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Subjective Social Status and Health:
Environmental Antecedents and Molecular Mechanisms

A dissertation submitted in partial satisfaction of the requirements for the degree Doctor of Philosophy in Psychology

by

Melissa Fales

2017
ABSTRACT OF THE DISSERTATION

Subjective Social Status and Health:
Environmental Antecedents and Molecular Mechanisms

by

Melissa Fales

Doctor of Philosophy in Psychology
University of California, Los Angeles, 2017

Professor Martie G. Haselton, Co-Chair
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Social status, one’s relative rank in a social hierarchy, is a ubiquitous part of human social life. A large focus of the literature has been on subjective social status (SSS), more specifically, which is one’s psychological perception of his position within the social hierarchy. It is also one factor that accounts for variation in health. While there is abundant evidence for an association between SSS and health, there are several important gaps in this literature. First, the antecedents of SSS remain largely unknown. What developmental and contextual factors (Chapter II) and observable cues (Chapter III) predict whether an individual will experience high or low SSS? Second, there is limited research regarding how social hierarchies unfold over time in a population of young adults. How does SSS in young adults change in a new social group and affect physical and mental health (Chapter IV)? Beyond needing to clarify the antecedents and stability of SSS, the molecular mechanisms explaining the relationship between SSS and health remain unclear.
(Chapter V). Chapters II, III, and IV tested aims in a sample of 94 undergraduate college freshmen living in residence halls. Results of Chapter II indicated that how individuals appraised potentially negative social situations predicted SSS, whereas early life stress did not. Chapter III results suggested that other-rated attractiveness, and dominance to a lesser extent, positively predicted SSS rated by an individual and by outside observers. Together, Chapters II and III highlight contextual and observable cues that predict SSS. The findings of Chapter IV identified that SSS was stable or increased for the majority of freshmen throughout the academic year, but SSS did not reliably predict physical or mental self-rated health; this is perhaps due to the nature of the social group targeted. Chapter V, a study conducted in a population of 47 young, healthy women, revealed that lower SSS individuals have heightened pro-inflammatory gene expression. Thus, those lower in SSS likely perceive diminishing social resources and a threatening social world, which manifests as heightened inflammatory processes, and has potential downstream consequences for inflammatory-related illness.
The dissertation of Melissa Fales is approved.

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**SELECTED CONFERENCE PRESENTATIONS**


General Introduction

Social status, one’s relative rank in a social hierarchy, is a ubiquitous part of human social life (Anderson, John, Keltner, & Kring, 2001). It is also one factor that accounts for variation in health. Researchers have examined two types of social status: (1) objective socioeconomic status (SES) and (2) subjective social status (SSS). SES is typically defined as status within one’s country (e.g., income and education). SSS is defined in the context of face-to-face groups (Anderson, Kraus, Galinsky, & Keltner, 2012; Singh-Manoux, Adler, & Marmot, 2003) and has been defined as a person’s belief about his location in a status order (Davis, 1956), or one’s psychological perception of his position within the social hierarchy. Abundant research examining connections between social status and health have focused on SES (Adler et al., 1994); however, SSS predicts health over and above SES (Demakakos, Nazroo, Breeze, & Marmot, 2008; Destin, Richman, Varner, & Mandara, 2012; Singh-Manoux et al., 2003; Singh-Manoux, Marmot, & Adler, 2005).

Euteneuer (2014) recently reviewed the SSS and health literature, reporting evidence for a negative relationship between SSS and risk factors for disease. A recent meta-analysis corroborated the results of the qualitative review, revealing a robust but small positive effect size for the association between SSS and a variety of health outcomes (Quon & McGrath, 2014). For example, those who report low, relative to high, SSS have increased rates of upper respiratory infections when experimentally infected with the common cold virus (Cohen et al., 2008) and poorer self-rated health (Demakakos et al., 2008; Destin et al., 2012; Hu, Adler, Goldman, Weinstein, & Seeman, 2005; Miyakawa, Hanson, Theorell, & Westerlund, 2012). Beyond physical health, low SSS individuals also experience relatively poorer mental health outcomes, as those low in SSS have greater incidence of depressive symptoms compared to their high SSS
counterparts (Adler et al., 2008; Goodman et al., 2001; Miyakawa et al., 2012; Singh-Manoux et al., 2003; Subramanyam et al., 2012).

While there is abundant evidence for an association between SSS and health, there are several important gaps in this literature, which I will address in my dissertation research.

First, the antecedents of SSS remain largely unknown. What predicts whether an individual will experience high or low SSS? This is an important gap to address because identifying antecedents of SSS might permit scholars to classify those who are more susceptible to poorer physical and mental health outcomes in the future, and thus tailor intervention programs to meet the needs of those individuals.

Several factors are implicated as antecedents of SSS. Children raised in a harsh family environment marked by abuse, conflict, nonnurturant parenting, or neglect are prone to a broad array of adverse social outcomes, including impaired emotion processing and social competence (Repetti, Taylor, & Seeman, 2002). Given that the early environment influences a broad array of psychosocial resources (Repetti et al., 2002; Taylor, 2010), which are proposed to be components of SSS (Matthews & Gallo, 2011), early life stress could result in low SSS. Furthermore, how people make meaning of social situations, or their cognitive appraisals, is a predicted antecedent of SSS. In a study of first and second year graduate students, participants read vignettes that proposed a personalistic (i.e., the cause of the behavior is attributed to target) and non-personalistic (i.e., the cause of the behavior is external to the target) appraisal for a behavior whose meaning was ambiguous. First year students were more likely to make personalistic appraisals than second year students, consistent with the notion that newcomers are concerned about their status in the group (Kramer, 1994). Finally, observable cues of physical attractiveness (Anderson, John, Keltner, & Kring, 2001; Dodge, 1983; Kennedy, 1990; Vaughn
and dominance (Cheng et al., 2013; Henrich & Gil-White, 2001) are potentially predictors of SSS.

Second, there is limited research regarding how social hierarchies unfold over time. Few studies have longitudinally followed a social group to assess individuals’ changes in status (Goodman et al., 2007; Goodman et al., 2015; Nobles, Weintraub, & Adler, 2013; Thompson, Gaglani, Naleway, Thaker, & Ball, 2014), and changes in status in tandem with health. Filling this gap will not only clarify the stability of social hierarchies in humans, but will also provide further evidence that SSS affects health outcomes.

Beyond needing to clarify the antecedents and stability of SSS, the molecular mechanisms explaining the relationship between SSS and health remain unclear. While there has been an abundance of research establishing the positive association between SSS and health, we have yet to test physiological mechanisms that plausibly mediate this relationship. Two related mechanisms, inflammation and glucocorticoid receptor (GR) desensitization, are likely candidates as indicated by the extant literature (Chen et al., 2009; Chen, Miller, Kobor, & Cole, 2011; Miller, Chen, Fok, et al., 2009; Sapolsky, Alberts, & Altmann, 1997; Tung et al., 2012).

This dissertation extends the current literature by furthering the understanding of the nature of SSS and its association with health. Chapters II through IV of this dissertation longitudinally examined the antecedents of SSS, its stability, and relation to health in an emerging social hierarchy—freshmen living in dorms—to better understand the nature of social hierarchies in humans and its downstream consequences for health. Chapter V of this dissertation tested several hypothesized mechanisms to identify factors that explain the relationship between SSS and health. To test these mechanisms, I examined the gene expression profiles of high relative to low SSS individuals in a sample of young women.
Antecedents of Subjective Social Status
Antecedents of Subjective Social Status

The present study focused on subjective social status (SSS), or the psychological perception of one’s rank within the social hierarchy (Anderson et al., 2001; Singh-Manoux et al., 2003; Singh-Manoux et al., 2005). SSS has garnered attention in the literature for its robust association with health outcomes (Adler, Epel, Castellazzo, & Ickovics, 2000; Euteneuer, 2014; Quon & McGrath, 2014). However, there is limited empirical research examining the antecedents of SSS. This gap in the literature prevents scholars from identifying potential targets for intervention that might prevent poor downstream health consequences. Therefore, the current research aims to provide the first assessment of hypothesized antecedents of SSS: early life stress and cognitive appraisals of ambiguous social situations.

The prime population in which to examine the antecedents of SSS features individuals who have limited experience in establishing their SSS and who are in a novel context; this aptly characterizes undergraduate freshmen. Every year, 3.17 million freshmen enroll in college (Hussar & Bailey, 2013). Incoming college freshmen, recently uprooted from their home environment and thrust into independence, must navigate a new social context in which a social hierarchy develops (Gruenewald, Kemeny, & Aziz, 2006): dormitory life. How does one’s experiences and cognitions predict the social status s/he will attain in the dorms?

Children who have experienced early life stress have a greater likelihood of negative developmental outcomes and psychopathology (Cicchetti & Toth, 1995). Those raised in a harsh family environment marked by abuse, conflict, nonnurturant parenting, or neglect are prone to a broad array of adverse social outcomes, including impaired emotion processing and social competence (Repetti, Taylor, & Seeman, 2002). For example, children raised in such “risky families” lacked the skills to facilitate successful interaction with peers (Crockenberg & Lourie,
and engaged in more aggressive or antisocial behavior (Hart, Nelson, Robinson, Olsen, & McNeilly-Choque, 1998; Schwartz, Dodge, Pettit, & Bates, 1997) compared to children who were not raised in such households. Much like they co-vary with socioeconomic status (Dodge, Pettit, & Bates, 1994; Repetti et al., 2002), these risky family characteristics are expected to be tied to SSS. Specifically, given that the early environment influences a broad array of psychosocial resources (Repetti et al., 2002; Taylor, 2010), which are proposed to be components of SSS (Matthews & Gallo, 2011), early life stress could result in low SSS.

In addition to early life stress, how people make meaning of social situations, or their cognitive appraisals, is a predicted antecedent of SSS. Previous research has documented the tendency for individuals to make threat appraisals in situations where they feel self-conscious and/or under evaluative scrutiny (Fenigstein, 1979). New students are a prime population in which to study this topic. Because their standing in the group is being actively negotiated, newcomers may have considerable anxiety regarding their status. In a study of first and second year graduate students, participants read vignettes that proposed a personalistic (i.e., the cause of the behavior is attributed to target) and non-personalistic (i.e., the cause of the behavior is external to the target) appraisal for a behavior whose meaning was ambiguous. First year students were more likely to make personalistic appraisals than second year students, consistent with the notion that newcomers are concerned about their status in the group (Kramer, 1994). Investigating the appraisals of individuals from the same class (i.e., incoming freshmen) could offer predictive insight into which individuals will develop high versus low SSS. Individuals who develop low SSS might make more personalistic relative to non-personalistic appraisals than individuals who develop high SSS.
The present study longitudinally tracked freshmen living in dorms to test two antecedents of SSS. College freshmen are an excellent model for studying factors related to SSS because these individuals are independently navigating an emerging hierarchy for the first time. I hypothesized that those who report more early life stress will report low SSS, relative to individuals who report less early life stress. Second, individuals who make more personalistic relative to non-personalistic cognitive appraisals in response to ambiguous social situations will report lower SSS.

**Method**

*Participants.* Participants were 94 undergraduate freshmen (29 men, 64 women, 1 gender queer) from the University of California, Los Angeles (UCLA) living in residence halls, ranging in age from 18 to 21 years ($M = 18.2$, $S.D. = .50$). The sample was predominantly Asian-American (42%) and Caucasian (36%), with smaller numbers of individuals self-identifying as Latino/a (8%), mixed ethnicity (12%), or other (2%).

All potential participants completed an online eligibility questionnaire. Eligible participants met the following criteria: 1) first year students, 2) live in residence halls (i.e., double or triple occupancy rooms that have group bathrooms on each floor), 3) have randomly assigned roommate(s), 4) be at least 100 miles from where they attended high school, 5) did not participate in summer programs at UCLA in 2015, and 6) do not use medication that affects immune or psychiatric functioning.

Enrollment occurred at the start of the academic year (September, 2015) to just before Spring Break (March, 2016). On average, participants enrolled in the study six weeks after moving into the dorms ($S.D. = 6.63$ weeks; range = 5 days before moving in – 21 weeks after
moving in), and remained in the study for an average of 3.32 months (S.D. = 2.41, range = 1 to 9).

Procedure. The study was comprised of three key components: a baseline questionnaire, monthly questionnaires, and a lab session. Data gathered from the lab session (photographs and video) are reported in Chapter III of the dissertation.

Baseline and monthly questionnaire. Upon enrollment in the study, participants completed an online baseline questionnaire. One month after completing the baseline questionnaire, and every subsequent month thereafter, participants completed an online questionnaire. Because the study concluded at the close of the academic year, but participants enrolled in the study over the span of six months, the number of monthly questionnaires varied by participants.

Measures.

Subjective social status. Participants completed the MacArthur Scale of SSS (Adler et al., 2000) with the instructions, “Imagine a 10-rung ladder representing where people “rank” on your dorm floor. At the top of the ladder are people on your dorm floor who are most respected, esteemed, and admired. At the bottom of the ladder are those who are least respected, esteemed, and admired. Mark your response on the scale below that best represents where you think you stand on the ladder.” Participants completed ratings of SSS at baseline and every monthly questionnaire.

Early life stress. To assess early life stress, participants responded to the Risky Families Questionnaire (Felitti et al., 1998; Taylor, Lerner, Sage, Lehman, & Seeman, 2004). Participants rated aspects of their early family environment on a 5-point scale ranging from 1 (not at all) to 5 (very often), including whether the individual received physical affection
or observed aggression between family members. Participants completed this questionnaire only at baseline, and Cronbach’s alpha was .86.

*Cognitive appraisals.* To examine participants’ cognitive appraisals of ambiguous social situations, they read a series of vignettes. Specifically, I developed a scale to portray ambiguous social situations that could arise with dorm mates (e.g., “Three of your dorm mates are casually talking to each other in front of the elevator of your dorm floor. As you approach the elevator, your friends continue their conversation as if you aren't there.”). After reading each vignette (vignette presentation randomized), participants responded to two 7-point Likert scale items regarding their appraisals of the behavior. One item targeted participants’ personalistic appraisals (e.g., “How likely is it that your dorm mates did not want to talk to you?”), and one item targeted participants’ non-personalistic appraisals (e.g., “How likely is it that your dorm mates did not see you approach the elevator?”). Participants also indicated on a 7-point Likert scale how bad it would make them feel if indeed the personalistic appraisal was true.

*Scale validation.* I completed the validation of the scale in several steps, guided by those outlined in Chen & Matthews (2003). First, the face validation of the vignettes involved ratings by a group of 10 individuals with backgrounds in psychology. Raters were asked to denote the ambiguity of the meaning behind the social situation, the likelihood of threat interpretation by a freshman (each rated on a 5-point scale), and the extent to which each vignette had implications for SSS (rated on a 4-point scale; Chen & Matthews, 2003). Of nine original vignettes, six were retained because raters rated the situations as ambiguous, threatening, and having implications for status ($M > 3$ out of 5 and $M > 3$ out of 4).

As the second phase of validation, I pilot tested the six vignettes on UCLA undergraduates in Winter 2015 using the Psychology Subject Pool. Specifically, I assessed
whether participants’ relative personalistic appraisals negatively predicted their SSS in the dorms, as expected. Given the vignettes targeted ambiguous social situations in the dorms, the sample of respondents were limited to those who indicated they currently lived in the dorms. Of 206 original respondents (177 women; $M_{age} = 20.36$ years, $SD = 2.36$), 69 currently lived in the dorms (58 women; $M_{age} = 19.12$ years, $SD = 1.58$). Participants were presented with the six vignettes (vignette presentation randomized), and responded to items assessing their personalistic appraisal, non-personalistic appraisal, and how bad they would feel if the personalistic appraisal was true for each vignette (all rated on 7-point scales). In addition, participants responded to items assessing SSS in the dorms and in high school, social anxiety (Peters, Sunderland, Andrews, Rapee, & Mattick, 2012), depression (Beck, Ward, & Mendelson, 1961), self-esteem (Rosenberg, 1965), and SES.

To determine whether the participants found the vignettes ambiguous, I first examined the mean ratings and standard deviations of responses to the three items associated with each vignette. Five out of the six vignettes were rated, on average, above the mid-point of the scale for all items (i.e., personalistic appraisal, non-personalistic appraisal, and how bad they would feel if the personalistic appraisal was true) and elicited variability. One vignette (“You walk past several dorm mates on your floor and hear them start to laugh.”) fell below the mid-point on personalistic appraisal ($M = 2.6$ on 7-point scale); therefore, it was dropped from the current study. All other vignettes were maintained for the present study (see Appendix).

Next, I computed a relative personalistic appraisal score. Individuals’ ratings of the personalistic appraisals were collapsed across the five retained vignettes. This yielded a mean score reflecting each respondent’s overall endorsement of the personalistic appraisals. I similarly created a mean score reflecting overall endorsement of the non-personalistic appraisals. The
difference between the two means reflected relative personalistic appraisals, the outcome of interest (Kramer, 1994).

Relative personalistic appraisal scores were negatively correlated with SSS in the dorms ($r = -.40, p < .001$), such that more personalistic relative to non-personalistic appraisals were associated with lower SSS. As predicted, relative personalistic appraisals negatively predicted SSS in the dorms, even with the inclusion of covariates ($\beta = -.27, p = .01$). The pilot test provided preliminary evidence for the hypothesis tested in the present study.

I classified the five piloted vignettes as negative. This is because making a personalistic appraisal in these ambiguous social situations would be a negative reflection of the self.

Endorsing the personalistic appraisal of the example above (“How likely is it that your dorm mates did not want to talk to you?”) indicates that the dorm mates did not want to speak to the target, which reflects poorly on the target. The incorporation of these five vignettes in the present study provided insight into how low versus high SSS individuals appraise potentially negative ambiguous situations. However, the negative vignettes alone cannot specify whether it is something about a potentially negative ambiguous social situation that discerns low from high SSS individuals, or whether lower SSS individuals are more likely to make personalistic appraisals in all ambiguous social situations. Therefore, participants also responded to three positive vignettes designed to examine appraisals in potentially positive ambiguous social situations. For example, “You are searching for a table in a crowded campus coffee shop. You notice three of your dorm mates seated at a four-person table. One of your dorm mates waves you over to sit with them.” As with the negative vignettes, participants responded to two 7-point Likert scale items regarding appraisals of the behavior. One item targeted participants’ personalistic appraisal (e.g., “How likely is it that your dorm mates wanted you to sit with
them?”), and one item targeted participants’ non-personalistic appraisal (e.g., “How likely is it that your dorm mates were simply being polite by having you sit with them?”). With this vignette, the personalistic appraisal suggests that the dorm mates like the target, which reflects positively on that individual. Participants also indicated on a 7-point Likert scale how good it would make them feel if indeed the personalistic appraisal was true.

Participants responded to the five negative and three positive vignettes at baseline (n = 94), in their January monthly questionnaire (n = 81), and in their final monthly questionnaire (n = 70).

SES. At baseline, participants indicated which socioeconomic class best described their family as they grew up (lower, lower-middle, middle, upper-middle, and upper).

