Hedonia and Eudaimonia: Associations with Academic Success, Wellbeing, and Neuropsychological Functioning

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Hedonia and Eudaimonia: 

Associations with Academic Success, Wellbeing, and Neuropsychological Functioning

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By

Maria Kryza-Lacombe

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Abstract

This study examined the relations between happiness and academic success and wellbeing in a diverse, urban college sample by viewing happiness through the lens of hedonia (seeking pleasure and relaxation) and eudaimonia (seeking meaning), and their neuropsychological correlates. Undergraduate students (n=76; 68.4% female; mean age [SD]=21.17 [3.12]) completed self-report measures of hedonia and eudaimonia, and depression, anxiety, and stress. They also completed objective measures of “cool” executive functioning (WAIS-IV Digit Span, Stroop Color-Word test, Wisconsin Card Sorting Task, and a Stop Signal task) and “hot” executive functioning (Iowa Gambling Task, Temporal Discounting Task). Semester GPA was collected from school records. Eudaimonia was significantly positively associated with GPA. Eudaimonia was also significantly negatively associated with depression, and individuals living the Full Life (high hedonia and high eudaimonia) had significantly lower depression compared to those living the Empty Life (low in both constructs). There were no significant correlations between “cool” executive functions and either hedonia or eudaimonia. Individuals living the Hedonic Life (high hedonia and low eudaimonia) were significantly more likely to prefer smaller more immediate rewards than those living the Eudaimonic Life (low in hedonia, high in eudaimonia). Additionally, there was a trend for individuals living the Full Life to make more risky decisions. Looking at both separate and combined effects of hedonia and eudaimonia might provide more nuanced insight into the relations between happiness and positive outcomes. Furthermore, affective decision-making offers promise for investigating the interaction between hedonic and eudaimonic processes, and how they exert an effect on positive outcomes.

**Keywords:** hedonia, eudaimonia, academic success, wellbeing, executive functioning
Hedonia and Eudaimonia:

Associations with Academic Success, Wellbeing, and Neuropsychological Functioning

The quest for happiness is at least as old as historical accounts of human thought and has come with numerous yet inconclusive solutions, from Confucius’ concept of Ren (Kupperman, 2002), or striving for virtue, to the more hedonistic philosophies of Aristippus (Watson, 1895). Today, we continue to strive for happiness and in the recent past, the pursuit of happiness has become a matter of global attention. In 2012 the United Nations convened the High Level Meeting on Happiness and Wellbeing, which resulted in the World Happiness Report. This document summarized life satisfaction data of 156 countries around the world (Helliwell, Layard, & Sachs, 2015) and showed that three-quarters of the differences in happiness among countries can be accounted for by six predictors: GDP per capita, healthy years of life expectancy, social support, trust in absence of corruption in government and business, perceived freedom in making life decisions, and generosity. This now annual report draws global attention to the importance of happiness and its role in economic wellbeing.

Thus happiness is beginning to be considered a measure of social progress and a goal of public policy, and is likewise an important outcome for each one of us personally. In addition to being an important outcome, research is beginning to show that happiness is a predictor of myriad positive outcomes that benefit us as individuals and also benefit society as a whole. For example, meta-analytic evidence suggests that higher levels of happiness are associated with greater life success (Lyubomirsky, King, & Diener, 2005a). Furthermore, when compared to those low in subjective happiness, people who are high in subjective happiness are more successful in the workplace (Boehm & Lyubomirsky, 2008), better at problem solving (Isen,
Daubman, & Nowicki, 1987), healthier (Cohen & Pressman, 2006), display more adaptive coping (Carver et al., 1993), and are more generous, kind, and benevolent (Aknin, Norton, & Dunn, 2009). As an extension of the existing research, in this study we investigated happiness, specifically happiness-related motives, as predictors of positive life outcomes relevant to an urban college population, namely academic success and wellbeing.

Defining Happiness

Before delving deeper into the positive outcomes of happiness, and its neuropsychological correlates, there must be agreement about how happiness is defined. As with many abstract terms, definitions of happiness are likely as numerous as people on earth; this can lead to miscommunication and misunderstanding. Close examination of the concept via the scientific method necessitates a clear definition, yet incongruent definitions among scientists still abound, which can make studying happiness particularly challenging.

Modern conceptions of happiness and how they are measured.

The most prevalent contemporary model of happiness is Edward Diener’s concept of subjective wellbeing, which encompasses simultaneous high positive affect, low negative affect, and high life satisfaction (Diener, 1984). “Affect” refers to an emotional experience, while “life satisfaction” is considered to be a cognitive judgment. Thus subjective wellbeing has both affective and cognitive components and is often considered incomplete one without the other.

An important common factor here is that these are subjective evaluations, which has important implications for how happiness is measured. Self-report is typically utilized to measure an individual’s feeling state and it has been argued that this subjective experience is the only meaningful way to assess the question “Are you happy?” By assessing magnitude of change in the individual’s own evaluation of his or her happiness, the benefits associated with increased
wellbeing are determined. Kahneman, for example, defines happiness as positive affect over time. His model for the objective measurement of happiness consists of an individual documenting a timeline of self-reported changes in positive affect (Kahneman, 1999). In reality, these are subjective evaluations of an individual’s emotional state.

Consistent with both Diener’s (1984) and Kahneman’s (1999) models, it is common for researchers to define happiness in terms of positive (and negative) affect. Most often, this is measured using the Positive Affect Negative Affect Scale (PANAS) (Watson, Clark, & Tellegen, 1988). Here, individuals rate themselves on 10 positive emotional states (e.g., interested, excited, inspired) and 10 negative states (e.g., scared, ashamed, hostile) based on a 7-point Likert scale, ranging from “Very Slightly or Not at All” to “Extremely.” To complement this measure of affect, Diener et al.’s Satisfaction with Life Scale is often used to evaluate the cognitive component of happiness (Diener, Emmons, & Larsen, 1985).

One of the most common ways to measure happiness in research today is Lyubomirsky’s Subjective Happiness Scale (Lyubomirsky & Lepper, 1999). It carries the name of Diener’s model of happiness, yet the content of the scale does not reflect his model of affective and cognitive components. The goal in creating this scale was to find a middle ground between commonly used one-item happiness assessments and the multi-measure assessments that were used to capture Diener’s model. In Lyubomirsky’s scale, happiness is assessed in terms of whether individuals generally consider themselves to be a happy person, and how they assess their happiness level in relationship to peers. Although this has high face validity, it measures happiness using the very word we want to define and does not add to understanding the components of happiness. Diener’s model of subjective happiness as consisting of both affective and cognitive aspects is useful, but separating these two constructs can be problematic because
attitudes or behaviors are rarely purely affective or cognitive. Further, the “cognitive” aspect of Diener’s model is “life satisfaction;” while a life satisfaction judgment is a cognitive process, it does not encompass the complexity of such processes involved with generating and maintaining happiness. Thus, another way of defining and measuring happiness is needed; one that will help us understand its core on a deeper level than merely a subjective feeling, and one that will address the intertwined nuances of affect and cognition.

**Parsing happiness into hedonia and eudaimonia.**

In the last decade, a new conceptualization of happiness has been gaining popularity in the literature whereby the construct is parsed into two distinct factors: hedonia and eudaimonia (Deci & Ryan, 2006; Henderson, Knight, & Richardson, 2013a; Huta & Ryan, 2009; Peterson, Park, & Seligman, 2005). Although hedonia is not cleanly defined in the wellbeing literature and at times has become a synonym of subjective happiness (Deci & Ryan, 2006), among social scientists and economists, hedonia may be broadly defined as positive affect or more specifically as pleasure, enjoyment, comfort, and absence of distress (Huta & Waterman, 2014), which accompanies satisfaction of needs, and may be physical, intellectual, or social (Waterman, 1993). Although the definitions of hedonia apparently overlap with positive affect, it is distinct as positive affect may be experienced as a result of all kinds of pursuits whether pleasure-related or achievement-related. Hedonia, therefore, carries more specificity as it generally relates to present-moment need satisfaction; it is predominantly affect driven, but also incorporates cognitive satisfaction judgments.

On the other hand, the term eudaimonia dates back to Aristotle and is associated with pursuits of higher order. According to Aristotle, eudaimonia is the path to wellbeing and refers to living in alignment with one’s deeper principles and seeking to use and develop the best in
oneself (Aristotle, 2001). Religious traditions throughout the world and history declare eudaimonic principles such as virtue and delay of gratification pivotal to wellbeing; and psychologists agree. For example, Maslow’s idea of self-actualization aligns well with the concept of eudaimonia (Waterman, 2008). Today’s major researchers define eudaimonia as psychological well-being that encompasses personal growth and expressiveness, pursuit of purpose and meaning in life, autonomy, environmental mastery, positive relations with others, and self-acceptance (Baumeister, Vohs, Aaker, & Garbinsky, 2013; Deci & Ryan, 2006; Ryff, 1989; Waterman, 1993). Thus eudaimonia incorporates affective components (e.g., wellbeing as a result of eudaimonic activities), but is predominantly cognitively driven (e.g., intentional inhibition of a drive for immediate satisfaction to achieve a longer term goal). In spite of this heterogeneity in definitions (Biswas-Diener, Kashdan, & King, 2009; Huta & Waterman, 2014), the common factor is creating meaning and outlook into the future.

To summarize, while hedonia refers to more present-moment experiences of pleasure and comfort, eudaimonia is a more future-oriented concept with a focus on achievement, meaning, and personal growth. Hedonia and eudaimonia are thus two different perspectives of happiness, with different goals, yet they both have affective and cognitive components. Hedonia is more affect driven, but eudaimonia has arguably a predominantly cognitive factor. They may therefore be a more nuanced way to conceptualize happiness, compared to Diener’s subjective happiness model and Lyubomirsky’s subjective happiness scale. Recent efforts have begun to integrate the hedonic and eudaimonic traditions and suggest that looking at both perspectives simultaneously may provide a crucial component to a broad conceptualization of happiness. This is the perspective taken in the present study, which leads into how hedonia and eudaimonia are measured.
One of the first questionnaires that was developed to measure both hedonia and eudaimonia was the Orientations to Happiness Scale (Peterson et al., 2005). This measure assesses attainment of happiness via pleasure (hedonia), meaning (eudaimonia), and engagement (flow). This and other questionnaires that evaluate hedonia and eudaimonia (e.g., the Personally Expressive Activities Questionnaire, Standard Form [PEAQ-S]; Waterman, Schwartz, & Conti, 2006) have been critiqued due to their selection of items (Henderson, Knight, & Richardson, 2013b; Huta & Ryan, 2009). Specifically, while some of the items are present-moment satisfaction judgments, others are more global trait-like self-evaluations or goal-oriented intentions. As a whole, this means that hedonia and eudaimonia do not share an equal playing field (i.e., state versus trait, predictor versus outcome) in these questionnaires, which in turn does not provide convincing predictive validity (Huta & Ryan, 2009).

This leads to a vital side note regarding the importance of clarifying the role happiness assumes in a specific context. For example, as alluded to previously, happiness can be an outcome, but it can also be a predictor of other outcomes. In everyday life, we may contemplate how we can become happier (happiness as outcome); much research has investigated the benefits of happiness (happiness as predictor). Consequently, a clear distinction and clarification of the way the term happiness is used in an empirical study is critical.

