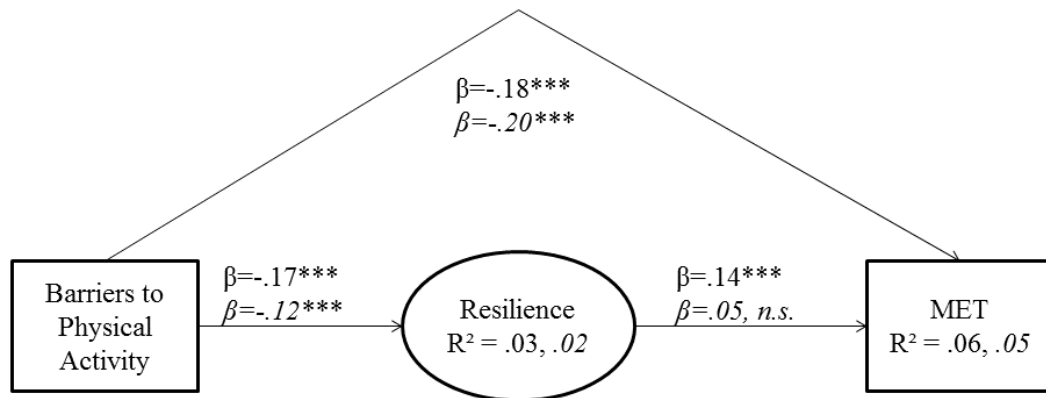


Figure 1. Standardized Coefficients for Full Latent Variable Model with MET Outcome

$p < .001 = ***$

*Note:* MTurk results in standard text, *Undergraduate Student results in italics*. Loadings on resilience factor omitted for simplicity of figure.

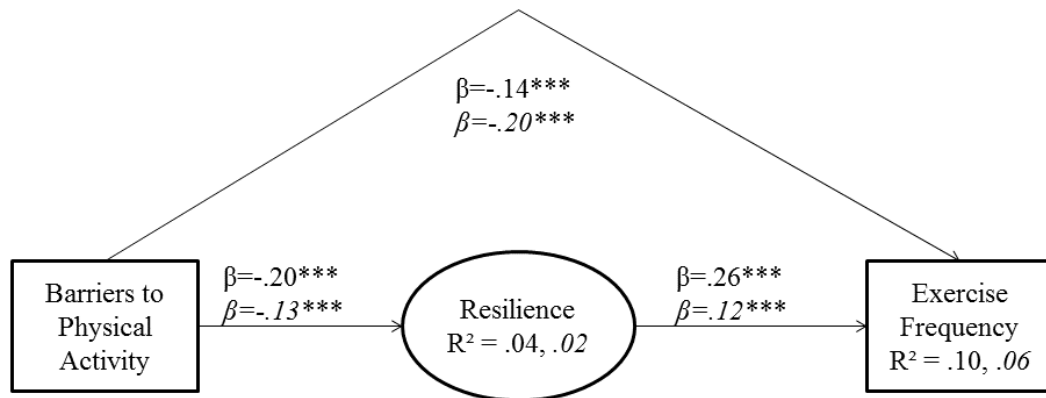


Figure 2. Standardized Coefficients for Full Latent Variable Model with Exercise Frequency Outcome

$p < .001 = ***$

*Note:* MTurk results in standard text, *Undergraduate Student results in italics*. Loadings on resilience factor omitted for simplicity of figure.