Potential covariates. To rule out potential alternative explanations, participants completed measures at baseline assessing high school SSS, trait anxiety (Beck, Epstein, Brown, & Steer, 1988), depression (Beck et al., 1961), social support (Cutrona & Russell, 1987), self-esteem (Rosenberg, 1965), personality traits (Gosling, Rentfrow, & Swann, 2003), perceived stress (Cohen & Williamson, 1988), and self-rated physical attractiveness (“Relative to individuals of your sex and age, do you consider yourself...[1= much less attractive, 7 = much more attractive]?”) as potential third variables. There were also several items that assessed the value participants attributed to individuals on their dorm floor. For example, “Of the time you spent socializing, what percent of that time is spent socializing with people from your dorm floor?”

Data Analytic Plan. I used Stata 13.1 to run multilevel models with measurement occasions (Level 1) nested within individuals (Level 2). Multilevel models estimate the within-

---

1 The positive vignettes were added shortly before launching the study, and were not subjected to pilot testing.
person effect of the predictor variables (early life stress and cognitive appraisals) on the dependent variable (SSS), while allowing the intercept and slope to randomly vary at the level of the individual.

To aid in interpretation, time was centered around the academic year (i.e., September = 0, October = 1…June = 9) and a one-unit increase in time is equivalent to one month. The distribution of early life stress was positively skewed, and thus analyses were conducted using the inverse of the variable. All predictor variables and covariates were grand mean centered.

The modeling approach began by including the key predictor variables, interactions between time and key predictor variables, and all potential covariates associated with SSS (gender, high school SSS, anxiety, depression, social support, self-esteem, personality traits, perceived stress, and physical attractiveness); all covariates were only measured at baseline. Upon running the model, I removed the single variable that had the greatest $p$ value, and then ran the model again. I repeated this process until only the key predictors and significant covariates remained, with one exception: SES was included as a covariate in all models to demonstrate that any observed effects of SSS are over and above the effect of SES This approach resulted in the most parsimonious model that was also theoretically-driven due to the inclusion of SES.

Two independent multilevel models tested whether early life stress (Prediction 1) and relative personalistic appraisals (Prediction 2) negatively predicted SSS. Early life stress was measured only at baseline; relative personalistic appraisals were measured at up to three time points for each participant (baseline, in the January monthly questionnaire, in the final monthly questionnaire); and SSS was assessed at every time point. Therefore, early life stress was entered as a Level 2 predictor, relative personalistic appraisals was a Level 1 predictor, and SSS was a repeated measures outcome.
Similar to the pilot study reported, I computed a relative personalistic appraisal score, which served as the key variable to test Prediction 2. Individuals’ ratings of the likelihood of personalistic appraisal were collapsed across the vignettes. This yielded a mean score reflecting each respondent’s overall endorsement of the personalistic appraisals. I similarly created a mean score reflecting overall endorsement of non-personalistic appraisals. The difference between the two means reflected relative personalistic appraisals (Kramer, 1994). I did this independently for the negative and positive vignettes, which resulted in a mean for negative relative personalistic appraisals and one for positive relative personalistic appraisals.

In the equation below, SSS\(_{ti}\) refers to SSS at time \(t\), for participant \(i\). \(g_{00}\) represents the average SSS across participants in September at the mean values of predictor variables. \(g_{01}\) is the linear change in SSS associated with a one-unit increase in EarlyLifeStress, above and beyond the covariates. \(g_{10}\) is the linear change in SSS associated with a one-unit increase in time (i.e., one month). \(u_{0i}\) represents person-level variance in the intercept, \(u_{1i}\) represents person-level variance in the slope, and within-person error variance is represented by \(e_{ti}\). The relative personalistic appraisals model followed a similar equation.

\[
\begin{align*}
L1: \quad & SSS_{ti} = b_{0i}Int_{1ti} + b_{1i}Time_{1ti} + e_{ti} \\
L2: \quad & b_{0i} = g_{00} + g_{01}EarlyLifeStress_{i} + g_{02}SES_{i} + g_{03}SelfEsteem + g_{04}Neuroticism + g_{05}PhysAtt + u_{0i} \\
& b_{1i} = g_{10} + u_{1i}
\end{align*}
\]

To further understand the association between the cognitive appraisals (assessed across several time points) and SSS, I ran time-lagged models to determine whether a) cognitive appraisals temporally precede SSS, b) SSS temporally precedes cognitive appraisals, or c) both
a) and b) are true. I calculated the average SSS between cognitive appraisal measures to run such analyses.

Results are first presented for early life stress, and subsequently for cognitive appraisals. Results remain unchanged when including early life stress and relative personalistic appraisals in the same model.

**Results**

Descriptive statistics and correlations of key variables and covariates are provided in Table 1-1.

**SSS.** Participants’ subjective ratings of social status in the dorms averaged above the midpoint ($M = 6.60$, $SD = 1.77$).

**SES.** The mean value of SES in the sample was 3.30 ($SD = .98$), indicating that participants, on average, were raised in middle or upper-middle class households. This is reflective of the SES distributions that characterize college populations (Astin & Oseguera, 2004).

**Early life stress.** The multilevel model to examine the effect of early life stress on SSS in the dorms included SES, self-esteem, neuroticism, and self-rated physical attractiveness as covariates. Upon examination of early life stress without covariates, greater early life stress was significantly associated with lower SSS ($b = 2.47$; 95% CI [.42, 4.52]), and marginally so with the inclusion of SES as the only covariate ($b = 1.87$; 95% CI [-.30, 4.01]). However, in contrast to the hypothesis, early life stress was not significantly related to SSS in the dorms upon the inclusion of significant covariates ($b = -.26$; 95% CI [-2.07, 1.55]; Table 1-2). Further examination of the model indicated that the addition of any other significant covariates (i.e., self-
esteem, neuroticism, or self-rated physical attractiveness) deemed early life stress a nonsignificant predictor of SSS in the dorms.

Cognitive appraisals. I first examined the intraclass correlations (ICC) to assess test-retest reliability of the cognitive appraisals. ICCs indicate the amount of between-person variance relative to the total variance (i.e., between- and within-person variance); it designates the consistency of measurements. ICCs range from 0 to 1, and values closer to 1 indicate that all variance is between-persons, which would indicate that there is a high degree of consistency between each cognitive appraisal assessment. For individuals who responded to the negative vignettes at three time points \((n = 53)\), the ICC for relative personalistic appraisals was .77; the ICC was .65 for individuals who responded to the vignettes at two time points \((n = 81)\). For relative personalistic appraisals of the positive vignettes, the ICC was .87 and .74 for those who responded to the vignettes at three \((n = 53)\) and two \((n = 81)\) time points, respectively. Overall, the ICCs indicate a high degree of test-retest reliability.

Table 1-3 presents the descriptive statistics for the personalistic and non-personalistic appraisals and how bad or good participants would feel if the personalistic appraisals of the negative and positive vignettes, respectively, were true.

Results were robust with and without the inclusion of covariates. Below I only report analyses with covariates.

Negative vignettes. Consistent with the hypothesis, individuals with higher relative personalistic appraisals (RPA) in response to the five negative vignettes reported lower SSS across the academic year \((b = -.16, 95\% CI [-.27, -.04]; \text{Table 1-4})\). Furthermore, there was a marginally significant interaction between time and how bad an individual reported s/he would feel if the personalistic appraisals were true \((b = .03, 95\% CI [-.002, .06])\). As shown in Figure 1-
1, there were no differences in SSS by how bad participants would feel if the personalistic appraisals were true during the first half of the academic year. However, during the last half of the academic year, individuals who reported that they would feel worse had higher SSS in the dorms.

Positive vignettes. There was a significant interaction between RPA in response to the three positive vignettes and time to predict SSS ($b = -.05, 95\% \text{ CI} [-.08, -.02]$; Table 1-4). As shown in Figure 1-2, for the majority of the academic year, RPA in response to positive vignettes did not predict SSS in the dorms. However, individuals who had greater RPA reported higher SSS during the first two months of the academic year. This effect reversed in the last month of the academic year, such that those who had lower RPA had higher SSS; given only 10 individuals completed questionnaires in June, this effect might not be entirely meaningful. In addition, results revealed a marginally significant effect of how good an individual reported s/he would feel if the personalistic appraisal was true on SSS ($b = -.17, 95\% \text{ CI} [-.38, .03]$). Those who reported that they would feel better if the personalistic appraisal was true had lower SSS than those who reported they would feel less good.

Are cognitive appraisals an antecedent of SSS? The time-lagged model revealed that negative cognitive appraisals were an antecedent of SSS, whereas positive cognitive appraisals were not. As exhibited in Table 1-5, individuals with higher RPA in response to the five negative vignettes subsequently reported lower SSS ($b = -.15, 95\% \text{ CI} [-.28, -.02]$). The same was not the case for positive vignettes, as those with higher RPA in response to the positive vignettes did not show subsequently higher SSS ($b = .10, 95\% \text{ CI} [-.02, .23]$; Table 1-5). Furthermore, upon the inclusion of SES, neuroticism, and self-rated physical attractiveness as covariates, cognitive appraisals in response to negative vignettes no longer predicted subsequent
SSS \((b = -.07, 95\% \text{ CI } [-.21, .06])\). Therefore, negative cognitive appraisals was an antecedent of SSS, but this association was not robust to the inclusion of covariates.

*Is SSS an antecedent of cognitive appraisals?*

**Negative vignettes.** Controlling for concurrent SSS, previous SSS did not predict subsequent RPA in response to the negative vignettes. This was the case without covariates \((b = -.12, 95\% \text{ CI } [-.30, .07])\), and with the inclusion of SES as a covariate \((b = -.13, 95\% \text{ CI } [-.32, .05])\).

**Positive vignettes.** With \((b = .18, 95\% \text{ CI } [.01, .34])\) and without \((b = .18, 95\% \text{ CI } [.02, .35])\) the inclusion of SES as a covariate, and controlling for concurrent SSS, individuals with higher SSS subsequently reported higher RPA in response to the positive vignettes.

**Discussion**

The current study examined the antecedents of SSS, one’s psychological perception of their position within the social hierarchy. Specifically, this study focused on college freshmen living in dorms because these individuals are independently navigating an emerging hierarchy for the first time. Results indicated that early life stress did not negatively predict SSS in the dorms above and beyond covariates. Consistent with the prediction, there was a significant effect of cognitive appraisals. For negative vignettes, individuals who made greater relative personalistic appraisals exhibited lower SSS in the dorms across the academic year. For positive vignettes, individuals who made greater relative personalistic appraisals reported higher SSS in the dorms, but only for the first two months of the academic year.

Contrary to the prediction, early life stress was not a robust predictor of SSS in the dorms. To test the association, I used a conservative statistical model that included all covariates
significantly associated with SSS; these covariates are not typically included in analyses of SSS. The key theoretically-driven covariate was SES, as it is the variable that scholars consistently include to isolate the unique variance SSS accounts for above and beyond SES. In the model that only included SES as a covariate, early life stress marginally negatively predicted SSS in the dorms. This suggests that individuals raised in a family environment characterized by abuse, conflict, nonnurturant parenting, or neglect likely develop lower SSS, and that this effect is not accounted for by SES. Given children from risky families are prone to impaired social competence (Repetti et al., 2002), the results point to social competence as one factor that plays a role in the development of SSS. However, results must be interpreted with caution given the association between early life stress and SSS was not robust to the inclusion of all covariates.

An important consideration is how early life stress in the present sample extends to other populations, such as those of non-college students. This will provide valuable insight into the generalizability of the findings as they relate to early life stress as measured by the Risky Families Questionnaire. In the present sample, the distribution of scores was right skewed (range = 1 – 4.31), indicating that the majority of participants in the study experienced relatively little early life stress. Among adults in the Coronary Artery Risk Development in Young Adults study ($M_{age} = 40.1$ years, $SD = 3.6$), scores on the Risky Families Questionnaire averaged 1.66 on a 4-point scale, indicating relatively low early life stress (Lehman, Taylor, Kiefe, & Seeman, 2005; Taylor, Lehman, Kiefe, & Seeman, 2006). In two studies of young adults (range = 18 – 36 years), average responses to the Risky Families Questionnaire ranged from 1 – 3.54 on a 4-point scale; data on overall mean and standard deviation were not reported (Taylor, Eisenberger, Saxbe, Lehman, & Lieberman, 2006; Taylor, Way, et al., 2006). Finally, in a study of adolescents ($M_{age} = 17.0$ years, $SD = 1.38$), responses averaged 1.93 ($SD = .46$) on a 5-point scale (Miller & Chen,
2010). Taken together, the distribution of scores in the present study appears to coincide with past research that has used the Risky Families Questionnaire. Therefore, it is plausible that the findings related to early life stress in the present study would extend to other populations, ranging from adolescents to adults.

Consistent with the prediction, individuals who made more personalistic relative to non-personalistic appraisals in response to negative vignettes reported lower SSS in the dorms; the association was robust with and without the presence of covariates. The results are complimentary to past research examining how individuals’ responses to ambiguous social situations vary by SES, as individuals from lower SES families made greater threat interpretations (Chen et al., 2006; Chen, Langer, Raphaelson, & Matthews, 2004; Chen & Matthews, 2003). Results also demonstrated that personalistic relative to non-personalistic appraisals in response to positive vignettes did not predict SSS for the majority of the academic year; only for the first two months of the school year did those who made more relative personalistic appraisals report higher SSS. Time-lagged models revealed that negative, but not positive, cognitive appraisals temporally preceded SSS; however, the former association was not robust to the inclusion of covariates. Conversely, SSS temporally preceded positive, but not negative, cognitive appraisals. Taken together, the findings suggest that appraisals of potentially negative ambiguous social situations discern low from high SSS individuals. Importantly, lower SSS individuals are not more likely to make personalistic appraisals in all ambiguous social situations, but only in those social situations that could negatively reflect the self.

In addition to reporting their appraisals of ambiguous social situations, participants reported how bad or good they would feel if the personalistic appraisals of the negative and positive vignettes, respectively, were true. I did not put forth predictions regarding how
responses to these items would relate to SSS, and thus these analyses should be considered exploratory. In response to negative vignettes, those who reported that they would feel worse if the personalistic appraisals were true reported higher SSS, but only during the last five months of the academic year; the interaction was marginally significant. In response to positive vignettes, individuals who reported feeling better if the personalistic appraisals were true had marginally lower SSS in the dorms. Thus, those reporting higher SSS in the latter half of the academic year were more upset should others see them in a negative light, whereas those reporting lower SSS were marginally more pleased if others saw them in a positive light. This suggests that higher SSS individuals want to avoid having others view them negatively, whereas lower SSS individuals want others to view them positively. The findings add a nuanced perspective to empirical research on social cognitive processes of social status. Past research often focused on how high versus low status individuals view others (Galinsky, Magee, Inesi, & Gruenfeld, 2006; Kraus, Côté, & Keltner, 2010; Muscatell et al., 2012). The present study is the first, to my knowledge, to target how high versus low social status individuals would like to be viewed by others. The findings potentially point to different methods by which high SSS individuals attempt to maintain their standing and by which low SSS individuals attempt to improve their standing.

Beyond the key variables, several covariates emerged as consistent predictors of SSS across analyses: self-esteem, neuroticism, and self-reported physical attractiveness. Self-esteem was positively associated with SSS. This is in line with previous studies reporting that lower SSS adolescents (Goodman et al., 2001) and college students (Gruenewald et al., 2006) had lower self-esteem. Neuroticism was also reliably negatively associated with SSS, contributing to a small literature of other studies reporting similar findings (Alfonsi, Conway, & Pushkar, 2011;
Anderson et al., 2001; Cundiff, Smith, Uchino, & Berg, 2013). For example, in a longitudinal study of middle-aged and older adults, more neurotic individuals had lower SSS over the course of two years (Alfonsi et al., 2011). Lastly, self-rated physical attractiveness was a consistent, positive predictor of SSS in the dorms, which aligns with past research on social status and other-rated physical attractiveness in young adults (Altemus, Rao, Dhabhar, Ding, & Granstein, 2001) and school-age children (Dodge, 1983; Kennedy, 1990; Vaughn & Langlois, 1983); the present study is the first to link self-rated physical attractiveness to SSS. A fruitful avenue for future research is developing theory for why these covariates might be antecedents of SSS. Furthermore, while analyses unveiled these potential antecedents of SSS, I encourage future work in this area to better understand the factors that predict social status development. For example, behavioral antecedents of SSS are a promising area for empirical study (Dodge, 1983).

**Strengths.** The present study aimed to identify factors that predicted SSS in the dorms. Only with multiple assessments of SSS can I conclude that the hypothesized factors precede the development of SSS; SSS in the dorms was assessed up to nine times, and cognitive appraisals up to three times, across the academic year. Thus, a key strength of this study is its longitudinal design. Using longitudinal methods is challenging, requiring close monitoring of participants over time to ensure they remain active in the study; but throughout the nine months of the study, I achieved an 85% participant retention rate.

An additional strength is that I developed a novel scale to assess cognitive appraisals in situations particularly relevant to the population of interest. The vignettes were based on a similar scale developed by Kramer (1994) and validated using several phases outlined by Chen & Matthews (2003). In addition, the scale exhibited good test-retest reliability (ICCs ranged from .65 to .87). The prediction, that cognitive appraisals are an antecedent of SSS, was aptly
assessed by matching the context in which I measured SSS with the situations presented in the vignettes.

A final strength is the focus on freshmen in dorms. Most empirical work on SSS has relied on long-standing, abstract groups (e.g., people in the United States; people in your community). Research on social status more broadly has often focused on artificial groups created in the laboratory. Thus, the literature stands to benefit from studies that examine nascent, naturally-occurring groups, which is offered by freshmen in dorms. Examining freshmen offers several unique attributes: They are navigating new hierarchies independently for the first time, and they are a social group of individuals living in close proximity to each other. While the present study only focused on college dorms, the results have the potential to extend to other individuals living in close proximity (e.g., boarding schools, military bases). Furthermore, I only recruited participants who moved more than 100 miles away from their hometown and are therefore likely to be especially invested in the budding hierarchy.

Limitations. With such a unique population, extrapolation of the findings to other contexts of SSS and measures of social status, or to established hierarchies and older adults, remains unknown; however, there is no reason to believe that the findings would not extend beyond college freshmen in dorms. Whether these findings extend to college freshmen in dorms who moved fewer than 100 miles away from their hometown remains an empirical question. I targeted such a group based on the assumption that freshmen further from home would be more invested in securing new social connections than freshmen closer to home. I was unable to empirically assess this assumption. The processes identified here are likely to also describe antecedents of SSS for freshmen living fewer than 100 miles from their hometown, but to a lesser degree. If students who live closer to home feel more secure in their ability to maintain
friendships with those from years past, then perhaps early life stress and cognitive appraisals have less of an impact on their SSS in the dorms. Examining the reach of these findings is a fruitful avenue for future research. Regardless of the few shortcomings that stem from examining this particular group, the targeted population is important to examine because the transition to college is marked by complex challenges in emotional, social, and academic adjustment.