With this in mind, Huta and Ryan (2009) identified the need for a measure that could use hedonia and eudaimonia as predictors for wellbeing outcomes, and consequently developed the Hedonic Eudaimonic Motives for Action (HEMA) scale (Huta & Ryan, 2009). It comprises nine items, each of which is phrased in terms of intentions behind daily activities; this creates conceptually equal grounds between these two orientations and makes it possible for hedonia and eudaimonia to be investigated as parallel constructs. Hedonic motives for action are
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characterized by seeking relaxation, pleasure, enjoyment, fun, and the desire to take it easy. These behaviors can be conceptualized as fulfilling basic rest and pleasure needs. This stands in contrast to eudaimonic motives for action which are associated with looking into the future and striving toward a “higher goal” such as developing a skill, or gaining insight into something, doing what one believes in, pursuing excellence or a personal ideal, and seeking to use the best in oneself. This present study utilized this questionnaire to assess hedonia and eudaimonia, and it is important to keep in mind that the way these constructs are measured here does not comprise an affective state of hedonia or eudaimonia, but rather happiness-related motivations. This alternative way of defining hedonia and eudaimonia has been determined as one of several valid ways to define the constructs (Huta & Waterman, 2014), and for the sake of linguistic fluidity the present study will therefore utilize the terms “hedonia”/”eudaimonia” and “hedonic motives”/”eudaimonic motives” interchangeably.

Hedonic and eudaimonic motives for action can each individually be viewed as predictors, but as levels of both hedonic and eudaimonic motives vary within each individual, looking at both simultaneously may provide a more nuanced perspective on how happiness is related to various life outcomes. One way to look at various constellations of hedonic and eudaimonic motives is to compare outcomes in individuals who have high levels of both constructs (coined the “Full Life”), low in both (“Empty Life”), and those who assume intermediate positions. The Full Life hypothesis posits that individuals living the Full Life show better outcomes when compared to particularly the Empty Life, but also to the other groupings, and preliminary findings support this (Huta & Ryan, 2009; Peterson et al., 2005). The current study will also look at the Full Life hypothesis in relation to its specific outcomes of interest.
Happiness as a Predictor of Positive Life Outcomes

Happiness (in its multifarious definitions) has been previously associated with positive outcomes. A meta-analysis conducted by Lyubomirsky, King, and Diener (2005) summarized 331 effect sizes derived from 225 papers that assessed the effect of happiness on successful outcomes (e.g., work life, global health) and on behaviors paralleling success (e.g., coping, problem solving). They investigated cross-sectional, longitudinal, and experimental data separately, and parsed the data into multiple categories of success for each data type. The effect sizes for cross-sectional data were medium ($r_s = .26 - .39$); small for longitudinal data ($r_s = .18 - .27$); and medium to large for experimental data ($r_s = .25 - .51$). The positive correlations indicate that greater happiness was associated with higher levels of positive outcomes. However, it should be noted that significant heterogeneity was observed across a number of effect sizes for the success categories, suggesting the need for examining moderating factors in future studies.

Most studies that have been carried out are correlational, which limits conclusions about causation, but gives a glimpse into whether happier people experience greater levels of positive outcomes. Some of the correlational studies demonstrated that greater happiness is associated with success; for example, more positive supervisory evaluations and job performance ($r_s = .22 - .43$) (Deluga & Mason, 2000; Cropanzo & Wright, 1999; Wright & Staw, 1999) and higher income ($r_s = .12 - .20$) (Lucas, Clark, Georgellis, & Diener, 2004; Graham, Eggers, & Sukhtankar, 2004; Staw, Sutton, & Pelled, 1994). One study, based on over 3,500 respondents showed a small, albeit positive association ($r = .18$) between quality of life and academic retention (Frisch et al., 2004). As far as psychological distress and mental health are concerned, significant negative correlations have been shown between happiness and internalizing symptoms, indicating that lower subjective happiness is associated with more severe depression.
More robust longitudinal and experimental studies point toward a potential causative relationship (Lyubomirsky, King, and Diener 2005). Evidence from longitudinal happiness research suggests that greater happiness predicts more positive supervisory performance evaluations and higher occupational attainment over time periods of between one and eight years \((rs = .16 - .47)\) (Roberts, Caspi, & Moffitt, 2003; Wright & Staw, 1999) and lower symptoms of anxiety and depression \((rs = -.40 - -.55)\) over time periods of three to six months (Epping-Jordan et al., 1999). There are far fewer experimental studies examining positive outcomes, but some of them have shown that happiness leads to improved goal setting via positive mood induction; for example, using fragrance (versus a no scent control condition), \(r = .22\) (Baron, 1990), and happy (versus sad) memory recall, \(r = .48\) (Hom & Arbuckle 1988). Additionally, intervention studies that aim to increase happiness levels are beginning to emerge and demonstrate that such changes are possible (Lyubomirsky & Layous, 2013). By comparing the effects of an intervention activity to a neutral control activity on changes in happiness, several studies have shown that such activities may lead to positive changes in wellbeing, defined as improvement of depressive symptoms (Layous, Chancellor, Lyubomirsky, Wang, & Doraiswamy, 2011; Sin & Lyubomirsky, 2009), increases in life satisfaction (Boehm, Lyubomirsky, & Sheldon, 2011), and an upsurge in positive emotions that in turn led to increased purpose in life, social support, and decreased illness symptoms (Fredrickson, Cohn, Coffey, Pek, & Finkel, 2008). Each of these intervention studies uses a different definition of wellbeing, which warrants a brief detour into the definition of wellbeing and how this term will be used in the present study.
Wellbeing is a multifaceted concept. Importantly, wellbeing is not merely the absence of, or low levels of psychological distress, but also encompasses positive constructs such as satisfaction with life (e.g., Layous, Chancellor, Lyubomirsky, Wang, & Doraiswamy, 2011). A recent review of common wellbeing instruments found that twelve conceptual domains emerge among them, which gives a glimpse into the multifaceted nature of the construct (Charlemagne-Badal, Lee, Butler, & Fraser, 2015). These domains include cognitive health, economic health, emotional health, environment, health behavior, health care, intellectual pursuits, leisure, life satisfaction, non-leisure activities, physical health, sleep, social health, spirituality/meaning, and vitality. The present study thus only looks at a small aspect of wellbeing, namely psychological distress; specifically, this study focuses on depression, anxiety, and stress. While this is an incomplete picture of overall wellbeing, these factors are highly salient among college students, the populations investigated in this study. For example a survey by the American College Health association asking students about their health over the past 12 months, demonstrated that 53.8% of undergraduate students experienced “more than average stress” (American College Health Association, 2014). The same study also showed that 31.8% of undergraduate students report to have felt “so depressed that it was difficult to function” and 51.2% reported “overwhelming anxiety” (American College Health Association, 2014). Thus the psychological distress aspect of wellbeing is important to study in this population, and identifying factors that predict depression, anxiety, and stress, such as hedonic and eudaimonic motives, may have important implications for intervention development to address high levels of distress.

However, hedonic and eudaimonic motives, or the balance of these happiness constructs in individuals’ lives, have thus far only been minimally examined as predictors of positive outcomes. The above-mentioned studies that investigated happiness as a predictor of life success
and wellbeing outcomes used a variety of happiness definitions ranging from 1-item happiness scales, to the PANAS, to life satisfaction inventories, but few studies have examined the outcomes of eudaimonia and hedonia specifically. To date, two studies demonstrated that individuals living the Full Life have the highest levels of many wellbeing outcomes compared to all other groups (i.e., those with both low hedonia and eudaimonia, those with low hedonia and high eudaimonia, and those high in hedonia but low in eudaimonia), but particularly those in the Empty Life group (low in both hedonia and eudaimonia). Such wellbeing outcomes include higher life satisfaction, positive affect, carefreeness, meaning, and flourishing (Huta & Ryan, 2009; Peterson, Park, & Seligman, 2005). Therefore, as individuals living the Full Life have high levels of both hedonia and eudaimonia, both constructs may also be related to the aspect of wellbeing that relates to levels of psychological distress, that is depression, anxiety, and stress.

The scientific investigation of the integration of hedonic and eudaimonic perspectives into a common pathway toward positive outcomes, such as wellbeing, is still at its inception, and a call for longitudinal studies has been made to validate this perspective so that we can move from theory to practice (Henderson & Knight, 2012). Furthermore, the Full Life has not yet been explored as a predictor of success, nor have hedonia and eudaimonia as separate contributors to life outcomes. With eudaimonic motives incorporating goal achievement and being more cognitively driven, it is possible that such motives will be associated with life success. Hedonic motives that encompass comfort and pleasure seeking, when considered on their own, may be negatively associated with life success, including academic success and GPA. However, considering the combined effects of hedonia and eudaimonia may be more fruitful. High hedonia in the context of a generally goal-oriented, eudaimonic outlook may not necessarily interfere with achievement. Thus for someone who is high in eudaimonia, high hedonia may
provide balance and reduce stress, therefore increasing the likelihood for success. It is possible that the Full Life will also manifest the best life success outcomes compared to the other groups. The present study attempts to contribute to elucidating these relations.

Neuropsychological Correlates of Happiness

In addition to looking at hedonic and eudaimonic motives and the Full Life hypothesis as a means to increase our understanding between happiness and positive outcomes, examining the neuropsychological correlates of happiness may provide further insight into the construct. Neuropsychological measures assess cognitive functioning, and several studies have shown an association between cognition and happiness (not defined in terms of hedonia and eudaimonia). For example, a comparison of individuals who rated themselves as happy versus unhappy revealed that chronically happy people use particular cognitive and motivational strategies of which unhappy individuals take less advantage. Such strategies include social comparison, dissonance reduction, self-reflection, self-evaluation, and person perception (Lyubomirsky, 2001).

While these types of cognitive strategies may be difficult to measure via tests of neuropsychological functioning, others can be more easily assessed. A small body of published research suggests a relationship between certain executive functions and happiness. For example, Cheung and colleagues (2014) have recently shown that higher self-control is related to higher levels of happiness (Cheung, Gillebaart, Kroese, & De Ridder, 2014). Self-control is defined as the ability to regulate undesirable behaviors and engage in desirable behaviors that may lead to the achievement of long-term goals (De Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2012). It is related to inhibition, an aspect of executive functioning, and can be measured using neuropsychological testing instruments. Another study looking at inhibition
showed that imagining the attainment of positive short-term goals interfered with performance on tests of inhibition compared to imagining achievement of long-term goals (Katzir, Eyal, Meiran, & Kessler, 2010). It is possible that this could be extended to hedonic and eudaimonic motives, which correspond to predominantly short-term and long-term outcomes respectively. Yet another study showed that better working memory for positive information is associated with higher levels of life satisfaction and affect balance (Pe, Koval, & Kuppens, 2013).

Additionally, motivational drive and strategic planning are related to positive psychological constructs such as gratitude and satisfaction with life (Miley & Spinella, 2006). Also, damage to the orbitofrontal cortex (OFC) has been associated with poor performance on measures of risk taking (Bechara, 2005) and with less subjective happiness (Berlin, Rolls, & Kishka, 2004).