Identifying antecedents of SSS might permit scholars to classify those who are more susceptible to lower SSS, and thus tailor intervention programs to meet the needs of those individuals to prevent negative downstream consequences. Established consequences of SSS include an array of health outcomes (Euteneuer, 2014; Quon & McGrath, 2014), and likely include adjustment to college (Ostrove & Long, 2007) and academic success (Sirin, 2005).

An additional limitation is that the positive vignettes were neither pilot tested nor subjected to validation prior to being employed in the present study. Examination of the standard deviations indicates substantial variation in responses, but it is possible that the vignettes were interpreted as positive rather than ambiguous. However, even if the vignettes were interpreted as positive, results still demonstrate that high versus low SSS individuals appraise potentially negative situations differently, but not positive ones. Given the abundance of research conducted on college populations (Henrich, Heine, & Norenzayan, 2010), the scale developed and presented here can be utilized to further understand how college students interpret ambiguous social situations. This can potentially provide insight into adjustment to college, and the development and maintenance of social relationships. I encourage other scholars to utilize, validate, and adapt the scale.

Conclusions. The study is the first direct test of antecedents of SSS, a construct that has received abundant attention for its ties to health. Results showed that freshmen’s appraisals of
ambiguous social situations, and potentially early life stress, have implications for the SSS they develop in budding social hierarchies. Given differences in social status guide many of our social interactions (Cummins, 1996), examining how social status arises will further our understanding of the nature of social relationships, which has important consequences for health and well-being. Furthermore, having identified factors that contribute to SSS, scholars are better able to classify those who are more susceptible to poorer physical and mental health outcomes in the future, and potentially tailor intervention programs to meet the needs of those individuals.
Table 1-1
Descriptive statistics and correlations of key predictor variables and covariates.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (SD)</th>
<th>Scale range</th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
<th>6.</th>
<th>7.</th>
<th>8.</th>
<th>9.</th>
<th>10.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. SSS&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.60 (1.77)</td>
<td>1 – 10</td>
<td>-</td>
<td>.20**</td>
<td>-.27**</td>
<td>-.10</td>
<td>.27**</td>
<td>-.17**</td>
<td>.20**</td>
<td>.44**</td>
<td>-.39**</td>
<td>.47**</td>
</tr>
<tr>
<td>2. Early life stress&lt;sup&gt;bc&lt;/sup&gt;</td>
<td>2.03 (.67)</td>
<td>1 – 5</td>
<td>-</td>
<td>-.03</td>
<td>-.08</td>
<td>.04</td>
<td>.10</td>
<td>.30**</td>
<td>.36**</td>
<td>-.38**</td>
<td>.28**</td>
<td></td>
</tr>
<tr>
<td>3. Negative RPA&lt;sup&gt;d&lt;/sup&gt;</td>
<td>-9.3 (1.57)</td>
<td>-5 – 2.6</td>
<td>-</td>
<td>.22**</td>
<td>-.39**</td>
<td>.06</td>
<td>.04</td>
<td>-.18*</td>
<td>.13†</td>
<td>-.17*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Feel bad&lt;sup&gt;d&lt;/sup&gt;</td>
<td>4.13 (1.43)</td>
<td>1 – 7</td>
<td>-</td>
<td>.09</td>
<td>.50**</td>
<td>-.03</td>
<td>-.11†</td>
<td>-.14*</td>
<td>-.17*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Positive RPA&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1.28 (1.66)</td>
<td>-3 – 6&lt;sup&gt;d&lt;/sup&gt;</td>
<td>-</td>
<td>.10</td>
<td>.11†</td>
<td>.27**</td>
<td>-.14*</td>
<td>.16*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Feel good&lt;sup&gt;d&lt;/sup&gt;</td>
<td>5.68 (1.00)</td>
<td>1 – 7</td>
<td>-</td>
<td>.07</td>
<td>.004</td>
<td>.05</td>
<td>-.10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. SES&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.30 (.98)</td>
<td>1 – 5</td>
<td>-</td>
<td>.29**</td>
<td>-.18**</td>
<td>.21**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Self-esteem&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.95 (.57)</td>
<td>1 – 4</td>
<td>-</td>
<td>-.43**</td>
<td>.44**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Neuroticism&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.58 (1.41)</td>
<td>1 – 7</td>
<td>-</td>
<td>-.28**</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Physical attractiveness&lt;sup&gt;b&lt;/sup&gt;</td>
<td>4.24 (1.11)</td>
<td>1 – 7</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

<sup>a</sup> Measured at every time point
<sup>b</sup> Measured at baseline only
<sup>c</sup> Inverse of item
<sup>d</sup> Measured at baseline, January, and final monthly questionnaire
<sup>e</sup> Actual range of responses
† p < .10, * p < .05, p < .001
### Table 1-2
Parameter estimates predicting SSS from early life stress.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
<th>SE</th>
<th>z</th>
<th>p</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fixed Effects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>6.39</td>
<td>.13</td>
<td>47.37</td>
<td>&lt;.001</td>
<td>6.13</td>
</tr>
<tr>
<td>Time</td>
<td>.05</td>
<td>.02</td>
<td>2.33</td>
<td>.02</td>
<td>.008</td>
</tr>
<tr>
<td>Early life stress</td>
<td>-.26</td>
<td>.92</td>
<td>-.28</td>
<td>--</td>
<td>-2.07</td>
</tr>
<tr>
<td>SES</td>
<td>.17</td>
<td>.14</td>
<td>1.23</td>
<td>--</td>
<td>-.10</td>
</tr>
<tr>
<td>Self-esteem</td>
<td>.68</td>
<td>.26</td>
<td>-2.55</td>
<td>.01</td>
<td>-1.19</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>-.30</td>
<td>.10</td>
<td>2.98</td>
<td>.003</td>
<td>.10</td>
</tr>
<tr>
<td>Physical attractiveness</td>
<td>.52</td>
<td>.13</td>
<td>4.08</td>
<td>&lt;.001</td>
<td>.27</td>
</tr>
<tr>
<td><strong>Variances</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>1.04</td>
<td>.20</td>
<td>.71</td>
<td>1.52</td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>.02</td>
<td>.005</td>
<td>.01</td>
<td>.03</td>
<td></td>
</tr>
<tr>
<td>Within-subject</td>
<td>.70</td>
<td>.05</td>
<td>.62</td>
<td>.80</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Parameter of inverse of early life stress reported. Time centered around academic year, where September = 0. All other variables centered around grand mean. Only p-values <.10 shown.
Table 1-3  
Descriptive statistics for each negative and positive vignette.

<table>
<thead>
<tr>
<th>Negative vignette</th>
<th>Personalistic (α=.72)</th>
<th>Non-personalistic (α=.53)</th>
<th>Feel bad (α=.83)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Lounge</td>
<td>4.19</td>
<td>1.74</td>
<td>5.52</td>
</tr>
<tr>
<td>Dining hall alone</td>
<td>4.03</td>
<td>1.60</td>
<td>4.22</td>
</tr>
<tr>
<td>Stop conversation</td>
<td>3.33</td>
<td>1.48</td>
<td>5.54</td>
</tr>
<tr>
<td>Facebook photo</td>
<td>3.55</td>
<td>1.67</td>
<td>4.07</td>
</tr>
<tr>
<td>Continue conversation</td>
<td>3.34</td>
<td>1.52</td>
<td>3.73</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Positive vignette</th>
<th>Personalistic (α=.69)</th>
<th>Non-personalistic (α=.52)</th>
<th>Feel good (α=.80)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Coffee shop</td>
<td>6.12</td>
<td>1.10</td>
<td>3.90</td>
</tr>
<tr>
<td>Dining hall wave</td>
<td>5.76</td>
<td>1.35</td>
<td>3.87</td>
</tr>
<tr>
<td>Facebook birthday</td>
<td>4.85</td>
<td>1.56</td>
<td>5.10</td>
</tr>
</tbody>
</table>

*Note.* For personalistic and non-personalistic, 1 = not at all likely and 7 = very likely. For how bad/good participants would feel if the personalistic appraisal was true, 1 = not at all bad/good and 7 = very bad/good. Data collected at baseline, in January monthly questionnaire, and in final monthly questionnaire.
### Table 1-4
Parameter estimates predicting SSS from cognitive appraisals.

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>SE</th>
<th>z</th>
<th>p</th>
<th>95% CI</th>
</tr>
</thead>
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|                          |          |      |       |      |         |
| **Variances**            |          |      |       |      |         |
| Intercept                | .62      | .10  | .45   | .86  |         |
| Time                     | .01      | .005 | .005  | .03  |         |
| Positive RPA             | .05      | .04  | .01   | .22  |         |
| Within-subject           | .74      | .20  | .43   | 1.27 |         |

*Note.* RPA = relative personalistic appraisal. Negative RPA = RPA in response to negative vignettes. Positive RPA = RPA in response to positive vignettes. Time centered around academic year, where September = 0. All other variables were centered around grand mean. Only p-values <.10 shown.
Table 1-5
Parameter estimates of time-lagged model predicting SSS from cognitive appraisals.

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</table>

*Note.* RPA = relative personalistic appraisal. Negative RPA = RPA in response to negative vignettes. Positive RPA = RPA in response to positive vignettes. Time centered around academic year, where September = 0. All other variables were centered around grand mean. Only p-values <.10 shown.
Figure 1-1. Two-way interaction between time and feeling bad in response to negative vignettes predicting SSS. Predicted marginal mean of SSS in the dorms by time and feeling bad in response to negative vignettes. Separate lines graphed at +/- 1SD from the grand mean of feeling bad in response to negative vignettes with 95% confidence intervals. Region of significance is within dashed rectangle.
Figure 1-2. Two-way interaction between time and relative personalistic appraisals in response to positive vignettes predicting SSS. Predicted marginal mean of SSS in the dorms by time and relative personalistic appraisals (RPA) in response to positive vignettes. Separate lines graphed at +/- 1SD from the grand mean of positive RPA with 95% confidence intervals. Region of significance is within dashed rectangles.
Appendix

Below is a list of several situations, followed by some questions for each situation. Please vividly imagine yourself in each situation. After reading each situation, answer the questions about how you would think or feel in the situation. Remember, really try to imagine how you would feel in each situation.

**Negative Vignettes**

**Lounge:** You walk into the lounge on your dorm floor. The students who are already in there look up and see you, but then quickly look down again without saying hi.

How likely is it that they did not want to talk to you?

1 2 3 4 5 6 7
Not at Very
all likely likely

How likely is it that they were busy focusing on their work?

1 2 3 4 5 6 7
Not at Very
all likely likely

If your dorm mates did not want to talk to you, how bad would this make you feel?

1 2 3 4 5 6 7
Not at Very
all bad bad

**Dining hall alone:** You are eating alone near the entrance of the dining hall. Right after you sit down, several of your friends from your dorm floor walk in together. One of your friends looks in your direction, but the group does not sit down with you.

How likely is it that your dorm mate did not want to eat with you?

1 2 3 4 5 6 7
Not at Very
all likely likely

How likely is it that your dorm mate didn't see you?

1 2 3 4 5 6 7
Not at Very
all likely likely

If your dorm mate did not want to eat with you, how bad would this make you feel?

1 2 3 4 5 6 7
Not at Very
all bad bad
Stop conversation: You are walking down the hall of your dorm floor. You see two of your friends engaged in conversation. As you approach your two friends, they immediately stop their conversation.

How likely is it that your dorm mates were talking about you?

1 2 3 4 5 6 7
Not at Very
all likely likely

How likely is it that your dorm mates were talking about something private and unrelated to you?

1 2 3 4 5 6 7
Not at Very
all likely likely

If your dorm mates were talking about you, how bad would this make you feel?

1 2 3 4 5 6 7
Not at Very
all bad bad

Facebook photo: You go on Facebook and see a photo posted by one of your friends. Ten of your dorm mates are in the photo and it looks like they were at a party last night that you didn't know about.

How likely is it that your dorm mates did not want to tell you about the party?

1 2 3 4 5 6 7
Not at Very
all likely likely

How likely is it that your dorm mates wanted to tell you about the party, but could not find you the evening of the party?

1 2 3 4 5 6 7
Not at Very
all likely likely

Continue conversation: Three of your dorm mates are casually talking to each other in front of the elevator of your dorm floor. As you approach the elevator, your friends continue their conversation as if you aren't there.
How likely is it that your dorm mates did not want to talk to you?

1 2 3 4 5 6 7
Not at Very all likely likely

How likely is it that your dorm mates did not see you approach the elevator?

1 2 3 4 5 6 7
Not at Very all likely likely

If your dorm mates did not want to talk to you, how bad would this make you feel?

1 2 3 4 5 6 7
Not at Very all bad bad

Positive Vignettes

**Coffee shop**: You are searching for a table in the crowded campus coffee shop. You notice three of your dorm mates seated at a four-person table. One of your dorm mates waves you over to sit with them.

How likely is it that your dorm mates wanted you to sit with them?

1 2 3 4 5 6 7
Not at Very all likely likely

How likely is it that your dorm mates were simply being polite by having you sit with them?

1 2 3 4 5 6 7
Not at Very all likely likely

If your dorm mates did want to sit with you, how good would this make you feel?

1 2 3 4 5 6 7
Not at Very all good good

**Dining hall wave**: You are in a crowded line at the dining hall, waiting to get dinner by yourself. In line, you spot two of your dorm mates. They wave in your direction.

1 2 3 4 5 6 7
Not at Very all likely likely
How likely is it that your dorm mates were waving at someone else in line?

1 2 3 4 5 6 7  
Not at Very likely
all likely likely

If your dorm mates were waving at you, how good would this make you feel?

1 2 3 4 5 6 7  
Not at Very good
all good good

**Facebook birthday**: You logon to Facebook and see you were invited to a birthday party by one of your dorm mates. Everyone else on your floor was invited, too.

How likely is it that your dorm mate invited you because they really want you to be at the party?

1 2 3 4 5 6 7  
Not at Very likely
all likely likely

How likely is it that your dorm mate invited you because they invited everyone else on your dorm floor?

1 2 3 4 5 6 7  
Not at Very likely
all likely likely

If your dorm mate really wanted you to be at the party, how good would this make you feel?

1 2 3 4 5 6 7  
Not at Very good
all good good
References


Judgments and Observables Cues of Subjective Social Status
Judgments and Observables Cues of Subjective Social Status

Individuals constantly assess different personal characteristics during social interactions, and can do so surprisingly well with minimal information (Ambady & Rosenthal, 1992). One important personal characteristic to judge is social status. This is because assessing status is a crucial skill for navigating social relationships and has implications for one’s ability to recognize what is and what is not permitted based on one’s position in the hierarchy (Cummins, 1996). However, limited research has examined whether individuals can accurately assess others’ status, and what observable cues are used to make such judgments. Therefore, the current study aimed to investigate whether people can accurately judge others’ social status, and to identify cues involved in status judgments.

Given social hierarchies are common to social groups across the animal kingdom (Brown, 1991; Chance, 1961; Ellis, 1995), and are even apparent in the play groups of preschool children as young as two years (Frankel & Arbel, 1980; Strayer & Trudel, 1984), it is expected that people are quite adept at judging others’ status. The available empirical evidence suggests that is indeed the case, even with limited information about the person whose status is being judged. Early research found that dominance judgments at first glance (i.e., prior to verbal interaction) predicted subsequent speaking time in a group interaction, an indicator of status (Kalma, 1991); dominance is a trait that is highly related to social status (Cheng, Tracy, Foulsham, Kingstone, & Henrich, 2013; Henrich & Gil-White, 2001). When presented with a photo of two individuals, an employee and a supervisor, perceivers performed at better than chance level when asked to indicate which individual was the supervisor (Barnes & Sternberg, 1989). In another study focusing on status in the workplace, targets were photographed with a coworker and asked to describe their hierarchical relation to that coworker. Subsequently, a
group of perceivers rated the relative status of the photographed target and coworker with respect to each other; perceivers were accurate in assessing status differences between targets and their coworkers (Mast & Hall, 2004). Overall, the evidence indicates that individuals can accurately assess others’ status with limited information.

If people assess others’ status accurately, what observable cues are used? While limited research exists on mechanisms of attaining accuracy, one potential cue is physical attractiveness. In young children who rated each other on likeability, a measure of status, children whom were more liked had their photographs and video rated as more physically attractive by other children (Kennedy, 1990) and by undergraduates (Dodge, 1983; Vaughn & Langlois, 1983). In one study of young adults that featured an all-male group (a fraternity), an all-female group (a sorority), and a mixed-gender group (a dorm floor), researchers examined whether physical attractiveness based on 10-second video clips of participants listening to instructions predicted peer-rated status; physical attractiveness was rated by a panel of raters unaffiliated with the groups. In the fraternity and among men in the mixed-gender group, physical attractiveness was significantly related to peer-rated status, such that more physically attractive men achieved higher status. However, there was no association between physical attractiveness and peer-rated status for those in the sorority or women in the mixed-gender group (Anderson et al., 2001). Thus, physical attractiveness does appear to predict social status, but perhaps for men more strongly than women.

Another potential cue of status is dominance, given that it has close ties to social status and is a promising path to successfully ascending the hierarchy (Cheng et al., 2013; Henrich & Gil-White, 2001). For example, individuals who were judged by peers to be dominant during a social interaction were perceived by peers and outside observers as possessing high status, and
exerted more behavioral influence over the decision-making process during a group task (Cheng et al., 2013). The empirical research on whether dominance ratings derived from photographs to predict social status is limited, but two studies provide evidence of such a relationship. Dominance ratings of men’s faces predicted social status in a cohort of military officers (Mueller & Mazur, 1996, 1997). In a study of female CEOs, participants rated facial photographs of the women for dominance. Perceptions of dominance positively predicted compensation for female CEOs, a viable indicator of status (Rule & Ambady, 2009). Therefore, it is plausible that ratings of dominance derived from visual stimuli predict social status.

Beyond exploring potential cues that are used to judge others’ status, an additional aim of the present study was to examine whether the same cues of physical attractiveness and dominance predict individuals’ judgments of their own status. This is a fruitful avenue for exploration because social status research thus far has only examined what cues predict status rated by others. While Chapter II of this dissertation presented evidence for two avenues that influence one’s own social status—early life stress and cognitive appraisals of ambiguous social situations—this study will explore observable cues that predict one’s own status.

Throughout the literature on social status discussed thus far, status itself was defined in myriad ways; varied conceptualizations plague the social status literature at large (Blader & Chen, 2014). In the present study, I applied a measure of social status that is largely accepted by scholars: subjective social status (SSS), or the psychological perception of one’s rank within the social hierarchy (Anderson et al., 2012; Singh-Manoux et al., 2003). One unique characteristic of SSS is that the measure can be adapted to best represent the sample of interest. Given the aims of the larger study from which the present data are drawn (see Chapters II and IV of this dissertation), the study population was undergraduate freshmen at the University of California,
Los Angeles (UCLA). Therefore, all ratings of SSS were made with reference to other individuals at UCLA. This necessitated having raters rate targets on SSS in order to assess accuracy, the first aim; the present study is the first to have individuals rate others’ SSS.