To date, possible neuropsychological correlates of eudaimonia and hedonia have not been established, but given the fairly distinct motives observed in eudaimonia and hedonia, distinct neuropsychological markers may be seen. Furthermore, neurocognitive correlates and their relations to the interaction between eudaimonic and hedonic motives, (i.e., the Full Life hypothesis) have thus far not been explored in the scientific literature, but may provide a clearer picture of what cognitive functions are associated with happiness.

Eudaimonia and hedonia may be related to “cool” executive functions and decision-making respectively. Executive functions comprise the ability to inhibit an immediate response and delay it to a more appropriate time point, to engage in strategic decision-making, and to hold a mental representation of a task and information relevant to reaching a desired future state or goal (i.e., working memory) (Welsh & Pennington, 1988). These skills are presumed to be mediated by the dorsolateral prefrontal cortex (DLPFC; Niendam et al., 2012).
motives for action may be related to executive functioning as striving toward excellence is a goal that requires the ability to inhibit drives to immediate gratification, strategic decision making to move toward that goal, and working memory to consider several different potential modes of action. In contrast, affective decision-making has been shown to be associated with the orbitofrontal cortex (OFC; Bechara, 2005). Hedonia in the absence of eudaimonia, which is associated with obtaining gratification sooner rather than later, may be related to altered motivational states, as observed in steeper discounting of delayed rewards and more impulsive, risky decision making.

Overall, hedonia and eudaimonia may be based on neurological mechanisms and could be represented via commonly-used measures of executive function. Specifically, hedonia may be associated with performance on “hot” executive functions, presumably mediated by the OFC, such as affective decision making, including risk-taking and temporal discounting. Eudaimonia may be associated with performance on “cool” executive functions, such as inhibition, working memory, and cognitive flexibility, presumably mediated by the DLPFC. Furthermore, the interaction between hedonia and eudaimonia (i.e., the Full Life Hypothesis) may also reflect the interaction between the two systems, such that living the Full Life requires cognitive flexibility to effectively switch between the two. Also, in line with the literature that “cool” executive functions can regulate “hot” executive functions (Zelazo & Carlson, 2012), it is possible that when both high eudaimonia and high hedonia are present, as is the case with individuals living the Full Life, the “cool” executive functions will regulate hedonic tendencies, such that the Full Life individuals will not differ in executive functioning or affective decision making from the Eudaimonic Life group (high in eudaimonia, but low in hedonia).
The Current Study

Before moving on to outlining the aims and hypotheses, the framework for this study should be restated and summarized: (1) the term happiness is predominantly used to describe a predictor of positive outcomes; (2) happiness (as a predictor) is conceptualized as hedonic and eudaimonic motives for action; (3) the term wellbeing is used predominantly in the context of an outcome, and in this study refers to levels of depression, anxiety, and stress specifically, which is only a small aspect of the multifaceted concept of wellbeing.

The purpose of this study is two-fold. First, building on the evidence that happiness is associated with success and wellbeing, we investigated to what extent hedonia and eudaimonia contribute to these outcomes. End of semester GPA served as an index of “life success” which is appropriate for our college sample. Additionally, we examined one aspect of wellbeing, namely psychological distress, defined as levels of depression, anxiety, and stress. We first looked at the influence of hedonic and eudaimonic motives separately, and then we used the Full Life hypothesis to investigate the combined effect of the two happiness constructs.

We hypothesized that: (1) eudaimonic motives would be positively related to GPA; (2) that the Full Life group would have the highest GPA among all of the hedonia/eudaimonia groupings; (3) that both high hedonic and eudaimonic motives would be associated with lower levels of psychological distress; and (4) that wellbeing as a whole would differ between happiness groups, such that the Full Life would be associated with the best outcome (i.e. lowest depression, anxiety, and stress) compared to the other happiness groups.

Second, the neuropsychological correlates of eudaimonic and hedonic motives were examined in an effort to gain a deeper understanding of these constructs. It was hypothesized that: (1) eudaimonic motives would be positively associated with “cool” executive functioning;
(2) hedonic motives would be negatively associated with performance on measures of affective decision-making; (3) compared to the other happiness groups, Full Life individuals would perform best in our measure of cognitive flexibility; (4) there would be a difference between groups who are high in eudaimonia and those who are low in eudaimonia, in “cool” executive functioning, such that those high in eudaimonia would perform better than those low in eudaimonia; but the Full Life would not differ from the Eudaimonic Life; and (5) there would be a difference between the Hedonic Life and the Eudaimonic Life on measures of affective decision making, such that the Eudaimonic Life would perform better than the Hedonic life; but individuals living the Full Life would not differ from those living the Eudaimonic Life.

**Methods**

**Participants**

Eighty undergraduate students (52 females) aged 18-30 years (mean=21.17, SD=3.12) attending the City College of New York participated in this study. The final sample of eligible participants (n=76) was diverse, reflecting the urban population from which it was obtained, with 18.4% Caucasian, 15.8% Black or African American, and 30.3% Asian. Additionally, 35.5% of the sample indicated that they did not identify with one of these groups and specified that they consider themselves as belonging to racial classes such as Dominican (n=3), Hispanic (n=7), Mexican (n=3), Puerto Rican (n=3), and Middle Eastern (n=2). None of the participants identified as Native American or Pacific Islander. Ethnicity was captured separately and 38.2% of participants self-identified as Hispanic. Previous semester GPA was available for 64.4% of our sample; the average previous semester GPA for these students was 2.97 (SD=.68), which is in the B- to B range. Mean (SD) estimated IQ, as measured using the Matrix Reasoning subtest
of the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999) was 51.68 (7.08) (T-score: mean of 50, SD of 10). Full demographic characteristics can be found in Table 1.

Participants were recruited via the City College Psychology Department online subject pool and via flyers posted in highly visible areas around the university campus. Participants who signed up through the subject pool (n=77) were given study participation credits that are a requirement for several core psychology courses and/or an opportunity for extra credit. Participants who were recruited after responding to flyers (n=3) received a single entry into a draw for a $150 Amazon.com gift card. Thus, participants either obtained participation credits or had a chance of winning a gift card as compensation for their time.

Individuals were excluded from the study if they were not between the ages of 18 to 35 years; if they were not fluent in English; if their estimated level of intellectual functioning was significantly low, as indicated by a score of $T \leq 30$ (comparable to an IQ standard score at or below 70) on the Matrix Reasoning subtest of the WASI (Wechsler, 1999) (see Materials section below for more detail); or if they did not consent to have the Principal Investigator (PI) retrieve their grades at the end of the semester. Four participants were excluded from the study based on these criteria; one was excluded because the student’s age exceeded our eligibility range, and three had an estimated IQ of below 70. No participant withdrew from the study part way through the evaluation.

The study and all outlined procedures were approved by the University’s Institutional Review Board. All participants signed written consent forms prior to carrying out the study.
Materials

**Matrix Reasoning subtest, Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999):** The WASI is a reliable, age-normed test comprising 4 subtests, which is used as a brief screen of intellectual functioning for individuals aged 6:0-89:11 years. In the present study, participants completed the Matrix Reasoning subtest, which required them to complete a visually presented pattern by choosing the correct item from a group of stimuli. This test took approximately 5-10 minutes to complete. The resulting scores were used as an estimate of IQ. Participants whose score was equal to or lower than two standard deviations below the population mean (i.e., T-score ≤ 30) were excluded from the study. In the normative adult sample the reliability coefficient of the Matrix Reasoning subtest was 0.90.

**Demographics Questionnaire** (see Appendix A): This questionnaire asked participants about their demographic information (i.e., age, date of birth, gender, year of education), their background (i.e., race, ethnicity, self, maternal and paternal occupation and years of education) and their household (i.e., number of people living in household, number of bedrooms, income).

**Hedonic Eudaimonic Motives for Action (HEMA) questionnaire** (Appendix B; Huta & Ryan, 2009): This 9-item questionnaire was used to assess hedonia and eudaimonia, measured by asking about the individuals’ hedonic and eudaimonic motives for action. The HEMA has been validated in a young adult population (Huta & Ryan, 2009). On a seven point Likert-style scale (from 1 = “not at all”, to 7 = “very much”), subjects indicated to what degree they generally approach their daily activities with each of nine different intentions, of which five are related to hedonia (e.g., “relaxation”, “fun”) and four to eudaimonia (e.g., “to pursue excellence or a personal ideal”). The measure generates two scores, one for each of the constructs measured (i.e., hedonia and eudaimonia). Higher scores indicate greater levels of hedonia and eudaimonia.
In the present sample, Cronbach’s alphas for the hedonia and eudaimonia scale were 0.79 and 0.75 respectively.

**Depression and Anxiety Stress Scale** (DASS; Lovibond & Lovibond, 1995): Wellbeing was measured via this 42-item questionnaire, which comprises three self-report scales that measure depression, anxiety, and stress. Items included both psychological and physiological manifestations of depression, anxiety and stress. For example, depression items included “I couldn’t seem to experience any positive feeling at all” and “I just couldn’t seem to get going”; sample anxiety items were “I felt scared for no reason” and “I experienced trembling (e.g., in the hands)”; stress scale items included “I found myself getting upset by quite trivial things” and “I was in a state of nervous tension.” Participants provided a self-rating on each item based on a four-point severity/frequency scale (from 0 = “did not apply to me at all” to 3 = “applied to me very much or most of the time”) allowing the individual to rate the extent to which they have experienced the respective symptoms over the past week. This questionnaire was introduced later in the study, thus only part of our sample (n=44) completed it. In our sample, Cronbach’s alphas for depression, anxiety, and stress were 0.93, 0.86, and 0.89 respectively.

**Digit Span subtest from the Wechsler Adult Intelligence Scale - Fourth Edition** (WAIS-IV; Wechsler, 2008): The WAIS-IV is a standardized neuropsychological battery to assess intellectual functioning in individuals 16:0-90:11 years. In the present study we used the Digit Span subtest of the WAIS-IV to assess verbal working memory. The subtest has three parts: First, strings of numbers must be repeated in the exact same order (Digit Span Forward); next, additional strings of numbers are to be repeated in the reverse order in which they were presented (Digit Span Backward); finally, individuals must repeat back strings of numbers in numerical order (Digit Span Sequencing). The entire subtest takes approximately ten minutes to
complete. Raw scores of each part were converted to age-normed scaled scores with a mean of 10 and standard deviation of 3. Higher scores indicate better performance. In the normative sample the reliability coefficients for our sample’s age groups ranged from 0.92 to 0.94.

**Stop Signal task** (Shuster & Toplak, 2009; Logan & Cowan, 1984; Schachar, Mota, Logan, Tannock, & Klim, 2000; Williams, Ponesse, Schachar, Logan, & Tannock, 1999): This computer-based task assesses impulse inhibition. ‘GO’ stimuli (letters X and O) are presented on the screen and subjects must press a key that corresponds to the presented stimulus as quickly as possible (go trial). However, whenever they hear an auditory cue, participants must refrain from pressing the key (stop-signal trial). Stop-signal trials occurred randomly for each participant on approximately 25% of the trials and the stop-signal delay (the time between the auditory signal and the presentation of the go stimulus) changed dynamically based on the participant’s performance on the previous stop-signal trial. If the individual was able to inhibit a response, the stop signal delay was adjusted so that it was more difficult to respond on the next stop signal trial, and when the individual failed to inhibit his or her response, stop-signal delay adjustment occurred in the opposite direction. The purpose of this tracking algorithm was to allow participants to successfully inhibit approximately 50% of the stop-signal trials. The task consisted of 6 blocks of 32 trials each and took approximately 15 minutes to complete.

Response inhibition is evaluated by measuring the stop-signal reaction time (SSRT), which is the average time it takes an individual to stop a response. It is calculated by subtracting the mean stop-signal time delay from the mean go trial reaction time for each block. Only accurate go trials were used to calculate mean go trial reaction time. Per recommendation by (Congdon, 2012) who demonstrated that the following method was the most reliable way to estimate SSRT, all blocks were included to calculate overall SSRT, and “lenient outlier criteria”
were applied to exclude unreliable blocks. (Lenient outlier criteria included the following: 1) percent inhibition on stop trial was outside the 25-75% range; 2) the Go trial response rate was less than 60%; 3) response errors comprised more than 10% on the Go trials; and 4) the SSRT estimate was negative or less than 50ms. Weaker inhibition is indicated by longer SSRT.

**Stroop Color and Word Test** (Golden & Freshwater, 2002): To evaluate processing speed, cognitive switching, and inference control we administered this word and color naming task which consists of three conditions: The subject first reads words (word condition), then names colors on a list (color condition), all as quickly as possible. Finally the subject is required to name colors of the ink in which words on a list are printed (color-word condition). This condition is a measure of interference control because participants must ignore the word (i.e., a written name of a color) and instead name the conflicting color of the ink in which the word is printed. It takes approximately five minutes to complete this task.

The raw score for each condition is generated by counting the number of words/items the subject was able to read/name in 45 seconds. These raw scores were then transformed into T-scores (with a mean of 50 and a standard deviation of 10) using age-corrected norms. Higher scores indicate better performance. In the normative sample the reliability coefficients range from 0.71 to 0.88.

**Wisconsin Card Sorting Task – 64** (WCST; Kongs, Thompson, Iverson & Heaton, 2000): This task evaluates cognitive shifting ability, reasoning, and cognitive control and takes approximately 15 minutes to administer. Four “key cards” with symbols are laid out in front of participants. The participant is handed a deck of 64 cards that depict similar symbols and is instructed to match the cards in the deck, one by one, to one of the key cards. The cards are to be matched according to predefined rules that change after the participant has sorted a certain
number of cards correctly. Neither the rules nor the rule changes are revealed to the participant. The only feedback participants are provided is whether their match is correct or incorrect on each trial.

The test generates five main scores, which are highly correlated with each other. The most commonly used measure of performance on the WCST is the total errors made, which is also the measure we used for the present study. The raw number of errors was transformed into age and, when available, education corrected T-scores, with a mean of 50 and a standard deviation of 10. Higher T-Scores are indicative of better performance. Generalizability coefficients for the WCST range between .60 and 85 and average .74, which indicates very good scale reliability.

**Iowa Gambling Task** (IGT; Bechara, 2007): This game-like computerized gambling task evaluates affective decision-making impairments that have been observed in individuals with damage to the medial orbitofrontal cortex and ventromedial prefrontal cortex. It is thought to closely mimic real-life decision-making. Four decks of cards are presented on the screen and subjects are told that each card carries a hypothetical monetary reward and/or penalty. The subject is told that they start the game with a borrowed balance of $2000, which is displayed on the screen above the decks of cards (balance owed). Thus the game starts with $2000 “in the bank”. This balance is also displayed on the screen and changes according to the wins and losses throughout the game. The game is played by selecting a card from any deck, one card at a time. The participant is free to switch decks at any time. Each deck is associated with a specific reward schedule: two of the decks are more advantageous than the others. Task instructions include information that “some decks are better than others” but do not indicate which decks are better or worse. The task consists of 100 trials and lasts approximately 10 minutes.
The most common way to evaluate performance on this task is via the total NET score, which is calculated by subtracting the total number of cards drawn from both disadvantageous decks from the number of cards drawn from both advantageous decks. These raw scores were transformed into age-corrected T-scores with a mean of 50 and a standard deviation of 10. Higher T-Scores are indicative of better performance.

Another score used in our analyses was the number of cards drawn from the deck associated with the most severe, but not the most frequent levels of punishment. We will refer to this deck as “Deck Z”. Although the net loss from the two disadvantageous decks is equivalent, due to their unique reward schedules, neurologically intact individuals perceive the deck with more frequent punishment to be more disadvantageous than Deck Z, and consequently tend to avoid the deck with more frequent punishment. Additionally, Deck Z has relatively high rewards compared to the two advantageous decks, which makes the deck appealing. Many individuals who are tolerant of risk, such as sensation seekers and risk takers, continue to choose from Deck Z. The raw number of cards drawn from this deck was used in analyses, as continuous age-adjusted scores were not available. A high number of cards drawn from this deck is indicative of high risk taking in neurologically intact individuals such as our sample.

The IGT is one of its kind in measuring affective decision-making thus convergent validity is difficult to establish. However, it has also been conceptualized as a test of set-shifting, and correlations to tests of executive functioning are significant for many of the relevant subscales (Bechara, 2007). On the other hand no relationship exists between the IGT and general intellectual ability. This, taken together with extensive clinical studies demonstrating specificity

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1 The deck names used in the IGT have not been identified to preserve test security.
of the IGT in detecting impairments in affective decision-making, suggests that this measure is valid.

**Temporal discounting (TD) task** (de Water, Cillessen, & Scheres, 2014): The preference for immediate rewards was assessed with a computerized temporal discounting task. The task was programmed in E-Prime 2.0 and was modified from its original Dutch-language version that used Euros as the currency, to an English-language version that used U.S. dollars by de Water. The TD task took approximately 5 minutes to complete.

Participants were asked to make repeated choices between a small variable hypothetical monetary reward delivered immediately or a stable, larger hypothetical monetary reward delivered after a delay period. The subjective value (SV) of the delayed reward ($10) could be estimated by varying the amount of the immediate reward and the delay time. Five separate delay intervals (2, 14, 30, 180, and 365 days) were presented and six choices had to be made for each interval. The six choices of each delay interval were presented in blocks, such that the six choices of one interval were always presented in succession. The delay interval blocks were presented in random order for each participant. The first choice always had a reward of $5, and this amount was adjusted on the subsequent choice presentations based on the preference the participant indicated on the previous choice. On the next trial, the amount of the immediate reward was increased by half if the subject chose the delayed reward, and decreased by half if he or she chose the immediate reward.

The SV of the delayed reward was estimated using the amount that would have been presented had there been a seventh choice for each delay interval. The area under the curve (AUC) was the dependent variable used in the analyses, and was calculated via the five SVs using a procedure described by Myerson, Green, & Warusawitharana (2001). The AUC is a
score between 0 and 1, with smaller values indicating a preference for smaller, more immediate rewards.

**Procedures**

Participants completed a single, 1.5-hour session one-on-one with the evaluator. After oral and written consenting procedures were completed, participants were screened to ensure eligibility for the study. As IQ and neuropsychological functioning are highly correlated, to avoid skewed findings screening procedures included an assessment of general intellectual functioning (WASI Matrix Reasoning, see materials section for description). All participants were asked about their medication use and anyone who had taken stimulant medication or atomoxetine the morning of the evaluation would have been rescheduled and asked to abstain from taking this medication (and only this medication) in the 24 hours before study participation. None of the participants in this sample had to be rescheduled for this reason. Participants were also asked their age, if they were fully conversant in English (as all consent documents and neuropsychological tests used in the study were in English) and if they were willing for the PI to access their academic transcript via the College’s electronic database, CUNYFirst.

If participants met eligibility criteria for the study they then completed the demographic, HEMA and DASS questionnaires. Next they completed the six neuropsychological tests. To prevent order effects, administration of the neuropsychological tests took place in six possible orders that were determined via a 6 x 6 Latin Square. Participants were randomly assigned to one of the resulting six orders of administration in a stratified fashion, so that each condition would be equally represented in the sample. Finally, at the end of the semester the PI obtained the participants’ semester GPA.
Statistical Analyses

SPSS version 23 was used for all statistical analyses. Descriptive statistics were obtained for demographic variables, happiness (hedonia and eudaimonia), all of the neuropsychological measures, GPA, and wellbeing (depression, anxiety, and stress). Prior to conducting further analyses, all measures were investigated for normality. Several measures showed evidence of non-normality (z-score of skew and/or kurtosis exceeded an absolute value 1.96): eudaimonia, hedonia, depression, anxiety, stress, Matrix Reasoning raw and T-score, Digit Span Backward scaled score, Stroop color-word raw and T-score, WCTS total error raw and T-score, TD task AUC, and current semester GPA. These variables underwent transformations to correct the skew and/or kurtosis. Logarithmic (to base 10) transformations corrected non-normality in all but five variables: Matrix Reasoning T-score, TD task AUC, WCST raw and T-score. For these variables square root or reciprocal transformation successfully corrected skew and/or kurtosis. If transformations required a reversal of scores (negative skew or reciprocal transform), all variable scores were reversed back into their original directionality. The transformed values were used in all parametric analyses.

Pearson correlations were conducted to assess the relations among the cognitive variables, as well as all of the self-report measures. For cognitive measures for which age norms were available (Digit Span, Stroop, WCST, and IGT NET total), bivariate correlations were carried out using age-adjusted scores (i.e., T-scores or scaled scored). For the variables for which no age-norms were available (SSRT, TD task, IGT Deck Z), partial correlations (controlling for age) were performed using the raw scores of the cognitive measures.

In order to assess the Full Life hypothesis, “happiness groups” (i.e., Full Life, Empty Life, Hedonic Life, and Eudaimonic Life) were created according to Huta and Ryan’s (2009)
method. That is, a median split was applied to both the untransformed hedonia and eudaimonia scales. Individuals for whom both hedonia and eudaimonia scores were above the median were assigned to the Full Life group. People whose scores on both scales were below the median were assigned to the Empty Life group. People were classified as belonging to the Hedonic Life group if their hedonia score was above the median and their eudaimonia score fell below the median. Finally, individuals in the Eudaimonic Life group had a eudaimonia score above the median, but a hedonia score that fell below the median.

To examine happiness as a predictor of educational and emotional outcomes (i.e., GPA and wellbeing), hedonia and eudaimonia were first examined separately, by carrying out Pearson correlations. Then, an Analysis of Variance (ANOVA) was performed to assess the Full Life hypothesis in relation to GPA, and a Multivariate Analysis of Variance (MANOVA) was conducted to determine differences in wellbeing among the happiness groups.