In summary, the literature supports the notion that raters can accurately assess targets’ status with limited information and that physical attractiveness and dominance might be viable cues to targets’ status. However, it is unclear whether these results extend to SSS and if the same cues that raters use to assess targets’ status is used by targets to assess their own status. In the present study, I investigated this in an attempt to offer insight into the accuracy of SSS judgments, and the observable cues that lead to such judgments by raters and targets. First, I hypothesized that targets’ SSS (hereafter referred to as “self-rated SSS”) align with raters’ judgments of targets’ SSS (hereafter referred to as “other-rated SSS”). That is, raters can accurately judge targets’ SSS. Second, I predicted that targets’ physical attractiveness and dominance as assessed by raters (i.e., other-rated attractiveness and other-rated dominance, respectively) positively predict other-rated SSS. Lastly, I predicted that other-rated attractiveness and dominance positively predict self-rated SSS.

Method

Chapter II of the dissertation details the participant pool and procedure of the study from which the data on targets are drawn. Briefly, 94 undergraduate freshmen (29 men, 64 women, 1 gender queer) from UCLA living in residence halls participated in a longitudinal study conducted from September, 2015 to June, 2016. Enrollment occurred at the start of the academic year (September, 2015) to just before Spring Break (March, 2016). On average, targets enrolled in the study six weeks after moving into the dorms ($\text{S.D.} = 6.63$ weeks; range = 5 days before
moving in – 21 weeks after moving in), and remained in the study for an average of 3.32 months 
($S.D. = 2.41$, range = 1 to 9).

Procedure. The study was comprised of three key components: a baseline questionnaire, 
monthly questionnaires, and a lab session. Upon enrollment in the study, participants completed 
an online baseline questionnaire. One month after completing the baseline questionnaire, and 
every subsequent month thereafter, they completed an online questionnaire. Targets also 
completed one laboratory session within one month of enrolling in the study.

Measures.

Subjective social status. Targets completed the MacArthur Scale of SSS 
(Adler et al., 2000) with the instructions, “Imagine a 10-rung ladder representing where people 
“rank” at UCLA. At the top of the ladder are UCLA students who are most respected, esteemed, 
and admired. At the bottom of the ladder are those who are least respected, esteemed, and 
admired. Mark your response on the scale below that best represents where you think you stand 
on the ladder.” Targets completed ratings of SSS at baseline and every monthly questionnaire.

SES. At baseline, targets indicated which socioeconomic class best 
described their family as they grew up (lower, lower-middle, middle, upper-middle, and upper).

Potential covariates. Targets completed measures at baseline assessing 
high school SSS, anxiety (Beck et al., 1988), depression (Beck et al., 1961), social support 
(Cutrona & Russell, 1987), self-esteem (Rosenberg, 1965), personality traits (Gosling et al., 
2003), perceived stress (Cohen & Williamson, 1988), and self-rated physical attractiveness 
(“Relative to individuals of your sex and age, do you consider yourself…[1= much less 
attractive, 7 = much more attractive]?”) as potential third variables. There were also several 
items that assessed the value participants attributed to individuals on their dorm floor. For
example, “Of the time you spent socializing, what percent of that time is spent socializing with people from your dorm floor?”

*Lab session.* During the 15-minute lab session, targets had a series of photos taken and completed a video recording task. Two targets did not respond to lab session scheduling requests, one did not consent to participating in the lab session, two did not consent to complete the video recording, and three did not consent to have their photographs or video rated. Therefore, 87 targets provided photographs and 85 targets provided video recordings for rating².

Experimenters took four standardized photographs of each target: two facial photos and two full body photos. Targets first maintained a neutral expression and then smiled for each standardized photograph. Following the standardized photographs, participants were asked to take a “selfie” using a cell phone. Experimenters provided the use of their own cell phone if participants were unable or unwilling to use their own. Targets were left alone in a private room for up to one minute to take a selfie that they were satisfied with. Upon capturing a satisfactory selfie, they emailed the photograph to the lab e-mail account. Lastly, targets completed a video recording task. They were instructed to act naturally and to use their normal speaking voice and mannerisms. While seated in a chair, targets were asked to discuss for one minute how they manage the balance, or how they plan to manage the balance, between the academic and personal parts of their lives. Experimenters monitored the timer on the video recorder and stopped participants’ speech after approximately one minute.

The lab session concluded following the video recording task, and targets were sent home with the reminder that they would receive monthly questionnaires through the end of the study.

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² Participants who did and did not participate in the lab session did not meaningfully differ on any variables of interest, with one exception. Participants who did not provide photographs, compared to those who did, reported marginally more anxiety (t(92) = 1.78, p = .08).
academic school year. Following the conclusion of all lab sessions, photos and video were prepared to be rated by a group of raters outside of the UCLA campus.

*Photo and video rating.* Photos and videos were rated by 1000 individuals (520 male, 475 female, five gender queer) on Amazon Mechanical Turk (mTurk). Raters were, on average, 35 years old ($SD = 17.12$). The majority self-identified as Caucasian (77%) with smaller percentages identifying as Black/African-American (6%), Asian-American (6%), Latino/a (5%) and multi-racial or other (6%).

Prior to having photos and videos rated by raters on mTurk, the stimuli were prepared for presentation. Of the standardized photographs, only those in which targets were asked to smile were presented. Photograph sizes were standardized to 300x400 pixels for body photographs and selfies and 400x300 pixels for facial photographs. Videos were prepared for presentation by creating 10-second video clips; the clips consisted of the first 10 seconds in which targets responded to the video prompt.

Each photograph and video clip was uploaded into Qualtrics. Controls were set in Qualtrics to permit each photograph to appear on screen for four seconds, and each video to appear on screen for 13 seconds. Videos appeared for 13 seconds, despite the length of each clip being 10 seconds, to permit for any buffering time due to individual differences in the internet speed of the raters. Following each stimulus, raters responded to the items, “How physically attractive is this person?” and “How much does this person appear as though s/he could get what s/he wanted (i.e., dominant)?” on scale from 1 = extremely [unattractive/non-dominant] to 9 = extremely [attractive/dominant]. Raters also responded to the item, “Imagine a 10-rung ladder representing where college students “rank”. At the top of the ladder are college students who are most respected, esteemed, and admired. At the bottom of the ladder are those who are least
respected, esteemed, and admired. Mark your response on the scale below that best represents where you think this person stands on the ladder.” At any given time, only a single stimulus (i.e., photograph, video) was present on the page with the three items.

To prevent fatigue, each rater saw only one type of stimulus: facial photographs, full body photographs, selfies, or video clips. Given there were up to 87 targets who provided stimuli, raters were only asked to rate a subset of one type of stimulus.

To determine which targets’ stimuli raters would view, I created blocks. Specifically, each type of photograph (i.e., facial, full body, selfie) was organized into three blocks and the 10-second videos were organized into six blocks. A random number generator determined which targets’ stimuli would be placed in which block; this randomization was accomplished independently for each of the four types of stimuli. Therefore, each target’s stimuli were randomly placed into one of three blocks for facial photos, one of three blocks for full body photos, one of three blocks for selfies, and one of six blocks for video clips. In order to prevent order effects, I randomly generated two orders for each block. Therefore, the final survey on Qualtrics housed 30 blocks of stimuli. Qualtrics randomly assigned raters to view and rate one of the 30 possible blocks. On average, raters rated 24 photographs ($S.D. = 4$) or 13 video clips ($S.D. = 2$).

Data Analytic Plan. I used Stata 13.1 to run simple linear regressions to test whether other-rated attractiveness and dominance predicted other-rated SSS. I conducted multilevel models with measurement occasions (Level 1) nested within targets (Level 2) to examine whether other-rated attractiveness and dominance predicted self-rated SSS across the academic year, given targets provided numerous assessments of SSS. To aid in interpretation, time was centered around the academic year (i.e., September = 0, October = 1…June = 9) and a one-unit
increase in time is equivalent to one month. In all analyses, predictor variables and covariates were grand mean centered.

The modeling approach began by including the key predictor variables, interactions between time, gender, and said predictor variables, and all potential covariates associated with the outcome. Upon running the model, I removed the single variable that had the greatest $p$ value, and then ran the model again. I repeated this process until only the key predictors and significant covariates remained, with one exception: SES was included as a covariate in all models to demonstrate that any observed effects of SSS are over and above the effect of SES. This approach resulted in the most parsimonious model that was also theoretically-driven due to the inclusion of SES.

**Results**

*Accuracy of other-rated SSS.* Other-rated SSS of facial, body, and selfie photographs were highly related ($\alpha = .88$), and thus combined to create a composite for analyses; analyses conducted individually on other-rated SSS of facial, body, and selfie photographs resulted in consistent findings. While other-rated SSS based on video was highly correlated with other-rated SSS based on photographs ($r = .73$, $p < .001$), analyses were conducted on the two mediums independently.

Table 2-1 presents descriptive statistics for other- and self-rated SSS, and Table 2-2 reports the intraclass correlation (ICC) by stimuli type and rating. Inconsistent with the notion that individuals can judge others’ SSS with accuracy, other-rated SSS based on photographs was only modestly correlated with self-rated SSS ($r = .19$, $p = .09$), and other-rated SSS based on video was not correlated with self-rated SSS ($r = .07$, $p = .52$). Given precedent set by Anderson, John, Keltner, and Kring (2001), I examined whether the association differed by target gender. For male targets, other-rated SSS based on photographs ($r = .44$, $p < .001$) and video ($r = .39$, $p$
was strongly correlated with self-rated SSS. For female targets, there was an association between other-rated SSS based on photographs and self-rated SSS ($r = .17, p = .002$), but not for other-rated SSS based on video ($r = .01, p = .72$)

*Observed cues predict other-rated SSS.*

**Photographs.** Other-rated attractiveness and dominance from targets’ facial, body, and selfie photographs were highly related ($\alpha = .92$ and $.88$ for other-rated attractiveness and dominance, respectively), and thus combined to create one composite for other-rated attractiveness and one for dominance; analyses conducted individually on facial, body, and selfie other-rated attractiveness and dominance resulted in consistent findings. Ratings of other-rated attractiveness and dominance were highly correlated ($r = .85, p < .001$). However, analyses were conducted on the constructs independently to examine the unique contributions of other-rated attractiveness and dominance on other-rated SSS. I first conducted analyses on each predictor independently, and then also examined them in the same model.

Simple linear regression revealed an interaction between other-rated attractiveness and target gender in predicting other-rated SSS ($b = -.22, 95\% \text{ CI } [-.38, -.07]$). For targets one standard deviation below the grand mean of other-rated attractiveness, there were no gender differences in other-rated SSS. With increasing levels of other-rated attractiveness, however, male targets were granted higher other-rated SSS than female targets (Figure 2-1).

There was a marginally significant interaction between other-rated dominance and target gender to predict other-rated SSS ($b = -.15, 95\% \text{ CI } [-.32, .01]$). For targets one standard deviation above the grand mean of other-rated dominance, there were no gender differences in other-rated SSS. However, with decreasing levels of other-rated dominance, male targets were granted lower other-rated SSS than female targets (Figure 2-2).
The nature of the interactions between other-rated attractiveness and dominance and target gender on other-rated SSS was altered upon entering both predictors in the same regression model. Results identified a marginally significant interaction between other-rated attractiveness and target gender ($b = .28$, 95% CI [-.05, .62]). Gender differences only emerged for targets rated above the grand mean of other-rated attractiveness; however, in contrast to findings when other-rated attractiveness was entered in the model as the sole predictor, attractive female targets received marginally higher other-rated SSS than attractive male targets. Results again revealed an interaction between other-rated dominance and target gender ($b = -.49$, 95% CI [-.85, -.14]), but the pattern of results changed compared to when other-rated dominance was the sole predictor. There were no gender differences in other-rated SSS for targets at or below the grand mean of other-rated dominance. For targets above the grand mean of other-rated dominance, male targets were granted greater other-rated SSS than female targets.

Video. Other-rated attractiveness and other-rated dominance based on video were significantly correlated ($r = .61$, $p < .001$). However, I again first conducted analyses on each predictor independently before examining them in the same model.

There was a marginally significant interaction between other-rated attractiveness and target gender to predict other-rated SSS ($b = -.37$, 95% CI [-.77, .03]). With increasing levels of other-rated attractiveness, male targets were awarded marginally higher other-rated SSS than female targets, mirroring the effects of other-rated attractiveness based on photographs.

Simple linear regression revealed a significant interaction between other-rated dominance and target gender on other-rated SSS ($b = -.44$, 95% CI [-.87, -.01]). Gender differences only emerged for those rated one standard deviation below the grand mean of other-rated dominance. Specifically, low dominant male targets received lower other-rated SSS than low dominant
female targets; this finding is similar to that reported for other-rated dominance based on photographs.

The inclusion of other-rated attractiveness and dominance in the same model to predict other-rated SSS revealed a marginally significant interaction between target gender and other-rated dominance ($b = -1.04$, 95% CI [-2.12, .04], but not between target gender and other-rated attractiveness ($b = .59$, 95% CI [-.41, 1.59]). With decreasing levels of other-rated dominance, male targets were granted marginally lower other-rated SSS than female targets; this is consistent with findings when other-rated dominance based on photographs or video was the sole predictor.

*Observed cues predict self-rated SSS.*

**Photographs.** Consistent with the hypothesis, other-rated attractiveness positively predicted self-rated SSS ($b = .50$, 95% CI [.08, .91]; Table 2-3). Furthermore, analyses revealed that male targets reported higher self-rated SSS than female targets ($b = -.80$, 95% CI [-1.51, -.08]).

In contrast to the hypothesis, there was not a significant effect of other-rated dominance on self-rated SSS ($b = .37$, 95% CI [-.11, .85]; Table 2-3).

In the multilevel model with other-rated attractiveness and dominance included simultaneously, other-rated attractiveness emerged as a significant positive predictor of self-rated SSS ($b = .96$, 95% CI [.08, 1.83]), whereas other-rated dominance did not ($b = -.61$, 95% CI [-1.61, .40]; Table 2-3). Male targets also reported higher self-rated SSS than female targets ($b = -1.03$, 95% CI [-1.84, -.22]).

**Video.** In contrast to the hypothesis, other-rated attractiveness based on video did not predict self-rated SSS ($b = .28$, 95% CI [-.11, .67]; Table 2-4). Furthermore, analyses revealed
that male targets reported marginally higher self-rated SSS than female targets ($b = -.59$, 95% CI [-1.29, .10]).

Targets who were rated as more dominant did not report higher self-rated SSS ($b = -.01$, 95% CI [-.45, .43]; Table 2-4).

In the multilevel model including both other-rated attractiveness and dominance, other-rated attractiveness emerged as a marginally significant and positive predictor of self-rated SSS ($b = .47$, 95% CI [-.02, .96], whereas other-rated dominance did not ($b = -.34$, 95% CI [-.89, .21]; Table 2-4). Furthermore, male targets reported marginally higher self-rated SSS than female targets ($b = -.65$, 95% CI [-1.34, .04]).

**Discussion**

The current study examined the accuracy of SSS judgments and the observable cues that lead to such judgments by others and oneself. Results indicated that other-rated SSS aligned with male targets’, but not consistently with female targets’, self-rated SSS. Furthermore, greater other-rated attractiveness and dominance based upon photographs and video generally indicated higher other-rated SSS, and these cues mattered more for male targets’ other-rated SSS than for females’. Lastly, other-rated attractiveness, but not other-rated dominance, emerged as a reliable cue of self-rated SSS.

In contrast to previous studies of accuracy of social status judgments, raters did not accurately judge targets’ SSS across men and women. Analyses by target gender revealed that raters accurately assessed men’s SSS across stimuli, and were able to judge women’s SSS with relative accuracy based on photographs. Status differences by target gender were also apparent in analyses testing the second aim.
The second aim of the present study was to offer insight into the observable cues that lead to status judgments, and other-rated attractiveness and dominance did contribute to judgments of other-rated SSS. When entered into statistical models independently, other-rated attractiveness and dominance based on photographs mattered more for male targets’ other-rated SSS than for female targets’. Specifically, attractive men were granted greater other-rated SSS than attractive women, but non-dominant men were granted lower other-rated SSS than non-dominant women. When other-rated dominance was held constant, other-rated attractiveness mattered marginally more for female than male targets’ other-rated SSS, such that attractive women had higher other-rated SSS than attractive men. When other-rated attractiveness was held constant, other-rated dominance still mattered more for male targets’ other-rated SSS. Turning to other-rated attractiveness and dominance based on video, much like with photographs, both factors mattered more for male than female targets when entered independently into statistical models to predict other-rated SSS. Other-rated attractiveness did not predict other-rated SSS when other-rated dominance was held constant, but other-rated dominance mattered more for male targets’ other-rated SSS than female targets’ when other-rated attractiveness was held constant.

Overall, the findings of the first two aims follow from those reported in Anderson, John, Keltner, and Kring (2001). Anderson and colleagues (2001) found that physical attractiveness was positively associated with peer-rated status of male targets, but not female targets. As reported in the present study, other-rated attractiveness and dominance influenced other-rated SSS more strongly for male targets than for female targets. Specifically, highly attractive men were granted high other-rated SSS and highly non-dominant men had low other-rated SSS, compared to on par women. Furthermore, raters more reliably made accurate assessments of
other-rated SSS for male than for female targets. This suite of findings likely stems from the fact that status has greater implications for men than for women (Von Rueden, Gurven, & Kaplan, 2010). For example, higher status men have more biological children than higher status women (Hopcroft, 2006; Weeden, Abrams, Green, & Sabini, 2006). Given the strong evolutionary significance of status for men compared to women, as status is more closely tied to men’s reproductive success, our evolved psychology may be better apt to decipher male targets’ status than females’. This could also explain why factors such as attractiveness and dominance affect judgments of male targets’ status more than females’. Specifically, it appears that men possessing desirable traits are rewarded with greater other-rated SSS, whereas they are granted lower other-rated SSS when they lack desirable traits. Women’s traits, including other-rated attractiveness and dominance, do track other-rated SSS, but women do not receive the same reward for possessing desirable traits or penalty for lacking them as do men. Overall, it appears that male targets’ other-rated SSS are more sensitive to their traits compared to female targets’. Future research should continue to blend social psychology and evolutionary theory to derive key insights into the nature of judgments of other’s social status.

The final aim of the study was to assess whether the same observable cues of other-rated attractiveness and dominance predicted self-rated SSS. Results revealed that other-rated attractiveness, but not dominance, based on photographs positively predicted self-rated SSS. Observable cues based on video did not predict self-rated SSS. Therefore, it appears that other-rated attractiveness is a reliable predictor of self-rated SSS; the findings based on photographs may be more informative than video because the verbal channel is the most controllable channel (Ambady & Rosenthal, 1992). This is an intriguing finding because targets who completed assessments of self-rated SSS were not privy to raters’ judgments. However, it is possible that
after many social interactions with individuals who made similar judgments based on observable cues, targets are aware of how others perceive them and this feeds into their self-rated SSS. Indeed, the extant literature indicates that attractive targets are treated differently in social interactions than less attractive targets (Karraker, 1986; la Frenier & Charlesworth, 1983). Importantly, this finding was above and beyond targets’ self-rated physical attractiveness, which was also a consistent and positive predictor of self-rated SSS. Furthermore, results revealed that in the context of other students at UCLA, other-rated dominance does not play a key role in shaping targets’ self-rated SSS. These results add to those described in Chapter II of this dissertation, which identified developmental and contextual predictors of self-rated SSS.

**Strengths.** There are several notable strengths of the present study. Beyond being the first study to explore the identified aims, the study furthers our understanding of the components of SSS. Researchers have typically focused on what SSS precedes (Euteneuer, 2014; Quon & McGrath, 2014), but it is important to identify predictors of SSS if scholars hope to launch programs that can increase SSS and have positive downstream consequences. While increasing objective physical attractiveness is not a suitable target, interventions aimed at increasing self-perceived physical attractiveness might have positive outcomes on self-rated SSS. An additional strength is the methodological rigor of the study, particularly with respect to the photo ratings. I put careful consideration into the design of the blocks to ensure that raters did not experience fatigue, and that targets’ stimuli were randomized as best as possible to prevent order effects. A final strength is the incorporation of an evolutionary approach to understand the importance of judging social status and nature of gender differences. The integration of an evolutionary approach with a social psychological one boosts the reach of the present findings, and provided an explanation of the observed gender differences.
Limitations. Accompanying the strengths of this study are numerous limitations. As evidenced by the descriptive statistics, there was a restriction of range problem with other-rated SSS based on photographs and video (Table 2-1). This potentially made the relationship between other-rated SSS and observable cues weaker than it actually is. An additional limitation is that the raters were significantly older than the targets they were judging. It was likely a challenge for the adult raters to judge undergraduate freshmen’s attractiveness, dominance, and SSS relative to other college-aged individuals. Future studies should utilize a similarly-aged group of raters and targets to increase the external validity of the study. Beyond methodological concerns, a theoretical concern is that traits might be less readily expressed than states in the stimuli presented (Mast & Hall, 2004). The trait of dominance is expected to be related to social status, but raters potentially identified cues of state dominance in stimuli. In the laboratory environment, the variation in state dominance, and its relation to trait dominance, is likely low. Given trait dominance, specifically, is expected to be related to social status (Cheng et al., 2013; Henrich & Gil-White, 2001), this is a potential explanation as to why other-rated dominance did not emerge as a consistent predictor of other-rated or self-rated SSS.

Conclusions. Social interactions occur frequently in daily life, as do accurate judgments of one’s and others’ social status during interactions. The present study unveiled a particular domain of social status, SSS in the context of college students, in which observers are more adept at judging men’s status compared to women’s and in which observable cues affect men’s status more than women’s. Being able to judge others’ characteristics, such as social status, based on minimal observable cues is critical for successful social interaction. The belief that characteristics can be deciphered from a person’s face has persisted over the centuries (Oosterhof & Todorov, 2008), and social status appears to be one such indicated characteristic.
Table 2-1
Descriptive statistics for other- and self-rated SSS.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mean</th>
<th>SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other-rated SSS (photos)</td>
<td>5.53</td>
<td>.63</td>
<td>3.98 – 6.67</td>
</tr>
<tr>
<td>Other-rated SSS (video)</td>
<td>5.39</td>
<td>.72</td>
<td>3.23 – 6.91</td>
</tr>
<tr>
<td>Self-rated SSS</td>
<td>5.29</td>
<td>2.03</td>
<td>1 – 10</td>
</tr>
</tbody>
</table>
Table 2-2
Intraclass correlation (ICC) by stimuli type and rating.

<table>
<thead>
<tr>
<th></th>
<th>Attractiveness</th>
<th>Dominance</th>
<th>SSS</th>
</tr>
</thead>
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<td>.13</td>
<td>.14</td>
</tr>
<tr>
<td></td>
<td>.32</td>
<td>.24</td>
<td>.20</td>
</tr>
<tr>
<td></td>
<td>.31</td>
<td>.22</td>
<td>.20</td>
</tr>
<tr>
<td><strong>Body</strong></td>
<td>.28</td>
<td>.16</td>
<td>.14</td>
</tr>
<tr>
<td></td>
<td>.37</td>
<td>.14</td>
<td>.20</td>
</tr>
<tr>
<td></td>
<td>.16</td>
<td>.13</td>
<td>.09</td>
</tr>
<tr>
<td><strong>Selfie</strong></td>
<td>.35</td>
<td>.22</td>
<td>.21</td>
</tr>
<tr>
<td></td>
<td>.31</td>
<td>.26</td>
<td>.18</td>
</tr>
<tr>
<td></td>
<td>.29</td>
<td>.18</td>
<td>.15</td>
</tr>
<tr>
<td><strong>Video</strong></td>
<td>.27</td>
<td>.13</td>
<td>.18</td>
</tr>
<tr>
<td></td>
<td>.28</td>
<td>.14</td>
<td>.14</td>
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<tr>
<td></td>
<td>.34</td>
<td>.15</td>
<td>.14</td>
</tr>
</tbody>
</table>

*Note. ICCs represent correlation of measurements made on the same individual. Each cell represents a unique group of raters and targets.*
Table 2-3
Parameter estimates predicting self-rated SSS at UCLA from other-rated attractiveness and other-rated dominance based upon photographs.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Other-rated attractiveness</th>
<th>Other-rated dominance</th>
<th>Other-rated att. &amp; dom.</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>SE</td>
<td>z</td>
</tr>
<tr>
<td>Intercept</td>
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<td>19.93</td>
</tr>
<tr>
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<td>.02</td>
<td>4.64</td>
</tr>
<tr>
<td>Gender</td>
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<td>.36</td>
<td>-2.18</td>
</tr>
<tr>
<td>Other-rated attractiveness</td>
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<td>.21</td>
<td>2.36</td>
</tr>
<tr>
<td>Other-rated dominance</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>SES</td>
<td>.35</td>
<td>.16</td>
<td>2.22</td>
</tr>
<tr>
<td>Self-rated attractiveness</td>
<td>.67</td>
<td>.15</td>
<td>4.55</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variances</th>
<th>Estimate</th>
<th>SE</th>
<th>95% CI</th>
<th>Estimate</th>
<th>SE</th>
<th>95% CI</th>
<th>Estimate</th>
<th>SE</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.36</td>
<td>.28</td>
<td>.91</td>
<td>2.02</td>
<td></td>
<td></td>
<td>1.42</td>
<td>.29</td>
<td>.96</td>
</tr>
<tr>
<td>Time</td>
<td>.01</td>
<td>.005</td>
<td>.007</td>
<td>.03</td>
<td></td>
<td></td>
<td>.01</td>
<td>.005</td>
<td>.007</td>
</tr>
<tr>
<td>Within-subject variance</td>
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<td>.07</td>
<td>.83</td>
<td>1.10</td>
<td></td>
<td></td>
<td>.96</td>
<td>.07</td>
<td>.83</td>
</tr>
</tbody>
</table>

63
Table 2-4
Parameter estimates predicting self-rated SSS at UCLA from other-rated attractiveness and other-rated dominance based upon 10-second video clips.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Other-rated attractiveness</th>
<th>Other-rated dominance</th>
<th>Other-rated att. &amp; dom.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate</td>
<td>SE</td>
<td>z</td>
</tr>
<tr>
<td>Intercept</td>
<td>5.55</td>
<td>.28</td>
<td>19.57</td>
</tr>
<tr>
<td>Time</td>
<td>.09</td>
<td>.02</td>
<td>4.10</td>
</tr>
<tr>
<td>Gender</td>
<td>-.60</td>
<td>.35</td>
<td>-1.68</td>
</tr>
<tr>
<td>Other-rated attractiveness</td>
<td>.28</td>
<td>.20</td>
<td>1.42</td>
</tr>
<tr>
<td>Other-rated dominance</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>SES</td>
<td>.38</td>
<td>.16</td>
<td>2.34</td>
</tr>
<tr>
<td>Self-rated attractiveness</td>
<td>.78</td>
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<td>5.20</td>
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<tr>
<td>Variances</td>
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<tr>
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<td>.29</td>
<td>.97</td>
</tr>
<tr>
<td>Time</td>
<td>.01</td>
<td>.005</td>
<td>.06</td>
</tr>
<tr>
<td>Within-subject variance</td>
<td>.88</td>
<td>.06</td>
<td>.76</td>
</tr>
</tbody>
</table>
Figure 2-1. Two-way interaction between other-rated photograph attractiveness and target gender predicting other-rated SSS. Predicted marginal mean of other-rated SSS by other-rated photograph attractiveness and target gender with 95% confidence intervals. Region of significance is within dashed rectangle.
Figure 2-2. Two-way interaction between other-rated photograph dominance and target gender predicting other-rated SSS. Predicted marginal mean of other-rated SSS by other-rated dominance and target gender with 95% confidence intervals. Region of significance is within dashed rectangle.


Subjective Social Status: Stability and Health in College Freshmen
Subjective Social Status: Stability and Health in College Freshmen

Social status, one’s relative rank in a social hierarchy, shapes the social experiences and health of human and nonhuman species (Anderson et al., 2001; Sapolsky, 2005). Researchers have focused on two types of social status: (1) socioeconomic status (SES) and (2) subjective social status (SSS). SES is typically defined as status within one’s country (e.g., income and education). SSS is defined as the psychological perception of one’s rank within the social hierarchy (Anderson et al., 2012; Singh-Manoux et al., 2003). Most research on social status and self-rated health, a strong indicator of health status and predictor of future mortality (Idler & Benyamini, 1997), has focused on SES (Adler et al., 1994); however, SSS predicts self-rated health over and above SES (Demakakos et al., 2008; Destin et al., 2012; Singh-Manoux et al., 2003; Singh-Manoux et al., 2005).

Despite the growing literature on SSS and self-rated assessments of health, the majority of studies have been cross-sectional and measured SSS in adulthood (but see Goodman, Huang, Schafer-Kalkhoff, & Adler, 2007; Goodman, Maxwell, Malspeis, & Adler, 2015). How SSS changes and relates to health as youth transition into adulthood (i.e., emerging adulthood, a distinct developmental period from the late teens to early twenties; Arnett, 2000) is an important gap in the literature to address. One-third of emerging adults enter college and straddle the line between independent living in dorms and continued reliance on adults (Goldscheider & Goldscheider, 1994). Longitudinally examining SSS and its relation to health in emerging adulthood will offer unprecedented insight into how this population navigates social groups in a new role, and how this affects physical and mental health.

*Stability of SSS.* Across all age groups, there is a dearth of research examining the stability of SSS. Does SSS ebb and flow, or does it remain stagnant? Of the four studies that
have longitudinally tracked SSS, SSS measurements were made six or more months apart, and a maximum of six times. In a study of older adults (N = 8,430), the correlation between SSS measures made in 2000 and 2007 was 0.29, suggesting that SSS changes across time (Nobles, Weintraub, & Adler, 2013). In contrast, a study of healthcare personnel (N = 1,781) reported that 82 percent of participants offered either the same SSS rating or were within one point of their original rating between two assessments made an average of seven months apart (Thompson, Gaglani, Naleway, Thaker, & Ball, 2014). These studies suggest that we might only see shifts in SSS across long periods of time, but both of these studies were conducted in adult populations, whom have more stability than those in emerging adulthood (Arnett, 2000).

Two studies longitudinally assessed SSS in a population of adolescents. In one study, adolescents (N = 1,179) completed surveys annually for four consecutive years. Mean values of SSS across the four waves of data collection were nearly identical, but there was significant within-person variation. Correlations between SSS rankings increased at each follow-up period, indicating that SSS stabilized among older teens (Goodman et al., 2007). In a separate study on the same population of adolescents, Goodman and colleagues (2015) identified the shape of SSS trajectories as adolescents transitioned into emerging adulthood. Each participant reported SSS two to six times (∆dn = 4) over the course of up to 10 years. Results demonstrated that for most adolescents, SSS was stable through the transition into emerging adulthood; a small composition of adolescents started high and then had declining SSS over time (Goodman et al., 2015). Taken together, the evidence generally points to SSS stability in adolescence; however, all SSS assessments were made with reference to the family’s position in the United States. How does entering a brand new social group alter the stability of SSS?
Prior research on social status more broadly, rather than SSS, suggests that status emerges and remains stable soon after the establishment of a social group. In a study of army recruits randomly assigned to housing units, social status stabilized as quickly as two weeks after the group was established (Hellhammer, Buchtal, Gutberlet, & Kirschbaum, 1997). Anderson and colleagues (2001) examined the stability of status on dormitory floors. Peer-rated status was assessed at three times in the academic year: within the first two weeks of the fall semester, in the last week of the fall semester, and in the last week of the spring semester. Status stabilized within four months, and maintained stability through the end of the academic year (Anderson et al., 2001).

The present study will significantly contribute to the literature by assessing SSS in emerging adults each month for up to nine months (i.e., one academic year) in a new social group: freshmen in dorms. Based on the available extant literature, I predicted that SSS will be stable throughout the academic year. Assessing SSS specifically also allowed for an examination of how SSS longitudinally predicts health outcomes in this population.

SSS and Health in Young Adults. The association between SSS and health in adults is well established. Euteneuer (2014) recently reviewed the SSS and health literature, reporting evidence for a negative relationship between SSS and risk factors for disease. For example, those who report low, relative to high, SSS have poorer self-rated health (Demakakos et al., 2008; Destin et al., 2012; Hu et al., 2005; Miyakawa et al., 2012) and report greater incidence of depressive symptoms (Adler et al., 2008; Goodman et al., 2001; Miyakawa et al., 2012; Singh-Manoux et al., 2003; Subramanyam et al., 2012).

Turning to SSS and health in younger individuals, a recent meta-analysis of adolescents (ages 12-19) revealed a robust but small positive effect size ($Z = .10$) for the association between
SSS and a variety of health outcomes (Quon & McGrath, 2014). Of the 44 studies included in the meta-analysis, only 12 assessed self-rated health and six assessed depressive symptoms. Of these 18 studies that assessed self-rated health and depression, two were longitudinal. Thus, there remains a gap in the literature regarding how SSS in emerging adulthood, a time characterized by instability, affects self-rated physical and mental health; the present study aimed to fill this gap. I predicted that SSS will positively predict self-rated physical and mental health throughout the academic year.

**Method**

Chapter II of the dissertation detailed the participant pool and procedure for the present study. Briefly, 94 undergraduate freshmen (29 men, 64 women, 1 gender queer) from the University of California, Los Angeles (UCLA) living in residence halls participated in a longitudinal study conducted from September, 2015 to June, 2016. Enrollment occurred at the start of the academic year (September, 2015) to just before Spring Break (March, 2016). On average, participants enrolled in the study six weeks after moving into the dorms (S.D. = 6.63 weeks; range = 5 days before moving in – 21 weeks after moving in), and remained in the study for 3.32 months (S.D. = 2.41, range = 1-9).

*Procedure.* The study was comprised of three key components: a baseline questionnaire, monthly questionnaires, and a lab session. Key findings from the lab session are reported in Chapter III of the dissertation.

**Measures.**

*Subjective social status.* Participants completed the MacArthur Scale of SSS (Adler et al., 2000) with the instructions, “Imagine a 10-rung ladder representing where people “rank” on your dorm floor. At the top of the ladder are people on your dorm floor who are most
respected, esteemed, and admired. At the bottom of the ladder are those who are least respected, esteemed, and admired. Mark your response on the scale below that best represents where you think you stand on the ladder.” Participants completed ratings of SSS at baseline and every monthly questionnaire.

Health. Participants completed items from the Medical Outcomes Study 36-item short-form health survey (SF-36; Ware Jr & Sherbourne, 1992). There are eight subscales of the survey: physical functioning, role limitations due to physical health, role limitations due to emotional problems, energy, emotional well-being, social functioning, pain, and general health. All subscales ranged from 0 (worst health) to 100 (best health). Due to the age of the study population, participants did not respond to the physical functioning subscale, which focuses on how health limits one’s ability to participate in daily activities (e.g., climbing several flights of stairs, walking several blocks). Participants completed the remaining seven subscales at baseline. At each monthly questionnaire, participants only completed the subscales assessing role limitations due to physical health, pain, and general health. Not all subscales could be included due to constraints on the length of the monthly questionnaire.

For further assessment of mental health, participants completed the Beck Depression Inventory (Beck et al., 1961) and Beck Anxiety Inventory (Beck et al., 1988) at baseline. Scores can range from 0 (minimal) to 63 (severe); thus, higher values indicate poorer mental health. At each monthly questionnaire, participants completed eight-item scales assessing depression and anxiety from the Patient-Reported Outcomes Measurement Information System (PROMIS). PROMIS is an NIH Roadmap initiative designed to improve self-reported outcomes using psychometric methods. The depression and anxiety scales have been validated (Pilkonis et al.,
2011; Pilkonis et al., 2014) and were chosen for their brevity. Scores can range from 8 (minimal) to 40 (severe).

SES. At baseline, participants indicated which socioeconomic class best described their family as they grew up (lower, lower-middle, middle, upper-middle, and upper).

Potential covariates. To rule out potential alternative explanations, participants completed measures at baseline assessing high school SSS, social support (Cutrona & Russell, 1987), self-esteem (Rosenberg, 1965), personality traits (Gosling et al., 2003), perceived stress (Cohen & Williamson, 1988), and self-rated physical attractiveness (“Relative to individuals of your sex and age, do you consider yourself...[1= much less attractive, 7 = much more attractive]?”) as potential third variables. There were also several items that assessed the value participants attributed to individuals on their dorm floor. For example, “Of the time you spent socializing, what percent of that time is spent socializing with people from your dorm floor?”

Data Analytic Plan. I assessed the stability of SSS by examining SSS trajectories using Traj in Stata 13.1, a method of group-based modeling of longitudinal data. Traj identifies clusters of individuals following similar progressions of an outcome (i.e., SSS) over time (Jones & Nagin, 2007). The clusters of SSS are subgroups that differ in mean SSS and/or in the rate and direction of change in SSS across the academic year (Goodman et al., 2015). I considered models with 1 to 6 trajectories and those fitting linear, quadratic, and cubic trajectories. I used the Bayesian Information Criterion (BIC) for selecting the optimal model (Jones, Nagin, & Roeder, 2001). The change in BIC from one trajectory to the next (e.g., three groups to four groups) assessed model fit (Jones et al., 2001).

To assess the effect of SSS on monthly health outcomes, I used a similar approach to that specified in Chapter II. Briefly, I used Stata 13.1 to run multilevel models with measurement
occasions (Level 1) nested within individuals (Level 2). Time was centered around the academic year (i.e., September = 0, October = 1…June = 9) and a one-unit increase in time is equivalent to one month. To assess the effect of SSS on health outcomes at baseline, I ran simple linear regressions.

The modeling approach began by including the key predictor variables, interactions between time and key predictor variables, and all potential covariates associated with health outcomes. Upon running the model, I removed the single variable that had the greatest p value, and then ran the model again. I repeated this process until only the key predictors and significant covariates remained, with one exception: SES was included as a covariate in all models to demonstrate that any observed effects of SSS are over and above the effect of SES. This approach resulted in the most parsimonious and theoretically-driven model due to the inclusion of SES.