Finally, the neuropsychological correlates of happiness were assessed. First, separate Pearson correlations for each of hedonia and eudaimonia total scores with each neuropsychological measure. Next, a MANOVA was conducted to assess differences among the happiness groups on related “Cool” executive functioning measures (i.e., Digit Span Backwards and Sequencing, Stroop color-word condition, and Stop Signal Task SSRT). Additionally, Analyses of Variance (ANOVAs) were carried out to establish group differences on single measures that showed low correlations with other theoretically related measures (i.e., WCST, TD task) or because they were too highly correlated each other (i.e., IGT Net Total, IGT Deck Z) to render MANOVA inappropriate (Field, 2009).

For all analyses, assumptions inherent to the tests (e.g., normality, equality of variance, equality of covariance matrices) were verified during the analyses. For all significant ANOVAs
and MANOVAs Tukey HSD post hoc tests were conducted where appropriate. Additionally, effect sizes were calculated using $\eta^2$ for ANOVAs and partial $\eta^2$ for MANOVAs.

The wellbeing scale (DASS) was collected from only a partial sample, as it was not implemented until the second semester of data collection. Thus data on depression, anxiety, and stress is only available for 44 participants.

**Results**

**Demographic Descriptive Statistics**

Key demographic variables of our samples are summarized in Table 1. Approximately 87% of undergraduate student participants were enrolled in full-time study. Just over one third of our sample (36.8%) were in their first year of college; 17.1% were in their second year; 25% were in their third year; 14.5% were in their fourth year; and 6.5% had been in college for more than four years. The mean (SD) end of semester GPA was 2.97 (0.75) (equivalent to a B letter grade), ranged from 0.86 to 4.00; the distribution was negatively skewed.

More than half of the participants in our sample (52.6%) reported household incomes of less than $40,000, yet 13.2% placed themselves in the >$100,000 category. The vast majority of students (85.5%) lived in households with two or more bedrooms, and the mean (SD) number of individuals living at their residence was 4.26 (1.38).
Table 1. *Demographic variables of participants overall and among happiness groups*

<table>
<thead>
<tr>
<th></th>
<th>Total (n = 76)</th>
<th>Full Life (n = 24)</th>
<th>Eudaimonic Life (n = 16)</th>
<th>Hedonic Life (n = 19)</th>
<th>Empty Life (n = 17)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>21.17</td>
<td>21.06</td>
<td>21.84</td>
<td>20.75</td>
<td>21.17</td>
</tr>
<tr>
<td></td>
<td>3.12</td>
<td>2.93</td>
<td>4.03</td>
<td>2.81</td>
<td>2.92</td>
</tr>
<tr>
<td>GPA</td>
<td>2.97</td>
<td>3.04</td>
<td>3.35</td>
<td>2.89</td>
<td>2.61</td>
</tr>
<tr>
<td></td>
<td>0.75</td>
<td>0.68</td>
<td>0.53</td>
<td>0.90</td>
<td>0.72</td>
</tr>
<tr>
<td>MR T-Score</td>
<td>51.68</td>
<td>50.04</td>
<td>52.07</td>
<td>52.89</td>
<td>52.31</td>
</tr>
<tr>
<td></td>
<td>7.08</td>
<td>8.04</td>
<td>7.96</td>
<td>6.39</td>
<td>5.50</td>
</tr>
<tr>
<td><strong>N %</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>52 68.4</td>
<td>17 70.8</td>
<td>13 81.3</td>
<td>13 68.4</td>
<td>9 52.9</td>
</tr>
<tr>
<td>Handedness (right)</td>
<td>71 93.4</td>
<td>23 95.8</td>
<td>16 100</td>
<td>16 84.2</td>
<td>16 94.1</td>
</tr>
<tr>
<td>Hispanic or Latino</td>
<td>29 38.2</td>
<td>13 54.2</td>
<td>5 31.3</td>
<td>3 15.8</td>
<td>8 47.1</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>23 30.3</td>
<td>6 25</td>
<td>4 25</td>
<td>10 52.6</td>
<td>3 17.6</td>
</tr>
<tr>
<td>Black/African American</td>
<td>12 15.8</td>
<td>3 12.5</td>
<td>1 6.3</td>
<td>3 15.8</td>
<td>5 29.4</td>
</tr>
<tr>
<td>White</td>
<td>14 18.4</td>
<td>4 16.7</td>
<td>4 25</td>
<td>3 15.8</td>
<td>3 17.6</td>
</tr>
<tr>
<td>Other</td>
<td>27 35.5</td>
<td>11 45.8</td>
<td>7 43.8</td>
<td>3 15.8</td>
<td>6 35.3</td>
</tr>
<tr>
<td>Bedrooms per household</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Studio</td>
<td>1 1.3</td>
<td>1 4.2</td>
<td>0 0</td>
<td>0 0</td>
<td>0 0</td>
</tr>
</tbody>
</table>
Happiness based on the 7-point Likert scale, mean (SD) hedonia in the overall sample was 5.20 (1.07) and mean (SD) eudaimonia was 5.80 (0.93). Hedonia and eudaimonia were not significantly correlated with each other, $r = .19, p = .11$. This was expected as the questionnaire was developed specifically to distinguish hedonia from eudaimonia, and correlations of similar magnitude have been reported in previous studies utilizing this questionnaire (e.g., Huta & Ryan, 2009).

Age was significantly associated with hedonia, $r = -.26, p < .05$, such that younger students tended to rate themselves higher on the hedonia items of the HEMA questionnaire. Although this finding differs from Huta and Ryan (2009) who found that age was not related to

### Household income

<table>
<thead>
<tr>
<th>Household income</th>
<th>One</th>
<th>Two</th>
<th>Three</th>
<th>Four or more</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
<td>27</td>
<td>25</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>13.2</td>
<td>35.5</td>
<td>32.9</td>
<td>17.1</td>
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<td></td>
<td>6</td>
<td>9</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>37.5</td>
<td>20.8</td>
<td>12.5</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>4</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>12.5</td>
<td>25</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>25</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>10.5</td>
<td>31.6</td>
<td>26.3</td>
<td>31.6</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>8</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>47.1</td>
<td>35.3</td>
<td>17.6</td>
</tr>
</tbody>
</table>

N = frequency; SD = standard deviation; GPA = Grade Point Average; MR = Matrix Reasoning
hedonia, in our sample the magnitude of the association is weak, as demonstrated by the small effect size. Consistent with Huta and Ryan (2009), eudaimonia was not significantly correlated to age.

Using a median split of both scales generated four HEMA groups; 24 individuals (31.6%) fell into the Full Life group (scores above the median on both hedonia and eudaimonia scales), 16 (21.1%) into the Eudaimonia Life group (scores above the median in eudaimonia, but below the median in hedonia), 19 (25.0%) into the Hedonic Life group (scores below the median in eudaimonia, but above the median in hedonia), and 17 (22.4%) fell into the Empty Life group (scores below the median in both hedonia and eudaimonia scales). These proportions are generally comparable to previous studies using the HEMA measure to generate these groups in a college sample (Huta & Ryan, 2009).

**Depression, Anxiety, and Stress**

Depression, anxiety and stress are displayed in Figure 1 according to severity classifications for each measure (Lovibond & Lovibond, 1995). Most of our sample fell within the normal range for depression, anxiety, and stress (63.6%, 56.8% and 65.9% respectively), although a notable number of students scored in the severe or extremely severe ranges for depression (18.15%), anxiety (11.4%), and stress (9.1%). There were significant positive relations among the DASS scales, such that individuals who scored higher on one scale also tended to score higher on the other two scales. Moderate effect sizes were observed in the relations between depression and anxiety ($r = .43, p < .01$) and depression and stress ($rs = .44, p < .01$). The relation between anxiety and stress was also of large magnitude ($r = .62, p < .001$).
Figure 1. Frequency (%) of participants with scores in each severity classification for depression, anxiety, and stress as measured by the DASS.

Neuropsychological Measures

Mean scores and standard deviations of the cognitive variables are displayed in Table 2. Age and, when available, education corrected scores are reported (T-scores or scaled scored), and for tests (and/or subscores) where such norms were not available (e.g., stop signal and temporal discounting tasks), raw scores are reported. Overall, mean standardized scores were close to the normative means (i.e., 10 for scaled scores, and 50 for T-scores), indicating that the tests were administered correctly.

Recall that for some tests, no age-norms were available. The mean (SD) Stop Signal Reaction Time (SSRT) across participants in our sample was 262.58 (41.10) ms. This is a somewhat higher mean compared to another college-aged sample (n=99), which performed the same task and had a mean (SD) SSRT of 218.10 (58.76) (Shuster & Toplak, 2009), indicating
slower reaction times on average for our sample. This may be accounted for by the slightly different procedure used to calculate SSRT in the present study (see Methods).

On the temporal discounting task, the mean (SD) of the area under the curve (AUC) was 0.33 (0.27) for our sample. This is approximately one half standard deviation below that obtained by Dutch investigators with their college sample using a Dutch version of the task [mean (SD) = 0.49 (0.29)] (de Water et al., 2014). The lower AUC observed among our sample indicates preference for more immediate rewards.

Pearson correlations were carried out among the cognitive measures for which normed scores (T-scores, scaled scores, or standard scores) were available. Measures for which normed scores did not exist were correlated with the raw scores of all the other measures, controlling for age.

Correlations among subscores of the Digit Span subtest of the WAIS-IV, the Stroop Color and Word test, and Wisconsin Card Sorting Test, and the Iowa Gambling test were in line with the expected relations that are outlined in the respective interpretative manuals (Wechsler, 2008; Golden & Freshwater, 2002; Kongs et al., 2000; Bechara, 2007).
Table 2. Means and standard deviations for scores on tests of neuropsychological functioning

<table>
<thead>
<tr>
<th>Variable (type of score)</th>
<th>Total n = 76</th>
<th>Full Life n = 24</th>
<th>Eudaimonic Life n = 16</th>
<th>Hedonic Life n = 19</th>
<th>Empty Life n = 17</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>DSF (SS)</td>
<td>9.78</td>
<td>2.98</td>
<td>9.33</td>
<td>3.61</td>
<td>9.94</td>
</tr>
<tr>
<td>DSB (SS)</td>
<td>10.70</td>
<td>2.80</td>
<td>10.21</td>
<td>3.51</td>
<td>10.75</td>
</tr>
<tr>
<td>DSS (SS)</td>
<td>10.72</td>
<td>3.07</td>
<td>9.75</td>
<td>3.08</td>
<td>10.81</td>
</tr>
<tr>
<td>Stroop Word (T)</td>
<td>43.70</td>
<td>11.00</td>
<td>42.29</td>
<td>10.61</td>
<td>45.56</td>
</tr>
<tr>
<td>Stroop Color (T)</td>
<td>45.18</td>
<td>10.62</td>
<td>45.25</td>
<td>11.33</td>
<td>45.44</td>
</tr>
<tr>
<td>Stroop C/W (T)</td>
<td>49.91</td>
<td>9.63</td>
<td>47.42</td>
<td>9.41</td>
<td>51.50</td>
</tr>
<tr>
<td>SSRT</td>
<td>262.58</td>
<td>41.05</td>
<td>279.32</td>
<td>45.29</td>
<td>254.76</td>
</tr>
<tr>
<td>WCST TE (T)</td>
<td>52.56</td>
<td>9.89</td>
<td>52.32</td>
<td>7.34</td>
<td>52.71</td>
</tr>
<tr>
<td>IGT Total NET(T)</td>
<td>44.83</td>
<td>8.71</td>
<td>41.79</td>
<td>9.46</td>
<td>46.38</td>
</tr>
<tr>
<td>IGT Deck Z (raw)</td>
<td>30.75</td>
<td>11.10</td>
<td>35.00</td>
<td>11.79</td>
<td>27.44</td>
</tr>
<tr>
<td>TDT AUC (raw)</td>
<td>0.33</td>
<td>0.28</td>
<td>0.38</td>
<td>0.30</td>
<td>0.46</td>
</tr>
</tbody>
</table>

SD = standard Deviation; SS = scaled score; T = T-score; DSF/DSB/DSS = Wechsler Adult Intelligence Scale IV, Digit Span Forward/Backward/Sequencing; C/W = Color-Word; SSRT = Stop Signal Reaction Time; WCST TE = Wisconsin Card Sorting Test, total errors; IGT = Iowa Gambling Task; TDT AUC = Temporal Discounting Task, Area under the Curve
Based on the correlations among the cognitive measures and the conceptual framework of the various tests, the measures can be divided into non-executive and executive elements. Digit Span forward and the Stroop Color condition could be conceptualized as a non-executive measures \( r = .26, p < .05 \); with better immediate verbal memory and attention associated with faster processing speed. Digit Span Backward and Sequencing, along with the Stroop Color-Word condition, and the SSRT are commonly used measures of executive functioning (working memory, interference control and inhibitory control respectively). Among our sample, significant positive associations were observed between Digit Span backward and sequencing \( r = .44, p < .001 \), between Digit Span sequencing and the Stroop color-word condition \( r = .33, p < .01 \), and the Stroop color-word condition and SSRT \( r = .30, p < .01 \).

Surprisingly, the WCST was not significantly associated with any of the other cognitive tests, expect for Digit Span Forward \( r = .30, p < .05 \). Similarly, the temporal discounting task showed no significant relations with any of the other neuropsychological measures.

As previous research has demonstrated cognition is associated with emotional wellbeing (i.e., depression, anxiety and stress) (Airaksinen, Larsson, & Forsell, 2005; Lempert, Porcelli, Delgado, & Tricomi, 2012; Zakzanis, Leach, & Kaplan, 1998), the relationship between our cognitive measures and the DASS scales was assessed. None of the wellbeing scales correlated significantly with any of the neuropsychological measures.

**Happiness as a Predictor of Academic and Wellbeing Outcomes**

**Happiness and academic success.**

The present study investigated whether academic success, as defined by end of semester GPA, is related to our happiness indices. As predicted, eudaimonia was significantly correlated with GPA, \( r = .26, p < .05 \), which is a small effect. Individuals who scored higher on eudaimonia
tended to have higher GPAs. No significant relation was observed between hedonia and GPA ($p > .25$). A one-way ANOVA revealed that the four happiness groups differed significantly from each other on GPA, $F(3, 72) = 3.37, p = .023, \eta^2 = .12$, a medium to large effect. Tukey’s post-hoc test revealed that the Eudaimonic Life mean GPA of 3.35 was significantly higher compared to the Empty Life group mean GPA of 2.61 ($p < .05$). None of the other groups differed significantly from each other, including the Eudaimonic and Full life groups. Figure 2 displays mean GPAs for the happiness groups.

![Figure 2](image)

*Figure 2. Mean (± 1 SE) GPA by happiness groups.*

**Happiness and wellbeing.**

Correlations among the self-report scales are displayed in Table 3. There was a significant negative correlation between eudaimonia and depression ($r = -.32, p < .05$), whereas the correlation between hedonia and depression was non-significant ($p = .22$). There are no significant associations between hedonia or eudaimonia and anxiety or stress (all $p > .10$).
Table 3. *Pearson correlations among hedonia, eudaimonia, depression, anxiety, and stress*

<table>
<thead>
<tr>
<th></th>
<th>HEMA</th>
<th>DASS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hedonia</td>
<td>Eudaimonia</td>
</tr>
<tr>
<td>Depression</td>
<td>-.19</td>
<td>-.32*</td>
</tr>
<tr>
<td>Anxiety</td>
<td>.03</td>
<td>.10</td>
</tr>
<tr>
<td>Stress</td>
<td>.05</td>
<td>-.01</td>
</tr>
</tbody>
</table>

** p < .001, two tailed; *p < .05, two tailed.
Note: all correlations in this table were based on logarithmic transformation of the scores
HEMA = Hedonic Eudaimonic Motives for Action Scale
DASS = Depression Anxiety and Stress Scale.

Mean depression, anxiety, and stress among the four happiness groups are displayed in Figure 3. To assess whether the happiness groups differed in wellbeing (i.e. depression anxiety and stress), a MANOVA was performed entering the three DASS subscales as dependent variables. The overall model was significant and had a large effect size, V = .41, F = 2.12, p < .05, partial \( \eta^2 = .14 \). However, univariate ANOVAs on the individual scales were not significant (p = .09 -.84), which suggests that that wellbeing as a whole differed meaningfully among groups, rather than any one distress variable by itself.

As the overall MANOVA model was significant, we performed a discriminant function analysis to further examine the interactions in the wellbeing variables and how they differ among the four groups (Field, 2009). Three discriminant functions were revealed: the first explained 87.7% of the variance, canonical \( R^2 = .34 \); the second explained 12.1% of the variance, canonical \( R^2 = .07 \); and the third was very small explaining only 0.2% of the variance. These discriminant functions, in combination, significantly differentiated the groups, \( \Lambda = .61, \chi^2(9) = 19.38, p < .05 \), but removing the first function indicated that the second through third functions did not
significantly differentiate groups, \( \Lambda = .93, \chi^2(4) = 2.79, p > .05 \). Due to the third function’s minimal variance contribution to the model, and because the outcomes load similarly onto this function \( (r = .76 -.91) \) only the first two functions will be discussed in more detail. The correlations between outcomes and the discriminant factors revealed that depression loaded more highly to the first function \( (r = .57) \) than the second \( (r = .33) \). Anxiety also loaded more highly on the first function \( (r = -.34) \) than the second function \( (r = .22) \). Stress on the other hand loaded more highly only on the second function \( (r = -.52) \) than the first function \( (r = .02) \). The discriminant function plot showed that the first function (depression and anxiety loaded in opposite directions) discriminated the Full Life and Eudaimonic life groups from the Empty Life group, with the Hedonic Life assuming an intermediate position. The second function (stress loaded in opposite direction compared to depression and anxiety) discriminated the Eudaimonic Life from the Full Life group, with the other two groups showing only minimal differentiation on the second function, and showing no effect on the second function.

*Figure 3.* Mean (± 1 SE) depression, anxiety, and stress score by happiness group.
Neuropsychological Correlates of Happiness

Associations among hedonia and eudaimonia and the neuropsychological tests of interest are displayed in Table 4.

Executive functioning.

Contrary to our prediction, there was no relation between eudaimonia and any individual DLPFC-mediated executive functioning measure. Raw scores of the WAIS-IV Digit Span Backwards and Sequencing, along with the Stroop Color-Word condition and the Stop Signal Task SSRT were entered into a MANOVA, with age as a covariate. Per Pillai’s Trace there were no differences in executive functioning between the HEMA groups, $V = .18, F(12, 204) = 1.10, p > .05$, partial $\eta^2 = .04$.

There were no significant associations between hedonia and our executive measures, although the relation with digit span backward had a small to medium effect size that was non-significant ($r = -.22, p = .06$). The relations is in the expected direction as individuals who are higher in hedonia tended to score worse on the digit span backward.

Cognitive flexibility.

A one-way between subjects ANOVA was carried out with WSCT Total Errors T-score as the dependent variable and Happiness groups as the independent variable. The overall model was not significant; no differences in total errors among happiness groups was observed, $F(3, 64) = .113, p > .05, \eta^2 = .01$. 
Table 4. *Associations among happiness and neuropsychological measures*

<table>
<thead>
<tr>
<th></th>
<th>MR, T</th>
<th>DSF, SS</th>
<th>DSB, SS</th>
<th>DSS, SS</th>
<th>Stroop Word, T</th>
<th>Stroop Color, T</th>
<th>Stroop C/W, T (log)</th>
<th>WCST TE, T</th>
<th>SSRT, T (sqrt)</th>
<th>IGT Deck Z, raw</th>
<th>TDT AUC, (sqrt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hedonia (log)</td>
<td>-0.08</td>
<td>-0.06</td>
<td>-0.22</td>
<td>-0.14</td>
<td>-0.06</td>
<td>0.05</td>
<td>-0.07</td>
<td>0.04</td>
<td>0.05</td>
<td>-0.16</td>
<td>0.14</td>
</tr>
<tr>
<td>Eudaimonia (log)</td>
<td>-0.13</td>
<td>-0.11</td>
<td>-0.14</td>
<td>-0.13</td>
<td>0.09</td>
<td>0.10</td>
<td>-0.00</td>
<td>-0.09</td>
<td>0.10</td>
<td>-0.13</td>
<td>0.10</td>
</tr>
</tbody>
</table>

SS = scaled score; T = T-score; sqrt = square root transformed; log = log (to base 10) transformed
DSF/DSB/DSS = Wechsler Adult Intelligence Scale IV, Digit Span Forward/Backward/Sequencing; C/W = Color-Word; SSRT = Stop Signal Reaction Time; WCST TE = Wisconsin Card Sorting Test, total errors; IGT = Iowa Gambling Task; TDT AUC = Temporal Discounting Task, Area under the Curve
**Affective decision-making.**

There was no significant relation between hedonia or eudaimonia and performance on either of our measures of interest in the IGT, that is, net advantageous cards drawn (IGT Total NET) and number of cards drawn from the high punishment deck (IGT Deck Z) \((rs = -.14 - .17, \text{all } p > .15)\). However, there was a positive yet non-significant relations with a small effect size between temporal discounting and eudaimonia, controlling for age, such that individuals lower in eudaimonia preferred more immediate results \((r = .20, p = .08)\).