The equation below provides an example of the multilevel model for physical and mental health scales assessed on a monthly basis. In the equation below, Health\(_{ti}\) refers to a health outcome at time \(t\), for participant \(i\). \(g_{00}\) represents the average health across participants in September at the mean values of predictor variables. \(g_{10}\) is the linear change in health associated with a one-unit increase in SSS, above and beyond the covariates. \(g_{20}\) is the linear change in health associated with a one-unit increase in time (i.e., one month). \(u_{0i}\) represents person-level variance in the intercept, \(u_{1i}\) and \(u_{2i}\) represents person-level variance in the slope of SSS and time, respectively, and within-person error variance is represented by \(e_{ti}\). SSS is included as a Level 1 predictor because SSS was assessed at baseline and every monthly questionnaire. All covariates were assessed only at baseline, and are thus included as Level 2 predictors.

\[
L1: \text{Health}_i = b_{0i}\text{Int}_i + b_{1i}\text{SSS}_i + b_{2i}\text{Time}_i + e_i
\]
L2: \[ b_{0i} = g_{00} + g_{01} \text{SES}_i + g_{03} \text{Covariates} + u_{0i} \]

\[ b_{1i} = g_{10} + u_{1i} \]

\[ b_{2i} = g_{20} + u_{2i} \]

To further understand the association between SSS and health, I ran time-lagged model to assess whether a) SSS temporally precedes health, b) health temporally precedes SSS, or c) both a) and b) are true.

Results will first be presented for the stability of SSS. Health outcomes collected only at baseline (i.e., role limitations due to emotional problems, energy, emotional well-being, and social functioning) are presented next. Subsequently, I will present results for role limitations due to physical health, pain, and general health followed by anxiety and depression, all of which were assessed on a monthly basis.

**Results**

*Stability of SSS.* Table 3-1 presents fit statistics for the trajectory models. Following the recommendations of Jones et al. (2001), the five-trajectory, linear model is optimal.

Figure 3-1 depicts the five-trajectory model and associated probabilities of group membership. All trajectories (High, Mid-High, Middle, Mid-Low, and Low-Lower) were linear. The majority of individuals exhibited no change (40.7%) or modest increases (53%) in SSS as the year progressed, and averaged at or above the mid-point of the SSS scale. This indicates that the majority of freshmen rated themselves at or above the middle rank of SSS in the dorms and that this remained constant or increased across the academic year. Members of the Low-Lower trajectory (6.3%) were the only individuals who reported low SSS that decreased throughout the academic year.

*SSS and Health.*
Descriptives. Across all SF-36 subscales, means hovered around the mid-point (50 out of 100). To assess the means and standard deviations of the present sample, I compared norm-based scores of the present sample to norm-based scores of individuals ages 18-34 from the Medical Outcomes Study (Table 3-2). Across six out of the seven included subscales, participants in the present study reported poorer health compared to individuals aged 18-34; freshmen only reported less pain than individuals from the Medical Outcomes Study. All subscales exhibited sufficient variability and reliability (as range from .58 to .86). Cronbach’s alphas were comparable to those reported in the Medical Outcomes Study, with the exception of the social functioning subscale; in the present study, 𝛼=.58 whereas 𝛼=.85 in the Medical Outcomes Study. At baseline, the mean value of anxiety was 34.33 (SD = 11.0) and depression was 27.37 (SD = 6.99). Correlations between SSS at baseline and all health outcomes are presented in Table 3-3.

Measures assessed only at baseline.

Role limitations due to emotional problems. SSS at baseline did not predict role limitations due to emotional problems (b = 1.00, 95% CI [-2.48, 4.48]), nor did SES (b = -2.72, 95% CI [-8.73, 3.29]). There was a significant effect of gender, such that women reported more role limitations than men (b = -14.84, 95% CI [-27.73, -1.94]). Furthermore, individuals with less anxiety (b = -1.31, 95% CI [-1.99, -0.63]) and depression (b = -2.47, 95% CI [-3.72, -1.21]) reported fewer role limitations due to emotional problems.

Energy. Above and beyond SES (b = 1.41, 95% CI [-1.18, 4.02]), depression (b = -1.93, 95% CI [-1.47, -.38]), and perceived stress (b = -1.77, 95% CI [-3.12, -.42]), higher SSS individuals reported more energy (b = 2.57, 95% CI [1.00, 4.14]).

Emotional well-being. SSS at baseline did not predict emotional well-being (b = 1.29, 95% CI [-.30, 2.88]), nor did SES (b = .04, 95% CI [-2.56, 2.64]). Individuals with less
depression \((b = -.89, 95\% \text{ CI } [-1.44, -.34])\), neuroticism \((b = -2.85, 95\% \text{ CI } [-5.27, -.42])\), and perceived stress \((b = -1.84, 95\% \text{ CI } [-3.33, -.35])\) reported better emotional well-being.

**Social functioning.** Individuals with higher SSS at baseline reported marginally poorer social functioning \((b = -2.27, 95\% \text{ CI } [-4.67, .15])\). SES did not predict social functioning \((b = -1.42, 95\% \text{ CI } [-5.67, 2.83])\), but individuals who reported lower anxiety had better outcomes on this subscale \((b = -1.13, 95\% \text{ CI } [-1.52, -.73])\).

Due to the relatively low Cronbach's alpha of this subscale, I examined the effect of SSS on the two items comprising this subscale independently: a) “During the past 4 weeks, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?” and b) “During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?” For a), SSS did not predict social functioning \((b = -1.21, 95\% \text{ CI } [-3.80, 1.38])\), whereas individuals with lower SSS at baseline reported marginally better social functioning for b) \((b = -3.32, 95\% \text{ CI } [-6.67, .03])\).

**Measures assessed monthly.**

**Role limitations due to physical health.** Repeated measures of SSS did not predict role limitations due to physical health across the academic year \((b = .35, 95\% \text{ CI } [-1.69, 2.39])\). The multilevel model included baseline role limitations due to physical health \((b = .22, 95\% \text{ CI } [.10, .35])\), SES \((b = 1.23, 95\% \text{ CI } [-3.07, 5.53])\), depression \((b = -1.13, 95\% \text{ CI } [-1.53, -.73])\), and conscientiousness \((b = 4.41, 95\% \text{ CI } [.91, 7.92])\) as covariates.

Time-lagged analyses revealed that previous SSS marginally predicted subsequent role limitations due to physical health, controlling for concurrent role limitations due to physical
health ($b = 2.27$, 95% CI [-.19, 4.73]). Examination of the reverse temporal effect revealed that role limitations were not an antecedent of SSS ($b = .002$, 95% CI [-.001, .004]).

Above and beyond SES ($b = .56$, 95% CI [-6.61, 7.72]) and anxiety ($b = -1.37$, 95% CI [-2.05, -.68]), baseline SSS and gender interacted to predict role limitations due to physical health at baseline ($b = -9.12$, 95% CI [-17.91, -.34]). SSS in men did not predict role limitations ($b = 3.82$, 95% CI [-6.51, 14.16]), whereas lower SSS women reported fewer role limitations due to physical health at baseline ($b = -5.25$, 95% CI [-9.87, -.63]).

**Pain.** SSS in the dorms did not predict pain across the academic year ($b = .15$, 95% CI [-1.0, 1.29]). The multilevel model included baseline pain ($b = .20$, 95% CI [.07, .32]), SES ($b = -1.04$, 95% CI [-3.61, 1.52]), conscientiousness ($b = 2.33$, 95% CI [.19, 4.47]), and neuroticism ($b = -4.25$, 95% CI [-6.11, -2.40]) as covariates.

Temporal analyses revealed that while SSS was not predictive of subsequent pain ($b = .10$, 95% CI [-1.09, 1.29]), previous pain marginally predicted future SSS ($b = .005$, 95% CI [-.001, .01]) while controlling for concurrent pain.

At baseline, lower SSS individuals reported less pain ($b = -3.41$, 95% CI [-5.72, -1.10]). This effect was above and beyond SES ($b = -.65$, 95% CI [-4.75, 3.45]) and anxiety ($b = -.73$, 95% CI [-1.11, -.36]).

**General health.** There was a significant interaction between time and SSS ($b = .36$, 95% CI [-.66, -.06]; Table 3-4) to predict general health across the academic year. An examination of simple slopes indicated significant differences in general health by SSS outside of measured time points; meaningful time points of the present study included values 0 through 9, and simple slopes were significant outside this region (Preacher, Curran, & Bauer, 2003).
Therefore, SSS did not predict differences in general health across the academic year (Figure 3-2).

Temporal analyses showed that SSS does not predict subsequent reports of general health ($b = -0.03$, 95% CI [-.80, .75]), nor does general health predict subsequent SSS ($b = -0.002$, 95% CI [-.008, .004]).

At baseline, SSS in the dorms did not predict general health ($b = -0.22$, 95% CI [-1.97, 1.53]) above and beyond SES ($b = 1.42$, 95% CI [-1.53, 4.36]) and perceived stress ($b = -1.44$, 95% CI [-2.62, -2.27]).

Anxiety. There was a significant interaction between time and SSS in the dorms to predict anxiety across the academic year ($b = .22$, 95% CI [.07, .37]; Table 3-5). As shown in Figure 3-3, high SSS individuals reported less anxiety than low SSS counterparts, but only during the first four months of the academic year. During the latter half of the year, SSS did not predict anxiety.

As demonstrated by time lagged analyses, SSS does not temporally precede anxiety ($b = -0.35$, 95% CI [-.88, .18]), not does anxiety temporally precede SSS ($b = -0.003$, 95% CI [-.02, .009]).

Above and beyond SES ($b = -0.65$, 95% CI [-1.27, -.04]), depression ($b = .64$, 95% CI [.50, .70]), extraversion ($b = -1.0$, 95% CI [-1.41, -.59]), neuroticism ($b = .87$, 95% CI [.30, 1.45]), and perceived stress ($b = .88$, 95% CI [.55, 1.21]), there was a marginally significant interaction between baseline SSS and gender to predict anxiety at baseline ($b = .66$, 95% CI [-.03, 1.34]). Lower SSS men reported marginally more anxiety ($b = -0.28$, 95% CI [-.60, .04]), whereas higher SSS women reported more anxiety ($b = .89$, 95% CI [.39, 1.39]).

Depression. There was a significant time by SSS interaction to predict
depression across the academic year ($b = .24$, 95% CI [.10, .38]; Table 3-6). Specifically, higher SSS individuals reported less depression during the first five months of the academic year; SSS did not predict depression after January (Figure 3-4).

Time lagged analyses revealed that previous SSS marginally predicts subsequent depression while controlling for concurrent depression, such that those with lower SSS went on to develop more depression ($b = -.41$, 95% CI [-.89, .08]). Testing the reverse temporal relationship revealed that depression did not predict subsequent SSS ($b = -.002$, 95% CI [-.01, .01]).

Baseline SSS did not predict baseline depression ($b = .11$, 95% CI [-.08, .31]) above and beyond SES ($b = -.40$, 95% CI [-.82, -.17]), anxiety ($b = .18$, 95% CI [.14, .21]), loneliness ($b = .98$, 95% CI [.28, 1.68]), self-esteem ($b = -.67$, 95% CI [-1.31, -.04]), conscientiousness ($b = .44$, 95% CI [.16, .70]), and perceived stress ($b = .87$, 95% CI [.70, 1.04]). Women reported more depression at baseline than men ($b = 1.77$, 95% CI [1.09, 2.44]).

*Trajectory membership and health.* Trajectory membership was associated with an array of health outcomes. One-way ANOVAs identified differences among membership groups with respect to role limitations due to emotional problems ($F(4,89) = 2.41, p = .06$), energy ($F(4,89) = 5.56, p < .001$), emotional well-being ($F(4,89) = 7.02, p < .001$; Figure 3-5), and depression ($F(4,89) = 2.39, p = .06$; Figure 3-6).

To identify where differences lie within the groups, I conducted independent samples t-tests. Because there were 10 comparisons made between groups per health outcome, I used a Bonferroni-corrected critical $p$ value of .005 to identify significant differences between groups.

Individuals in the Mid-Low group reported more role limitations due to emotional problems compared to those in the Mid-High group ($t(42) = -3.06, p = .004$). Similarly, those in
the Mid-Low group reported poorer energy than those in the Mid-High ($t(42) = -4.26, p = .0001$) and High group ($t(26) = -3.97, p = .0005$). Turning to emotional well-being, Mid-Low individuals reported poorer well-being than those in the Middle ($t(59) = -3.06, p = .003$), Mid-High ($t(42) = -4.69, p = .001$), and High ($t(26) = -4.56, p = .0001$) groups. Lastly, Mid-Low members reported marginally more depression compared to those in the Mid-High group ($t(42) = 2.82, p = .007$).

**Discussion**

The current study examined the stability of SSS and how it affected self-rated health in emerging adulthood. This longitudinal study specifically tracked college freshmen in dorms because they offer insight into a population that has received minimal attention in the SSS literature and unveil how SSS changes over time in a new social group. Results indicated that SSS was stable or increased for the majority of participants throughout the academic year; SSS was low and fell lower over time only for a small percent of the population. Contrary to the prediction and precedent set by past research (e.g., Quon & McGrath, 2014), SSS in the dorms did not reliably predict physical or mental self-rated health. Furthermore, SSS trajectory membership predicted only a subset of health outcomes.

I examined the stability, or trajectory, of SSS by using Traj to identify clusters of individuals that followed similar progressions of SSS over the course of the academic year. Aligning with Goodman, Maxwell, Malspeis, and Adler (2015), results revealed five unique trajectories. The vast majority of freshmen rated themselves at or above the middle rank of SSS in the dorms, and all five groups exhibited linear trends across time. A large percentage of freshmen maintained their baseline ranking of SSS for up to nine months; a majority exhibited increases in SSS as the academic year progressed; only a small percent of freshmen fell into a
group whose members reported low SSS at baseline and lower SSS across the academic year. Therefore, many freshmen exhibited stability in their ratings of SSS in a new social group. Half of freshmen likely reported moderate increases in SSS because they felt a greater sense of belonging with the progression of the academic year, which translated into higher SSS. Taken together, findings suggest that SSS is stable or improves for emerging adults navigating a new social group; this counters the relative instability that often characterizes emerging adulthood (Arnett, 2000). Factors that predict whether freshmen will maintain their SSS standing, improve upon it, or exhibit decreases in it remains an open question for future empirical research.

In contrast to findings from a history of scholarship (Euteneuer, 2014; Quon & McGrath, 2014), SSS did not reliably predict self-rated physical or mental health. There were few exceptions to the null findings. Consistent with the prediction, individuals with relatively higher SSS in the dorms reported more energy at baseline; higher SSS men reported less anxiety at baseline; and higher SSS individuals reported less anxiety and depression during the first half of the academic year. In contrast to the prediction, higher SSS women reported more role limitations due to physical health at baseline, and higher SSS individuals reported more pain and marginally poorer social functioning at baseline. Time-lagged analyses revealed that previous SSS marginally predicted subsequent role limitations due to physical health and depression. Furthermore, trajectory membership did not reliably predict health outcomes except for role limitations due to emotional problems, energy, emotional well-being, and depression. Given no theoretical rationale for why these scales should exhibit associations with trajectory membership, nor for the array of self-rated physical and mental health results, findings should be interpreted with caution.
Why would SSS not predict health outcomes despite vast empirical research supporting the association? The key likely lies in the social setting examined: the dorms. While SSS in the dorms offers a useful setting in which to assess the stability of SSS in a new social group, perhaps the group was too newly established for SSS to track health outcomes. Furthermore, the dorm setting is different than social settings typically referenced in the extant literature; the overwhelming majority of research examining associations between SSS and health outcomes studied SSS in reference to long-established groups, such as others in the United States (Adler et al., 2000; Adler et al., 2008; Garbarski, 2010; Ghaed & Gallo, 2007; Miyakawa et al., 2012; Operario, Adler, & Williams, 2004; Ostrove & Long, 2007; Sanders, Slade, Turrell, John Spencer, & Marcenes, 2006; Singh-Manoux et al., 2003; Singh-Manoux et al., 2005; Subramanyam et al., 2012; Thompson et al., 2014) or in the community (Garbarski, 2010; Ghaed & Gallo, 2007; Leu et al., 2008; Senn, Walsh, & Carey, 2014; Subramanyam et al., 2012; Woo, Lynn, Leung, & Wong, 2008). Among studies examining SSS and health in adolescence, SSS was most commonly assessed by referencing familial placement in society (Quon & McGrath, 2014; Table 2). Only one study in the extant literature focused on SSS in the dorms, inquiring how SSS moderated cardiovascular and cortisol responses to social evaluative threat (Gruenewald et al., 2006). Utilizing the same SSS scale as in the current study, findings showed that SSS did not moderate cardiovascular responses but did moderate cortisol responses. Thus, one possibility is that differences in biological outcomes are more sensitive to SSS differences in a new social group than self-reported health outcomes; however, there is currently no empirical evidence to suggest this is likely. Another possibility is that SSS will not reliably map onto health in the dorms because the social group is temporary. In most universities, students change housing each year by either moving from one dorm building and/or floor to another, or by
moving into off-campus housing. Therefore, it is plausible that SSS in temporary social groups has fewer downstream health consequences compared to longer-lasting groups. Fruitful avenues for future research would involve comparing how SSS longitudinally affects health in temporary new social groups (e.g., the dorms) versus more permanent new social groups (e.g., the workplace) versus long-standing social groups (e.g., the community). This has implications for furthering our understanding of the nature of SSS and how it relates to health outcomes.

Strengths. One aim of the present study was to explore how SSS unfolds in emerging adults navigating a new social group. The two facets of emerging adulthood and new social group are key strengths of this study.

For many young individuals, the years from late teens to early twenties are characterized by profound change. Adults often name this period as the time when the most important events in their lives transpired (Martin & Smyer, 1990). Emerging adulthood offers the most opportunity for identity change and exploration (Arnett, 2000), thus deeming it a fitting period to explore how SSS unfolds.

An additional strength is the focus on how SSS unfolds in a new social group. To my knowledge, this is first study to examine the trajectory of SSS in a budding social group, which was operationalized as freshmen in dorms. All prior studies aiming to examine the stability of SSS referenced longstanding social groups, such as one’s relative position in the United States (e.g., Adler et al., 2000) or in the community (e.g., Ghaed & Gallo, 2007). Furthermore, assessing SSS longitudinally in a new group is the most stringent test of stability, or lack thereof; if there was ever a time SSS would be expected show volatility, it would be in a new social group, when individuals are trying to establish their standing. The finding that SSS remained stable or exhibited moderate increases for the majority of freshmen suggests that individuals are
quick to recognize and adjust their relative position in a social group, which likely has positive implications for social relationships: People’s ability to recognize their relative status in a group is a crucial skill for navigating social relationships because it dictates what is and what is not permitted based on one’s position in the group (Cummins, 1996).