As each of our scores of interest on the IGT provides a unique perspective on performance and affective decision-making on this test, two separate analyses were conducted. Due to their high correlation \((r = -.91)\), a MANOVA would have been inappropriate (Field, 2009). A one-way between subjects ANOVA was carried out with total NET T-scores on the IGT as the dependent variable and happiness group as the independent variable. Total NET T-score, which is measure of overall performance on this test, did not differ significantly among groups, \(F(3, 72) = 1.60, p > .05, \eta^2 = .06\). However, a 1-way ANCOVA, with the Deck Z score as the dependent variable and happiness group as the independent variable, covarying for age, was non-significant but had a medium to large effect size \((F(3, 72) = 2.60, p = .06, \eta^2 = .10)\). That is, there was a trend for the mean number of cards drawn from Deck Z to differ among groups. Participants in the Full Life group tended to draw *more* cards than the Hedonic Life group from this deck. These group differences are not in the expected direction, as individuals living the Full Life performed *worse* than the other groups. Group means are displayed in Figure 4.
As the TDT stood alone in its relations with the rest of the measures, a one-way ANCOVA, with age as a covariate, was conducted to test whether a difference existed among groups. The overall model was significant, $F(3, 72) = 3.17, p = .03, \eta^2 = .12$. Tukey’s post hoc tests revealed that the Hedonic Life group differed significantly from the Eudaimonic Life group ($p < .05$). Individuals living the Hedonic Life had a stronger preference for earlier, smaller rewards compared to individuals living the Eudaimonic Life. Full Life and Eudaimonic Life individuals did not differ significantly (see Figure 5).
The current study had two aims. First, to assess to what extent happiness was associated with positive life outcomes; that is, academic success (as measured using end of semester GPA) and wellbeing (depression, anxiety, and stress) in urban college students. Specifically, both unique and combined effects of hedonic and eudaimonic motives on all outcomes were examined. Combined effects of hedonia and eudaimonia on academic achievement and wellbeing were assessed by separating the sample into four happiness groups that varied in levels of hedonic and eudaimonic motives: the Full Life, the Eudaimonic Life, the Hedonic Life, and the Empty Life. The second aim of the study was to investigate the neuropsychological correlates of these happiness constructs to gain a better understanding of their underpinnings.

It was predicted that GPA would be positively associated with eudaimonic motives and that the Full Life group would have the highest GPA. Results showed that, indeed, eudaimonia
was a predictor of GPA, while hedonia was not. However, the prediction that the Full Life groups would have the highest GPA was incorrect. In fact, the Eudaimonic Life had the highest GPA (group mean was equivalent to a B+). However, their GPA did not differ significantly from the Full Life group, which had a mean equivalent to a B letter grade. This suggests that, as predicted, high levels of hedonic motives in the presence of simultaneous high eudaimonic motives may not necessarily diminish the positive effect of eudaimonia on academic success, and perhaps also other life success factors. Hedonic motives may thus indeed add a balancing, perhaps distress-reducing effect to an otherwise eudaimonically-oriented life, but does so without significantly affecting success outcomes.

This finding adds to the literature because in prior work, happiness has been characterized as a concept with no direct relation to scholastic success and has even been used as a discriminant validation factor in the development of the widely used, and earlier described, subjective wellbeing questionnaire (Lyubomirsky & Lepper, 1999). A more nuanced approach, however, that takes into account students’ happiness-related motivations behind their daily activities may provide a more robust perspective for connecting happiness with academic achievement. Our results show that parsing happiness into its hedonic and eudaimonic components, and taking into account the integration of these constructs helps provide a clearer understanding of the association between happiness and academic success. The finding from the current study is supported by Okun and colleagues (2009) who used structural equation modeling to show that commitment to college mediated the relation between dispositional happiness and GPA. Furthermore, goal striving was also positively correlated to both dispositional happiness and GPA, although this mediation was non-significant (p < .06) (Okun, Levy, Karoly, & Ruehlman, 2009). The striving for excellence and the desire to develop the best in oneself that eudaimonic motives encompass, may be reflected in goal striving and commitment to college.
In addition to academic success, wellbeing as an outcome of our happiness constructs was also evaluated, and it was predicted that both high hedonic and eudaimonic motives would be associated with low depression, anxiety, and stress. Our results demonstrated that in our sample, higher eudaimonia, but not hedonia was associated with lower depression. This finding is in line with a study by Telzer et al. (2014), which showed that neural sensitivity to eudaimonic and hedonic rewards differentially predicted adolescent depressive symptoms over time, such that individuals who have greater ventromedial activity in response to eudaimonic decisions are more likely to have a decline in depressive symptoms over time (Telzer, Fuligni, Lieberman, & Galvan, 2014). With ventromedial activity having been previously associated with reward processing, it is possible that eudaimonic decisions have to feel rewarding in order to gain the beneficial effects on depression.

On the other hand, our finding is contrary to a study by Henderson et al. (2013), where hedonia, but not eudaimonia, was negatively associated with depression. Their sample consisted of community dwelling adults, however, which may benefit from different happiness motives. With college life being associated with the pressure to succeed, individuals with high eudaimonic motives may thus be in advantage; as our data show, eudaimonia is associated with academic success and therefore with the ability to achieve the goal of undergraduate study. Of note is also that neither of the happiness scales was significantly associated with anxiety or stress in our study, while Henderson et al. (2013) found a significant negative association between hedonia and stress. Thus it is possible that hedonia may not exert a protective effect on stress in college, but that eudaimonia is more important in an academic environment for wellbeing.

It was also predicted that wellbeing, specifically the psychological distress variables of depression, anxiety, and stress, would differ among happiness groups, and that compared to other groups, the Full Life would be associated with the best wellbeing outcomes (i.e., lowest
depression, anxiety, and stress). The groups differed significantly in wellbeing, and Full Life individuals may indeed garner the most benefit. Depression levels were lowest in this group, and anxiety levels were not as high as in the Eudaimonic Life group, but instead comparable to the Hedonic Life group. The discriminant function analysis showed that close to 90% of variance among groups is accounted for by differences in depression and anxiety. Specifically, depression and anxiety trends among the groups follow the opposite direction: there is an increasing trend in depression from the Full, to the Eudaimonic, Hedonic and Empty Life group (see blue bars in Figure 3) but the opposite trend emerges for anxiety, as it “increases” from the Empty Life, to the Hedonic and Eudaimonic Life. Based on this statistical pattern in the data, we may have expected the highest anxiety levels among the Full Life group, but this is not what we observed (see red bars in Figure 3), as the Eudaimonic Life group has the highest levels of anxiety. It is possible that high hedonia in Full Life individuals mitigates anxiety.

Almost all of the remaining variance (approximately 10%) is explained by differences in stress and distinguishes the Eudaimonic Life from the Full Life, in that the Full Life displays more stress. The magnitude of the differences in anxiety and stress is quite small and therefore difficult to interpret, but the overall model suggests that simultaneous high hedonic and eudaimonic motives (i.e., the Full Life), may be protective of depression and anxiety, but not necessarily of stress in the college population. Few other studies have investigated these distress constructs in combination in relation to hedonic and eudaimonic motives specifically, which brings us back to the multifaceted nature of wellbeing. This study only investigated psychological distress, which is merely a small aspect of global wellbeing. Peterson et al. (2005) looked at satisfaction with life, which is another aspect of wellbeing. They found that simultaneous pursuit of pleasure (hedonia), meaning (eudaimonia), and engagement (flow) (measured via the Orientations to Happiness Scale) was associated with the highest degree of life
satisfaction. Furthermore, Huta and Ryan (2009) in their validation study of the HEMA questionnaire, which was also utilized to assess hedonia and eudaimonia in the present study, demonstrated that among the four happiness groupings, individuals living the Full Life were highest in positive affect, life meaning, elevating experience, and vitality. Specifically, they found that Full Life individuals differed significantly from Empty Life individuals in these constructs. In light of the complexity of wellbeing as a construct, future studies should strive to look at hedonia and eudaimonia in association with a comprehensive assessment of wellbeing that incorporates psychological, physical, social, spiritual and economic wellbeing factors.

Next, we looked at the neuropsychological correlates of our happiness constructs and hypothesized that eudaimonic motives would be positively associated with DLPFC-mediated executive functions. Contrary to the prediction there were no notable associations between these “cool” executive functioning measures and eudaimonia. Furthermore, there were no differences in performance in “cool” executive functioning, including cognitive flexibility, across the different happiness groups. There are several explanations for these findings. First, the happiness constructs under investigation in this study were measured in terms of motives rather than behaviors. An individual’s hedonic and eudaimonic motives may not necessarily reflect this person’s behavior, and we cannot dismiss the possibility that had hedonic and eudaimonic behaviors been measured, there may have been an association with “cool” executive functioning. Future studies should consider this possibility. It is also possible that the measures we selected were not sensitive to the cognitive functions relevant to living a Full Life. The literature we based our hypotheses on investigated constructs that incorporate both cognitive and motivational factors, including self-control, which incorporates the idea of emotional regulation in Cheung et al.’s (2014) study, imagining goal attainment and inhibition (Katzir, Eyal, Meiran, & Kessler, 2010), and working memory for positive information (Pe, Koval, & Kuppens, 2013). While all of
these have executive components to them, the construct under investigation is either inherently coupled with motivation, which has affective underpinnings (i.e. self-control) or is coupled with an action that incorporates affective components (i.e. goal attainment, positive information). It is therefore possible that the executive functioning differences only become apparent when associated with affective and/or motivational factors. This suggests that it is the interaction between affective and executive factors that matters, rather than executive alone. As described earlier, the “cool” executive functions regulate the “hot” executive functions. A functional MRI study by Heller et al. (2013) looking at the neural correlates of eudaimonia supports this idea. They found eudaimonic wellbeing predicted sustained activity in both the right striatal (part of the reward network) and dorsolateral prefrontal cortexes (part of the executive circuitry).

This leads us into our measures of OFC-mediated executive functions, or affective decision-making, which inherently incorporate both affective and cognitive factors. We investigated affective decision-making on two levels: risk taking and temporal discounting. Contrary to our prediction, hedonic motives were not associated with performance on these tasks. To understand this finding we can take a closer look at what exactly the Iowa Gambling Task measures. It involves affective decision-making in terms of choosing between risky and less risky options in a game format. It has been associated with orbitofrontal recruitment (Bechara, 2007) which is part of the reward network, but it has also been shown to be associated with tests of executive functioning on previous studies, such as the WCST and the Tower of Hanoi. While our study also utilized the WCST and did not find such associations, we did find a relation with the Stroop Color-Word condition ($r = .33, p < .01$). This could indicate that the affective reasoning skills required for decision-making on the IGT involve abstract reasoning as well. Arguably, there is a notable executive component to decision-making on the IGT (Kongs et al., 2000).
While there were no significant associations between hedonic or eudaimonic motives and performance on the IGT, and also no group differences in the total NET score of the IGT (a summary performance score across all trials and all decks), an interesting, yet unexpected trend emerged for the number of cards drawn from Deck Z. This deck is characterized by being disadvantageous, but with an overall high chance for large rewards (compared to the advantageous decks) and with infrequent, large punishments. Deck Z may therefore be an especially good indicator of the amount of risk an individual is willing to take and our results showed that Full Life individuals were the most likely to draw from this deck. This suggests that individuals living the Full Life tended to make less favorable decisions in the IGT and were more likely to take the risk of a “big loss” for the hope of a “big win” in the game. As group differences exist between both the Hedonic Life group (lower eudaimonia compared to the Full Life) and the Eudaimonic Life group (lower hedonia compared to the Full Life), the group differences do not appear to be driven by hedonia or eudaimonia alone, but rather by the combination of high hedonia with high eudaimonia.