A final strength of the present study is the targeted focus of examining SSS with reference to individuals in the dorms. Given that status is associated with the group’s perception (Von Rueden, Gurven, & Kaplan, 2008), status is only meaningful within a specified group. In other words, status is local. Within the realm of SSS and health, more narrowly-defined social groups show stronger relationships between SSS and health, relative to more broadly-defined social groups (e.g., SSS relative to people in your community versus people in the United States, respectively; Euteneuer, Mills, Rief, Ziegler, & Dimsdale, 2012; Ghaed & Gallo, 2007; Goodman et al., 2003). However, this strength also serves as a limitation of the present study, as it likely contributes to the lack of an association between SSS and self-reported health outcomes.

**Limitations.** The assessment of SSS in the dorms might not be meaningful enough to uncover differential self-reported health outcomes. As with SSS and health research, most research on how the social environment gets “under the skin” considers how long-established factors (e.g., childhood SES) affect health later in life (Miller, Chen, & Cole, 2009); there is less research assessing how more novel social environments affect health. As discussed above, it remains an empirical question as to whether it is the temporary aspect of the new social group, or the new social group itself, that can explain the largely null findings. Furthermore, even though the current study longitudinally tracked freshmen for up to nine months, it is unknown whether SSS in the dorms eventually affects self-rated health outcomes.
An additional limitation of the present study lies in the self-reported health assessments. It is not a limitation because self-reported health measures are not important or valid measures of health; self-reported health is a strong indicator of health status and predictor of future mortality in unhealthy and older populations (Idler & Benyamini, 1997). However, the study would have benefited from an inclusion of biological measures (e.g., salivary measures of cortisol, inflammatory measures, etc.) to determine if biological outcomes match those of self-report, or whether biological data are more sensitive to SSS in the dorms. A related, final limitation is the frequency with which participants completed self-reported health measures. In order to prevent participant fatigue during monthly questionnaires, only a subset of health measures was chosen from those included at baseline. Therefore, I was unable to test the breadth of health outcomes in longitudinal analyses.

**Conclusions.** The study presents the first longitudinal assessment of SSS stability and self-rated health outcomes in a new social group of emerging adults. Results showed that SSS remained stable or increased in a population characterized by instability, but that SSS did not reliably track self-reported physical and mental health outcomes. The study diversifies the SSS literature, which has often focused on adults and long-established social groups. The findings also contribute more broadly to the literature seeking to understand the relationship between the social environment and health. Results indicated that health is not readily influenced by social relationships in new, temporary social groups. However, future research endeavors will reveal how long it takes for experiences in new social groups to influence health.
Table 3-1
Summary of model fit for models assessing 1 to 6 trajectory groups.

<table>
<thead>
<tr>
<th>Number of groups</th>
<th>BIC</th>
<th>Null model</th>
<th>ΔBIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-1277.35</td>
<td>1</td>
<td>239.88</td>
</tr>
<tr>
<td>2</td>
<td>-1157.41</td>
<td>1</td>
<td>138.6</td>
</tr>
<tr>
<td>3</td>
<td>-1088.11</td>
<td>2</td>
<td>102.66</td>
</tr>
<tr>
<td>4</td>
<td>-1036.78</td>
<td>3</td>
<td>35.16</td>
</tr>
<tr>
<td>5</td>
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<td>4</td>
<td>1.46</td>
</tr>
<tr>
<td>6</td>
<td>-1018.47</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

*Note.* Five groups selected because change in BIC with six groups was fairly minimal, and parsimony dictates selection of the fewest groups that provides substantive change in BIC from the null.
Table 3-2
Descriptive statistics for health outcomes in current study compared to Medical Outcomes Study.

<table>
<thead>
<tr>
<th></th>
<th>Norms for current study (N = 94)</th>
<th>Norms for ages 18-34 (N = 366)</th>
<th>Test of group differences</th>
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<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>Role limitations due to physical health&lt;sup&gt;a&lt;/sup&gt;</td>
<td>48.91</td>
<td>10.37</td>
<td>52.45</td>
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<tr>
<td>Role limitations due to emotional problems</td>
<td>44.60</td>
<td>12.31</td>
<td>50.02</td>
</tr>
<tr>
<td>Energy</td>
<td>47.03</td>
<td>8.53</td>
<td>49.14</td>
</tr>
<tr>
<td>Emotional well-being</td>
<td>44.39</td>
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<td>49.05</td>
</tr>
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<td>Social functioning</td>
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<td>9.28</td>
<td>50.45</td>
</tr>
<tr>
<td>Pain&lt;sup&gt;a&lt;/sup&gt;</td>
<td>54.48</td>
<td>8.60</td>
<td>52.05</td>
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<tr>
<td>General health&lt;sup&gt;a&lt;/sup&gt;</td>
<td>47.87</td>
<td>9.38</td>
<td>51.36</td>
</tr>
</tbody>
</table>

<sup>a</sup> Assessed at monthly questionnaires

*Note.* Scale ranges from 0-100, with values closer to 100 indicating better health.
Table 3-3
Correlations between SSS and health outcomes at baseline.

<table>
<thead>
<tr>
<th></th>
<th>SSS</th>
<th>Role lim due to physical health</th>
<th>Role lim due to emotional problems</th>
<th>Energy</th>
<th>Emotional well-being</th>
<th>Social functioning</th>
<th>Pain</th>
<th>General health</th>
<th>Depression</th>
<th>Anxiety</th>
</tr>
</thead>
<tbody>
<tr>
<td>SSS</td>
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<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>Role lim physical health</td>
<td>-.03</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Role lim emotional problems</td>
<td>.25**</td>
<td>.20**</td>
<td>1.0</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Energy</td>
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<tr>
<td>Emotional well-being</td>
<td>.43**</td>
<td>.33**</td>
<td>.54**</td>
<td>.34**</td>
<td>.39**</td>
<td>1.0</td>
<td></td>
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</tr>
<tr>
<td>Social functioning</td>
<td>.04</td>
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<td>.46**</td>
<td>.34**</td>
<td>.39**</td>
<td>1.0</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Pain</td>
<td>-.09*</td>
<td>.51**</td>
<td>.10*</td>
<td>.11*</td>
<td>.18**</td>
<td>.36**</td>
<td>.08*</td>
<td>.15**</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>General health</td>
<td>.10*</td>
<td>.08*</td>
<td>.18**</td>
<td>.35**</td>
<td>.38**</td>
<td>.08*</td>
<td>.15**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depression</td>
<td>-.23**</td>
<td>-.30**</td>
<td>-.65**</td>
<td>-.57**</td>
<td>-.59**</td>
<td>-.47**</td>
<td>-.23**</td>
<td>-.20**</td>
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</tr>
<tr>
<td>Anxiety</td>
<td>-.23**</td>
<td>-.14**</td>
<td>-.64**</td>
<td>-.67**</td>
<td>-.65**</td>
<td>-.39**</td>
<td>-.17**</td>
<td>-.25**</td>
<td>.62**</td>
<td>1.0</td>
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*Note.* *p* < .01, **p** < .0001. Greater values of SF-36 subscales, and lower values of depression and anxiety, indicate better health.
Table 3-4
Parameter estimates predicting monthly general health from SSS.

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
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<th>z</th>
<th>p</th>
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<tr>
<td>Time</td>
<td>.03</td>
<td>.27</td>
<td>.10</td>
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<tr>
<td>SSS</td>
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<td>.95</td>
<td>1.83</td>
<td>.07</td>
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</tr>
<tr>
<td>Time x SSS</td>
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<td>.15</td>
<td>-2.32</td>
<td>.02</td>
<td>-.66</td>
</tr>
<tr>
<td>Baseline general health</td>
<td>.63</td>
<td>.11</td>
<td>5.48</td>
<td>&lt;.001</td>
<td>.40</td>
</tr>
<tr>
<td>SES</td>
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<td>.28</td>
<td>--</td>
<td>-2.74</td>
</tr>
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<td>Depression</td>
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<td>.09</td>
<td>-3.84</td>
<td>&lt;.001</td>
<td>-.53</td>
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<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>SE</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Variances</strong></td>
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<tr>
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<td>30.23</td>
<td>115.79</td>
</tr>
<tr>
<td>Time</td>
<td>--</td>
<td>--</td>
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</tr>
<tr>
<td>Within-subject</td>
<td>154.42</td>
<td>10.51</td>
<td>135.14</td>
</tr>
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</table>

*Note.* Time centered around academic year, where September = 0. All other variables centered around grand mean. Only *p*-values <.10 shown. Negligible variation in slope of time. Greater values on general health subscale indicate more positive health outcomes.
Table 3-5
Parameter estimates predicting monthly anxiety from SSS.

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>SE</th>
<th>z</th>
<th>p</th>
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<tr>
<td>Intercept</td>
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<td>16.03 19.32</td>
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<tr>
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<td>.14</td>
<td>-.99</td>
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<td>-.40 .13</td>
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<td>SSS</td>
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<td>-2.92</td>
<td>.004</td>
<td>-2.19 .43</td>
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<td>.07 .37</td>
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<td>Baseline anxiety</td>
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<td>&lt;.001</td>
<td>.17 .37</td>
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<td>-.98 1.14</td>
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<td><strong>Variances</strong></td>
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<td>Intercept</td>
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<td>Within-subject</td>
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*Note.* Time centered around academic year, where September = 0. All other variables centered around grand mean. Only *p*-values <.10 shown. Negligible variation in slope of time. Greater values on anxiety subscale indicate more anxiety.
Table 3-6  
Parameter estimates predicting monthly depression from SSS.

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<tr>
<th>Fixed Effects</th>
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<th>SE</th>
<th>z</th>
<th>p</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>14.84</td>
<td>.78</td>
<td>18.94</td>
<td>&lt;.001</td>
<td>13.31</td>
</tr>
<tr>
<td>Time</td>
<td>-.05</td>
<td>.13</td>
<td>-.37</td>
<td>--</td>
<td>-.30</td>
</tr>
<tr>
<td>SSS</td>
<td>-1.44</td>
<td>.42</td>
<td>-3.41</td>
<td>.001</td>
<td>-.27</td>
</tr>
<tr>
<td>Time x SSS</td>
<td>.24</td>
<td>.07</td>
<td>3.31</td>
<td>.001</td>
<td>.10</td>
</tr>
<tr>
<td>Baseline depression</td>
<td>.45</td>
<td>.08</td>
<td>5.53</td>
<td>&lt;.001</td>
<td>.29</td>
</tr>
<tr>
<td>SES</td>
<td>-.10</td>
<td>.49</td>
<td>-.21</td>
<td>--</td>
<td>-1.05</td>
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<table>
<thead>
<tr>
<th>Variances</th>
<th>Estimate</th>
<th>SE</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>9.84</td>
<td>2.54</td>
<td>16.33</td>
</tr>
<tr>
<td>Time</td>
<td>--</td>
<td>--</td>
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</tr>
<tr>
<td>Within-subject</td>
<td>36.77</td>
<td>2.51</td>
<td>42.04</td>
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Note. Time centered around academic year, where September = 0. All other variables centered around grand mean. Only p-values <.10 shown. Negligible variation in slope of time. Greater values on depression scale indicate more depression.
Figure 3-1. SSS trajectories from the Traj 5-group censored normal model. Percentages reflect group membership probabilities. * $p < .05$, ** $p < .001$. 
Figure 3-2. Two-way interaction between time and SSS predicting general health. Predicted marginal mean of monthly general health by time and SSS in the dorms. Separate lines graphed at +/- 1SD from the grand mean of SSS in the dorms with 95% confidence intervals. No significant differences in general health by SSS across time within measured time span.
Figure 3-3. Two-way interaction between time and SSS predicting anxiety. Predicted marginal mean of monthly anxiety by time and SSS in the dorms. Separate lines graphed at +/- 1SD from the grand mean of SSS in the dorms with 95% confidence intervals. Region of significance is within dashed rectangle.
Figure 3-4. Two-way interaction between time and SSS predicting depression. Predicted marginal mean of monthly depression by time and SSS in the dorms. Separate lines graphed at +/- 1SD from the grand mean of SSS in the dorms with 95% confidence intervals. Region of significance is within dashed rectangle.
Figure 3-5. Association of assigned trajectory group membership to SF-36 health outcomes. * $p < .005$, ** $p < .001$. 
Figure 3-6. Association of assigned trajectory group membership to anxiety and depression. † p < .01.
References


determinants and its association with measures of ill-health in the Whitehall II study.

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health and change in health status better than objective status? _Psychosomatic Medicine,
67_(6), 855-861.

factors for cardiovascular disease among African Americans in the Jackson Heart Study.
_Social Science & Medicine, 74_(8), 1146-1154.

rated health and subjective social status over time in a cohort of healthcare personnel.
_Journal of Health Psychology, 19_(9), 1185-1196.


I. Conceptual framework and item selection. _Medical Care, 473-483.

Hong Kong Chinese women compared with men. _Women & Health, 48_(2), 209-234.
Molecular Mechanisms of Subjective Social Status and Health
Molecular Mechanisms of Subjective Social Status and Health

Low subjective social status (SSS) is associated with increased risk for poor health outcomes (Euteneuer, 2014; Quon & McGrath, 2014). Euteneuer (2014) conducted a qualitative review of the SSS and health literature, reporting evidence for a negative relationship between SSS and risk factors for disease. A recent meta-analysis corroborated the results of the qualitative review. Regarding the association between SSS and adolescent health, the meta-analysis revealed a robust but small positive effect size (Quon & McGrath, 2014). While associations between SSS and health are well established, the molecular mechanisms producing this link remain less clear.

Two related mechanisms are implicated by both the human and nonhuman literature: inflammation, and glucocorticoid receptor (GR) desensitization. Inflammation, the immune system’s first line of defense in response to infection and injury, is generally adaptive when it is acute. However, prolonged inflammation has been associated with an array of poor health outcomes, including cardiovascular disease, arthritis, cancer, and diabetes (Finch, 2010). A growing body of literature has found that various measures of social status negatively relate to inflammation. For example, in an experiment of dominance rank in rhesus macaques, macaques occupying lower ranks exhibited an up-regulation of genes involved in inflammation (Tung et al., 2012). In studies examining socioeconomic status (SES) in humans, an objective measure of status, low SES individuals exhibited an up-regulation of genes involved in inflammation, relative to high SES counterparts (Chen et al., 2009; Chen, Miller, Kobor, & Cole, 2011; Miller, Chen, Fok, et al., 2009). In one study examining SSS among adolescents at risk for depression, high and low status individuals did not differ in mRNA for pro-inflammatory transcription factor NF-κB (Murphy, Slavich, Rohleder, & Miller, 2012). This suggests that there are no differences
in NF-κB availability by SSS, but does not speak to whether there are differences in NF-κB activity, as identified by the previous studies. Collectively, the human and nonhuman animal literature point to increased pro-inflammatory gene expression among those lower in social status.

This increase in pro-inflammatory gene expression is thought to be an adaptation. When individuals perceive diminishing social resources and a threatening social world, as in low social status individuals (Chen et al., 2004; Fales, Slavich, Robles, & Haselton, in preparation), evolutionarily-conferred defensive programs are activated that served to protect against injury under ancestral social conditions. Meanwhile, the risk of viral infections decreases due to withdrawal from social contact, which is how such infections are exchanged. Therefore, it would be adaptive to temporarily up-regulate pro-inflammatory gene expression to defend against bacterial infections and down-regulate anti-viral gene expression. Such programming may have been adaptive in the ancestral environment. However, in modern societies that feature more complex and unstable social systems, the experience of threat in connection with pro-inflammatory/anti-viral transcriptional skewing promotes inflammation-related diseases (Cole, 2013).

This transcriptional profile has been labeled a conserved transcriptional response to adversity (CTRA), which can be activated by threatening or stressful appraisals of the environment and involves up-regulation of the transcription of pro-inflammatory genes and down-regulation of the expression of anti-viral genes (Cole, 2013, 2014). These effects are partially evoked by activation of fight-or-flight pathways in the sympathetic nervous system (SNS). SNS activation modulates gene expression by stimulating pro-inflammatory transcription factors (e.g., NF-κB), and inhibiting the activity of transcription factors that control transcription
of Type I interferon genes, such as the interferon response factor family (Cole, 2013, 2014). Activation of the glucocorticoid receptor (GR) by cortisol in response to stress would typically stimulate the expression of anti-inflammatory GR genes and inhibit pro-inflammatory gene expression (Irwin & Cole, 2011). However, in people experiencing chronic stress, as in individuals of low SSS (Adler et al., 2000), the dynamic appears to be blunted; this potentially contributes to, or fails to prevent, the CTRA profile.

Reduction in GR sensitivity is the second proposed mechanism explaining the link between low SSS and poor health outcomes. Under typical conditions, cortisol release activates GRs, and acts as a potent anti-inflammatory agent to reign in the inflammatory response. A growing body of work in the nonhuman and human literature has found that social status is related to GR desensitization, such that GR signals are no longer “heard” in lower social status individuals. For example, low-ranking male baboons and female rhesus macaques exhibited evidence consistent with GR desensitization (Sapolsky, Alberts, & Altmann, 1997; Tung et al., 2012). In both studies, lower-ranking primates displayed diminished glucocorticoid (GC) negative feedback following dexamethasone administration. Dexamethasone is a potent GC. If an individual has a typically-functioning hypothalamic-pituitary-adrenal (HPA) axis, the heightened presence of GCs (e.g., dexamethasone) should signal the HPA axis to halt endogenous production of GCs (e.g., cortisol). However, if an individual has an atypically-functioning HPA axis, consistent with GR desensitization, the HPA axis will be “deaf” to the signals of heightened GCs and will continue producing endogenous GCs. Lower-ranking primates exhibited the latter, in that they did not down-regulate their own production of GCs in the presence of dexamethasone. Corroborative evidence of GR desensitization also comes from experiments conducted in mouse populations (Avitsur, Stark, & Sheridan, 2001). Beyond failing
to diminish endogenous production of GCs, another consequence of GR desensitization is that the receptors will be deaf to the anti-inflammatory signals emitted by GCs. Thus, GR desensitization, suggested to prevail in low relative to high social status animals, can lead to high levels of endogenous GCs that fail to exert their typical anti-inflammatory action.

In humans, there is evidence of GR desensitization among low SES individuals. Relative to those raised in high SES household, adults raised in low SES households showed a down-regulation of genes with response elements for GR, and also an up-regulation of genes bearing response elements for pro-inflammatory transcription factors (e.g., NF-κB; Miller, Chen, Fok, et al., 2009). Similar results are reported for individuals experiencing chronic stress (Miller et al., 2008). In related research, Murphy, Slavich, Chen, and Miller (2015) did not find evidence of SSS differences in GR mRNA among asthmatic adolescents. This indicates that there are no differences in GR availability and potentially suggests that low status individuals have sufficient GR available to transduce hormone signals, but this message is not registered equivalently at the level of gene transcription.

In summary, the literature supports the idea that low social status individuals show evidence of greater pro-inflammatory gene expression, diminished anti-viral gene expression, and enhanced GR desensitization. However, it is unclear whether these results extend to low SSS individuals in healthy populations. In the present study, we investigated this link to offer insight into the molecular pathways linking low SSS to poorer health. We hypothesized that low SSS individuals will exhibit greater activation of the CTRA profile and down-regulation of genes responsive to GR-mediated signaling, relative to high SSS individuals. Specifically, we predicted a relative up-regulation of NF-κB, a pro-inflammatory transcription factor, a down-regulation of interferon response factors (IRFs), an innate anti-viral signaling pathway, and a down-regulation
of genes responsive to GR-mediated signaling in lower SSS individuals. Furthermore, we predicted that the relative up- and down-regulation of genes will mediate the relationship between SSS and health.