Individuals living the Full Life were willing to task risks, which in real life may not be maladaptive or necessarily lead to less successful life outcomes. A careful assessment of the severity of risk is necessary, and in this game scenario in a lab setting, to normally functioning individuals, the gambling losses do not carry a very high risk and interpreting such “risky” decisions to be adaptive in this context is plausible. Further research should investigate whether assessment of risk across various circumstances is adaptive in Full Life individuals. Interestingly, Cheung et al.’s (2014) study on happiness and self-control may be interpreted as in support of our findings. They found that an approach-oriented style more greatly influenced the connection between high trait self-control and happiness, compared to prevention-focus, a regulatory style that primarily avoids losses (Cheung et al., 2014). Frequently drawing cards from Deck Z, which
assumes a degree of risk, could be interpreted as an approach-oriented style. As Cheung et al. demonstrated, such an approach might be adaptive when coupled with self-control, leading to adaptive outcomes (happiness in Cheung’s case). Future research should investigate the interaction between the Full Life, risk taking, and positive outcomes. Our findings must however be treated with caution as they were not significant by standard convention.

Our other measure of affective decision-making was temporal discounting, or delaying gratification, and we hypothesized that hedonic motives would be negatively associated with performance on this task, so those high in hedonia would prefer more immediate rewards. Our result did not confirm our prediction, but instead we found a trend for an association between eudaimonic motives and temporal discounting. This finding may also be related to an interaction between “cool” and “hot” executive functioning. For example, striving for excellence is associated with a delay in reward, such as in studying for an exam. Consistent with this finding, we demonstrated that there was a significant difference between the Eudaimonic and Hedonic life group, such that individuals living the Hedonic Life (low in eudaimonia) were more likely to prefer immediate rewards. The differences among the groups seem to be driven by eudaimonia, but it is notable that the Full Life does not significantly differ from the Eudaimonic life in their discounting rate, meaning that high hedonia in the presence of eudaimonia does not meaningfully impact temporal discounting. This is consistent with our hypothesis.

Although both risk discounting (as in the IGT) and temporal discounting can be conceptualized as affective decision-making, both our results and those of de Water et al. (2014) have shown that performance on tasks measuring these processes are not correlated. One of the reasons for this may be that different neural circuits are associated with these processes. There is some evidence to suggest this. As outlined above, risk discounting has been found to be related to orbitofrontal activity, but choosing to delay an immediate reward for a larger future reward
has been associated with insular cortex activity (Wittmann, Leland, & Paulus, 2007). Interestingly, cortical thickness in the same area has recently been shown to be associated with eudaimonia (measured via the Psychological Wellbeing scale) (Lewis, Kanai, Rees, & Bates, 2014), which, taken together with Wittmann et al.’s study, supports our finding of a correlation between temporal discounting and eudaimonia.

There are several limitations to this study that warrant discussion. First, this study is correlational and any conclusions about potential causality should be made with caution. While we defined academic success and wellbeing (i.e., levels of depression, anxiety and stress) as our outcomes of hedonic and eudaimonic motives, it is possible that such motives result from academic success and wellbeing. However, there are reasons to suggest that it was the happiness-related motives that exerted an effect on our outcomes. First, our happiness measure was phrased to assess trait-like, or longstanding, motives for action and GPA was not collected until the end of the semester, which provides support that happiness exerted an effect on GPA and not vice versa. Also, the fact that the HEMA scale asks how participants generally approach their daily activities, while the DASS asks about symptoms within the past week, provides conceptual support for the general (hedonic and eudaimonic motives) having an influence on the current (depression, anxiety, and stress).

Furthermore, caution must be employed in concluding that eudaimonia predicts academic success, as it cannot be fully quantified via the GPA of only one semester. College retention and graduation GPA would have been more comprehensive measures of academic success, however this was outside the scope of this study. Future research should integrate measures of hedonia and eudaimonia in the prediction of scholastic achievement. Furthermore, not all participants attended college full time, thus GPA was not based on the same amount of classes across the sample. We consider this to be less of an issue, however, as 71 participants out of our sample of
76 were enrolled at least ¾ time (66 were full time), which means that GPA was calculated based on at least 3 classes for the majority of our sample.

Although it was demonstrated that eudaimonic motives are significantly associated with academic success it is unclear to what extent this example of “life success” may translate to other areas of life or whether it is applicable to life outside of college. Thus the generalizability of findings is limited. Future studies should therefore look at other common life success indexes such as health, income, altruistic behaviors, and employment, and in other populations, such as young and mid-adulthood when career achievement while maintaining adequate wellbeing, is of particular importance.

Another important limitation of this study is the sample size. For our measure of depression, anxiety, and stress we only collected data from 44 students; nevertheless we found a significant effect of happiness-related motives on depression. It is possible that this effect will increase with a larger sample, but we must still be cautious in interpreting the results.

It should also be re-emphasized that our measure of hedonia and eudaimonia is assessing motives for action rather than hedonic and eudaimonic behaviors. It is arguable that motives alone do not lead to outcomes, but rather that behaviors exert an effect on outcomes. While motives are certainly an integral part of actions, there are other factors that influence what individuals do despite their intentions. Such extraneous factors may include life circumstances, influence of other people, and illness, just to name a few. Nevertheless hedonic and eudaimonic motives are likely correlated to the amount of time spent engaging in behaviors mirroring hedonic and eudaimonic pursuits. Future studies should measure both motives and behaviors and relate them to outcomes, so that the relation between the two in the realm of these happiness constructs can be established, and to determine to what extent behaviors relate to the outcomes.
We also have to take into consideration the circumstances under which our participants completed the questionnaires. In particular, the questions about eudaimonic motives for activities may have triggered a desirability effect, such that rather than stating their true intentions, some student may have rated their eudaimonic motives as higher than they would have had data collection been done outside the lab environment where a test administrator is not present in the room during the completion of the questionnaire. Future studies should consider establishing a sense of anonymity when participants fill out this measure, such as using an electronic format.

**Conclusion**

Despite these limitations this study still contributes to the literature and several strengths should be pointed out. First, this study used objective measures of academic success (i.e., GPA derived from academic records) and of neuropsychological functioning, while self-report is the norm in this area of research. Furthermore, the sample is culturally and ethnically diverse, with similar proportions of Caucasian, African American or Black, and Asian individuals. This allows for more generalizable conclusions of the applicability of the findings as many studies of this kind are conducted at universities with a predominantly Caucasian population.

Overall, we found that parsing happiness into eudaimonic and hedonic motives and using them independently and jointly as predictors of positive life outcomes can provide a glimpse into how happiness - in our specific case, happiness-related motives for actions - may exert an effect on success. This study also found that looking at the neuropsychological correlates of eudaimonia and hedonia might further elucidate this complex relation.

In light of both individual and broader societal gains that happiness may engender, understanding the factors that increase hedonic and eudaimonic motives are important so that interventions can be developed. According to existing evidence it is possible to increase subjective happiness, and this could likely be extended to happiness-related motives, such as
hedonia and eudaimonia. While studies suggest that there is a genetic component to the level of happiness an individual experiences throughout his or her life (Braungart, Plomin, & DeFries, 1992; Lykken & Tellegen, 1996), also referred to as “the happiness set point” (Lyubomirsky, Sheldon, & Schkade, 2005b), it does not account for all of the variance in happiness levels. Estimates of heritability are as high as 50% (Lykken & Tellegen, 1996), with a further 10% of variance being accounted for by life circumstances (Argyle, Kahneman, Diener, & Schwarz, 1999). This leaves a theoretical 40% of variance for the influence of intentional activities (Lyubomirsky et al., 2005b). There is a growing pool of evidence that so-called “happiness interventions” (or positive psychology exercises) are associated with an increase in subjective wellbeing (Lyubomirsky & Layous, 2013) and improvements in depressive symptoms (Layous et al., 2011; Sergeant & Mongrain, 2011). While this would have to be to be investigated further, this idea could potentially be extended to hedonic and eudaimonic motives. This leaves hope for the potential to develop interventions that could help individuals adaptively adjust their level of hedonia and eudaimonia and thereby improve life outcomes, such as academic success and emotional functioning, including reducing depression, anxiety, and stress.

Our study provides support that incorporating the conceptualization of happiness as hedonic and eudaimonic motives for action, and also its neuropsychological correlates of temporal discounting and adaptive risk taking, into interventions, may provide a valuable perspective. Furthermore, assessing individuals’ unique levels of hedonia and eudaimonia may lead the way to individualized interventions that focus on strengthening the quality that an individual may need for optimal functioning. Huta (2015) outlines how eudaimonia and hedonia can be pursued in practice in her review on the complementary roles of the two concepts. She suggests authenticity, meaning, excellence, and growth as steps toward eudaimonia and savoring, taking care of oneself, selective attention, and focusing on the present as steps toward hedonia.
These guidelines are useful in a self-help setting, but may benefit from being formulated into a more formal intervention approach that could be used strategically in the academic setting, for example, to support students in their efforts toward academic achievement.

In our striving for optimal well-being and a successful life, it may be important to not only engender eudaimonia in ourselves, our students, and society, but also the cognitive skills necessary to maintain adaptive levels of hedonic and eudaimonic pursuits. This study provides evidence that both may be necessary for adaptive functioning – balance may be key.
References


Appendix A – Demographic questionnaire

ID: ________________________ Date: ______________________________

ASSOCIATIONS BETWEEN HAPPINESS, NEUROCOGNITIVE FUNCTIONING, AND ACADEMIC SUCCESS

DEMOGRAPHICS FORM

I. BACKGROUND INFORMATION:

Age: __________________________

Date of birth: __________________


Race (please circle):

[1] American Indian or Alaskan Native

[2] Asian

[3] Black or African American

[4] Native Hawaiian or Other Pacific Islander


[6] Other: Please specify: ________________________________________________

II. OCCUPATION/EDUCATION INFORMATION:

[Note: for years of education, consider a high school diploma 12 years]

Your current occupation: ____________________________ Years of Education: ______

Maternal occupation: ____________________________ Years of Education: ______

Paternal occupation: ____________________________ Years of Education: ______
III. HOUSEHOLD INFORMATION

How many individuals live in your household? ____________________________
[Note: if living in a dormitory or other temporary residence, this question pertains to your permanent residence only]

How many bedrooms are in your household (please circle)?

[5] Four or more bedrooms.

Total income of household is approximately (exclude roommates) (please circle):

ASSOCIATIONS BETWEEN HAPPINESS, NEUROCOGNITIVE FUNCTIONING, AND ACADEMIC SUCCESS

HEDONIC EUDAIMONIC MOTIVES FOR ACTIVITIES QUESTIONNAIRE

To what degree do you typically approach your activities with each of the following intentions, whether or not you actually achieve your aim?

1. Seeking relaxation?
   1 2 3 4 5 6 7
   not at all very much

2. Seeking to develop a skill, learn, or gain insight into something?
   1 2 3 4 5 6 7
   not at all very much

3. Seeking to do what you believe in?
   1 2 3 4 5 6 7
   not at all very much

4. Seeking pleasure?
   1 2 3 4 5 6 7
   not at all very much

5. Seeking to pursue excellence or a personal ideal?
   1 2 3 4 5 6 7
   not at all very much

(please go to next page)
6. Seeking enjoyment?
   |   1   2   3   4   5   6   7   |
   | not at all | very much |

7. Seeking to take it easy?
   |   1   2   3   4   5   6   7   |
   | not at all | very much |

8. Seeking to use the best in yourself?
   |   1   2   3   4   5   6   7   |
   | not at all | very much |

9. Seeking fun?
   |   1   2   3   4   5   6   7   |
   | not at all | very much |