**Method**

*Participants.* Participants were 47 women recruited from a larger longitudinal study (Haselton, Fales, Murray, & Cole, in progress). Due to the aims of the larger study, all participants were heterosexual women who recently entered new dating relationships (within the past month). Women were non-smokers and were not using medication that affects immune, cardiovascular, or psychiatric functioning. On average, women were 20.5 years old (range = 18 – 30). The sample was predominantly Caucasian (36%) or Asian-American (26%), with smaller numbers self-identifying as Latina (15%), Black/African American (4%), or multiracial (19%).

*Procedure.* Within two weeks of enrollment in the study, participants had their blood drawn at the UCLA Clinical and Translational Research Center. Nurses collected a 10mL blood sample for assessment of gene expression, from which peripheral blood mononuclear cells (PBMC) were isolated and stored at -70°C for subsequent transcriptome profiling. Prior to their blood draw appointment, participants were encouraged to be well hydrated and reschedule their blood draw if they felt ill. Within 24 hours of their blood draw appointment, participants completed an online questionnaire.

*Online Questionnaire.* Participants completed the MacArthur Scale of SSS (Adler et al., 2000) relative to individuals at UCLA: “Imagine a 10-rung ladder representing where people “rank” in your school. At the bottom of the ladder are people in your school who are not respected and do not have friends. At the top of the ladder are those who are respected and have friends. Mark your response on the scale below that best represents where you think you stand on
the ladder.” (1 = least respected; 10 = most respected). Women also responded to five items assessing general health status from the 36-item Short Form Health Survey (Appendix A; Ware Jr & Sherbourne, 1992), and reported SES (Adler et al., 1994), ethnicity, height, weight, and alcohol consumption.

**Gene expression profiling.** Total RNA was extracted from PBMC samples using an automated nucleic acid processing system (QIAcube; Qiagen), tested for suitable mass by spectrophotometry (Nanodrop ND1000), tested for suitable integrity by capillary electrophoresis (Agilent TapeStation), and subject to genome-wide transcriptional profiling using fluorescent target cRNA (TotalPrep, Ambion Inc.) hybridized to Illumina HT-12 v4 BeadArrays (Illumina, Inc.) in the UCLA Neuroscience Genomics Core Laboratory, following the manufacturers’ standard protocol.

**Gene transcription analyses.** Gene expression data were log2-transformed and differentially expressed genes were identified as those showing ≥1.5-fold difference in mean expression levels over the range from −2 SD to +2 SD relative to mean level of SSS.

To identify the upstream signal transduction pathways that underlie differential gene expression, TELiS promoter-based bioinformatics analyses (Cole, Yan, Galic, Arevalo, & Zack, 2005) were performed. TELiS analyzes differential gene expression data in terms of the prevalence of transcription factor-binding motifs (TFBMs) within the promoters across all differentially expressed genes. Putatively associated genes were subject to TELiS promoter-based bioinformatic analysis to assess activity of NF-κB (using the TRANSFAC V$NFKAPPAB_01 transcription factor-binding motif weight matrix), Type I interferon-activated transcription factor families (V$ISRE_01), and glucocorticoid receptor activity (V$GR_Q6). Statistical inference was based on standard errors derived from 200 cycles of
bootstrap resampling of linear model residual vectors (i.e., maintaining any residual correlation across genes).

Mediation analyses. Multiple mediation analysis was used to estimate the associations among SSS, differential gene activity, and general health. We tested whether a composite score derived from the averaged values of 1.5-fold up- and down-regulated genes over the general range of individual differences in SSS (-2SD vs +2SD relative to the mean) mediated the associations between SSS and general health using a multiple mediation analysis procedure. Values of the mediational variables were z-scored within each gene, and then averaged across the set of genes that were up-regulated and independently for those that were down-regulated. To minimize bias in the mediation analysis, we aggregated across all genes rather than post-hoc selecting the genes that were differentially expressed in association with transcription factor pathways; the post-hoc approach capitalizes on chance by selecting the already capitalized gene set based upon an analysis of the transcription factors (S. Cole, personal communication, October 4, 2016).

SSS was entered as the independent variable; 1.5-fold up- and down-regulated genes were entered as the mediational variables; general health was the dependent variable (Figure 4-1). We adjusted for age, ethnicity, BMI, alcohol consumption and SES as covariates. An SPSS macro was used to conduct the multiple mediation analysis, with a bootstrap technique to estimate standard errors for the path coefficients (Preacher & Hayes, 2008). We applied 1,000 bootstrap samplings to obtain stable estimates.

A significant association between SSS and general health is often seen as one of the requirements of identifying a mediation effect. However, while a significant product of $a_i$ and $b_i$ (see Figure 4-1) is necessary for identifying a mediation effect, a significant association between
SSS and general health is not always necessary, particularly when the direct and mediation paths have opposite signs and may cancel each other out (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). Thus, in the present study, we tested a mediation effect even when an association between SSS and general health (c) was not significant.

Results

**SSS and gene expression.** To test hypotheses regarding SSS-related alterations in transcription factor activity, we conducted promoter-based bioinformatics analyses of all gene transcripts that showed ≥1.5-fold difference in mean expression levels over the range from −2 SD to +2 SD relative to mean level of SSS. After age, ethnicity, BMI, alcohol consumption and SES had been statistically controlled, a total of 84 transcripts showed a 1.5-fold or larger difference in gene expression (genes listed in Appendix B). As Figure 4-2 illustrates, the TELiS results were consistent with only one of the three hypotheses.

Consistent with the hypothesis, there was a relative down-regulation of genes bearing NF-κB response elements with increasing levels of SSS (0.45-fold difference, \( SE = 1.50, p = .05 \)). This finding is corroborated by a relative down-regulation of another pro-inflammatory transcription factor, AP1 (0.50-fold difference in V$AP1FJ_Q2, SE = 1.22, p = .0004 \)). In contrast to the hypothesis, there was no relative down-regulation of IRF with decreasing levels of SSS (1.48-fold difference, \( SE = 1.96, p = .56 \)), but there was a relative up-regulation of STAT (0.48-fold difference in V$STAT_01, SE = 1.40, p = .03 \)), another Type 1 interferon-activated transcription factor. Lastly, in contrast to the third hypothesis, there was not a relative down-regulation of genes with response elements for GR with decreasing levels of SSS (.91-fold difference, \( SE = 1.27, p = .70 \)).
To identify whether the transcriptional correlates of SSS might occur within the same leukocyte subpopulations previously identified (i.e., monocytes, dendritic cells, and B lymphocytes) to mediate CTRA transcriptional effects (Cole et al., 2012; Cole, Hawkley, Arevalo, & Cacioppo, 2011; Knight et al., 2016; Miller et al., 2008), we conducted transcript origin analysis (TOA; Cole et al., 2011). The results indicated that differentially expressed downregulated genes derived primarily from monocytes and dendritic cells (Figure 4-3). No clear picture emerged as to which leukocyte subpopulations primarily drove differentially expressed upregulated genes.

Mediation analyses. For the total effect (c coefficient), SSS was not significantly associated with general health \((b = -1.23, 95\% \text{ CI } [-4.71, 2.25]; \text{Figure 4-4})\). In addition, neither an up-regulation of genes (indirect effect \(b = .23, [-.90, 2.37]\)) nor a down-regulation of genes (indirect effect \(b = .75, [-2.39, 4.36]\)) significantly mediated the association between SSS and general health (Figure 4-4).

Discussion

The present study aimed to identify molecular mechanisms that explain the association between SSS and health. Based on the human and nonhuman literature, likely candidates included transcription factors associated with the CTRA profile (i.e., up-regulation of the transcription of pro-inflammatory genes and down-regulation of the expression of anti-viral genes; Cole, 2013, 2014) and genes responsive to GR-mediated signaling. As hypothesized, results revealed a relative up-regulation of pro-inflammatory transcription factor NF-κB in lower SSS individuals. However, contrary to hypotheses, results revealed no significant differences in IRF nor GR by SSS. Furthermore, the relative up- and down-regulation of genes did not mediate the relationship between SSS and health.
The finding of a relative down-regulation of NF-κB and another pro-inflammatory transcription factor, AP1, is consistent with the notion that low SSS individuals perceive the social world as threatening. Under such conditions, evolutionarily-conferred defensive programs are activated that serve to protect against injury, and are accompanied by an increase in pro-inflammatory gene expression. The results add to a growing literature that has identified differences in NF-κB by both SES and chronic stress, such that those exposed to poorer environments exhibited heightened pro-inflammatory signaling (Chen et al., 2009; Miller, Chen, & Cole, 2009; Miller et al., 2008). The findings align with the view that the social environment can get “under the skin” at the level of genomic transcription control pathways, and is the first to identify differences in such pathways by SSS.

Counter to the hypothesis, lower SSS individuals did not exhibit a down-regulation of IRF. Rather, analyses revealed that higher SSS individuals had a relative down-regulation of STAT, another Type 1 interferon-activated transcription factor. These findings appear contradictory to what is predicted by the CTRA. However, it is possible that the IRF component of the CTRA is simply weaker in magnitude or consistency than the pro-inflammatory component, and was therefore missed due to limited statistical power; it may exist and be detected if sufficient sample size was available. Furthermore, STAT is a potentially less probative test of the presence of the anti-viral component of the CTRA compared to IRF. Unlike IRFs that specifically respond to Type I interferons, multiple cytokines and growth factors can mediate activation of STAT family transcription factors (Cole et al., 2007). Given the CTRA is largely mediated by SNS activation, which inhibits the activity of transcription factors that control transcription of Type I interferon genes, the introduction of other mediating factors with
STAT might explain the differences in results between IRF and STAT. Empirical research is warranted to test such possibilities.

In sum, the present study reported evidence only for the pro-inflammatory, and not the anti-viral, arm of the CTRA. This result is consistent with the few previous studies that found SES-related differences in NF-κB activity in the absence of significant IRF associations (Chen et al., 2009; Miller, Chen, & Cole, 2009). One potential explanation for this finding lies in the different cell types involved. Monocytes carry information regarding inflammation (Serbina & Pamer, 2006; Swirski et al., 2009), whereas much of the interferon signature is carried by dendritic cells (Feldman & Fitzgerald-Bocarsly, 1990; Ferbas, Toso, Logar, Navratil, & Rinaldo, 1994). While initial analyses identified monocytes and dendritic cells as the primary cellular mediators of CTRA transcriptome shifts (Cole et al., 2011), subsequent and more refined analyses revealed that monocytes mediated many of the transcriptional effects of social adversity (Miller et al., 2008; O’Donovan et al., 2011); this was reflected in TOA analyses conducted in the present study. Therefore, it is possible that SSS selectively impacts, or more strongly impacts, monocytes but not dendritic cells; yet, more research is needed to empirically test this idea.

Counter to the hypothesis and results of previous research in humans (Miller, Chen, Fok, et al., 2009; Miller et al., 2008) and nonhuman animals (Avitsur et al., 2001; Sapolsky et al., 1997; Tung et al., 2012), there was not a relative down-regulation of genes with response elements for GR with decreasing levels of SSS. These results do not definitively refute a role for GR in the differentiation of high versus low SSS individuals. However, failure to see positive signals for GR activation, when other transcription control pathways such as NF-κB and AP1
showed detectable differences in activity, suggests that GR does not constitute the most sensitive differentiation of SSS.

Lastly, evidence did not support the up- or down-regulation of genes as mediators of the established association between SSS and general health. One potential explanation for the null findings is the analysis, as there is no simple way to run mediational analyses that makes full use of the multi-gene nature of the measures involved (S. Cole, personal communication, April 2, 2015). We computed a single composite score (i.e., the average value of z-score standardized values for each gene that was found to be differentially expressed), and then used that univariate composite as a variable in a mediation analysis. Due to limitations in the analytic approach, we were unable to make full use of the unique gene data set in the mediation analysis. Another possibility lies in the measurement of health. The use of five self-report items, without the inclusion of biological assessments of health, was perhaps not sensitive enough serve as an outcome for mediational analyses (see Limitations for further discussion).

**Strengths.** The present study is the first to aim to identify the molecular mechanisms that explain the association between SSS and health. Using a transcriptome-driven bioinformatics strategy, we evaluated the activity of several transcriptional control pathways that were hypothesized to be differentially activated in high versus low SSS individuals. This study adds to the expanding literature that has documented the relationship between SSS and health (e.g., Euteneuer, 2014; Quon & McGrath, 2014) by identifying how SSS can get “under the skin”. Specifically, results suggest that low SSS, much like low SES (Chen et al., 2009; Miller, Chen, Fok, et al., 2009), social isolation (Cole et al., 2007), and chronic stress (Miller et al., 2008; Miller et al., 2014), prime the body to protect itself against injury. Potentially adaptive in the ancestral environment, the experience of threat in connection with pro-inflammatory
transcriptional skewing likely promotes inflammatory-related chronic disease in those of lower SSS (Adler et al., 2008; Demakakos et al., 2008; Manuck, Phillips, Gianaros, Flory, & Muldoon, 2010).

An additional strength is the targeted focus of examining SSS in reference to other individuals at UCLA. Given the sample population consisted of women from UCLA, it was important to inquire about SSS in regards to a social group that is expected to be meaningful. More narrowly-defined social groups show stronger relationships between SSS and health, relative to more broadly-defined social groups (e.g., SSS relative to people in your community versus people in the United States, respectively; Euteneuer et al., 2012; Ghaed & Gallo, 2007; Goodman et al., 2003); perhaps results would have been stronger had I specifically referenced other female students at UCLA.

**Limitations.** The principal limitation of the present study was the measure of health with five self-report items. Due to study design and funding constraints, we were unable to assess health-related outcomes beyond self-rated general health. In unhealthy populations and older adults, self-reported health predicts mortality (Idler & Benyamini, 1997); therefore, self-reported health is a valid measure. However, while the distribution of general health in the present study was reasonable, the variation that is typically exhibited in populations of older adults was absent in this population of young, healthy women. Furthermore, it is possible that biological measures of health are necessary to identify potential mediators of the association between SSS and health. While the present study is the first to attempt to isolate potential mediating factors, future research should continue this endeavor.

Another limitation of the present study regards the participant population; namely, healthy, young women in new romantic relationships. The population raises concern about the
external validity of the study. This population was selected to empirically test questions related to the formation of intense social bonds and gene expression, but presented an excellent opportunity to inquire how differences in SSS might be identifiable at the level of gene expression. Analyses indeed revealed differences in this young and healthy population of UCLA students. There is no evidence to suggest that results will not extend to populations of older adults or those who are relatively less healthy, but whether the present results generalize awaits future research.

Conclusions. The present study offered the first test of SSS-related differences in gene expression, and the molecular mechanisms that might explain the association between SSS and health. Despite an array of inconclusive results, analyses revealed heightened pro-inflammatory gene expression in lower SSS individuals; this finding is consistent with previous studies linking lower SES to enhanced pro-inflammatory gene expression. This work suggests that those lower in SSS likely perceive diminishing social resources and a threatening social world, which manifests as heightened inflammatory processes, and has potential downstream consequences for inflammatory-related illness. The study indicates that SSS is among the many social factors that can regulate human gene expression, and highlights the need for future empirical research to uncover mediating factors involved in the association between SSS and health.
Figure 4-1. Illustration of multiple mediation model.
Figure 4.2. Transcriptional activity in PBMC from people with high vs. low SSS. Data represent (log2-transformed) ratio of transcription factor binding motifs (TFBM) for pro-inflammatory (NF-κB and AP1), antiviral (IRF and STAT) and glucocorticoid (GR) transcription factors in the promoters of all genes showing ≥1.5-fold greater magnitude of activation over the general range of individual differences in SSS (-2SD vs +2SD relative to the mean). Differential gene expression was analyzed in continuous (log2) metric, with the 1.5-fold discrete threshold used to define a discrete gene set for promoter-based bioinformatic analyses.
Figure 4-3. PBMC cell type of origin as indicated by TOA cell-type diagnosticity. Mean bootstrap values presented. Error bars indicate bootstrap SE. Negative TOA values are uninformative, and suggest that the cell-specific signal is coming disproportionately from other cell types.
Figure 4-4. Results of multiple mediation model. Standard errors in parentheses. * $p < .05$. 
Appendix A

1. In general, would you say your health is...
   Poor        Fair        Good        Very good        Excellent

How true or false is each of the following statements for you?

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<th>Mostly true</th>
<th>Don't know</th>
<th>Mostly false</th>
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<td>3. I am as healthy as anybody I know.</td>
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<td>5. My health is excellent.</td>
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### Appendix B

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References


General Conclusion

The past 15 years have witnessed a surge in scientific interest in the association between subjective social status—one’s psychological perception of their position in a social hierarchy—and health, highlighting the importance of subjective perceptions in predicting health consequences. Taken together, this dissertation adds to the literature by furthering our understanding of the construct of SSS in terms of its antecedents and stability, and its molecular mechanisms that might explain its relationship to health.

Chapter II suggests that individuals’ responses to potentially negative ambiguous social situations have consequences for their SSS, as might early life stress. Another factor involved in SSS of young adults is other-rated physical attractiveness and self-rated physical attractiveness, as indicated by Chapter III. These findings substantially contribute to our understanding of SSS as a construct. SSS is consistently examined as the antecedent of outcomes, mainly related to health, but we lack an understanding of those factors that contribute to SSS development. The findings reported here begin to fill that gap.

Chapter III also revealed that outside observers are apt at assessing targets’ SSS, especially if the targets are men. In addition, two factors that contribute to other-rated SSS are other-rated physical attractiveness and dominance; again, this is especially the case for male targets. These findings not only highlight the ability of individuals to quickly assess social status, but also the importance of combining theoretical frameworks to comprehend a suite of findings.

Chapter IV suggested that college freshmen, a group commonly characterized by instability, quickly identify their SSS in a new social group, and that their SSS either remains stable or increases. Furthermore, these changes in SSS do not reliably track self-rated health. The null findings of SSS in relation to self-rated health speak to an importance for scholars to explore
how new and/or temporary social groups affect health, given we navigate through different social groups constantly as individuals change schools, jobs, and homes.

Findings from Chapter V serve as the foundation for future endeavors to understand the association between SSS and health. The results contribute to an emerging field examining how the social environment can get “under the skin” at the level of genomic transcription control pathways. Importantly, the finding of heightened pro-inflammatory gene expression in lower SSS individuals suggests that those lower in SSS likely perceive diminishing social resources and a threatening social world.

Beyond contributions to a more multi-faceted understanding of SSS and its association with health, the results of this dissertation have important implications in identifying potential points of intervention that may be most influential in improving health outcomes. As the field continues to grow its understanding of the nature of SSS, we are better suited to combat the negative health outcomes that typically follow from low social standing.