Detecting the Needs for Happiness and Meaning in Life from Google Books

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Abstract— **Research has shown that subjective well-being has two related but distinct dimensions, eudaimonic well-being and hedonic well-being. Hedonic well-being refers to one's overall positive affective experiences, while eudaimonic well-being is related to having a meaningful and noble purpose for life. While people are striving to have a happy and meaningful life, their motivations can be influenced by socio-economic conditions and contexts. In this study, we analyzed words frequencies in the Google Books corpus to measure the changing needs for eudaimonic and hedonic well-being and their relationships with economic growth. Results show that the frequencies of words related to hedonic well-being decrease while those related to eudaimonic well-being increase over the years. Furthermore, when people are poor, their motivation for hedonic well-being is relatively high. The hedonic motivational strength dramatically decreases and becomes stable when income reaches at a certain level. In contrast, people have relatively low motivation for eudaimonic well-being when they are poor. The eudaimonic motivational strength dramatically increases and becomes stable when income reaches at a certain level. Our study demonstrates an example of measuring subjective well-being through analysis of digital media.**

Index Terms—**Psychology, Google, happiness, well-being, wealth.**

I. Introduction

Research has shown that subjective well-being has two related but distinct dimensions, eudaimonic well-being and hedonic well-being. Hedonic well-being refers to one's overall positive affective experiences, while eudaimonic well-being is related to having a meaningful and noble purpose for life [1, 2]. Hedonic and eudaimonic well-being have been found to be highly related [3, 4]. Individuals with greater sense of meaning and purpose in life have higher levels of happiness and life satisfaction [2]. Those with unstable meaning in life have lower levels of life satisfaction, positive affect, and higher levels of negative affect and depression [5].

While hedonic and eudaimonic well-being are related, they are different. People may have a meaningful life but with little happiness or even distress, because they think about the past and future, and reflect on struggles and challenges [2]. Recent research discovered that eudaimonic well-being has unique health benefits that are not related to hedonic well-being [6 , 7]. Higher levels of eudaimonic but not hedonic well-being have been found to be associated with better neuroendocrine regulation and immune functioning [6]. Hedonic and eudaimonic well-being were found to be related to different gene expression patterns, with hedonic well-being associated with patterns related to increased risks of chronic adversity and eudaimonic well-being associated with patterns related to decrease risks of chronic adversity [7].

In this study, we aim to understand the changing needs for hedonic and eudaimonic well-being, and their relationships with economic growth. Research has shown that happiness is a crucial ingredient of human well-being, and the pursuit of happiness is considered human nature [8]. The motivation to seek meaning is also a fundamental motive rooted in human nature [9].They need to make sense of the world and construct a meaning system to interpret their experiences and feel that their lives are of value and worth [10].

While people are striving to have a happy and meaningful life [2, 4], their motivations can be influenced by socio-economic conditions and contexts. Economic development has been found to be associated with systematic changes in people's basic values [11]. In resource scarce societies, people are primarily motivated to meet their basic survival needs and do not wonder about meaning [12, 13]. As they focus on satisfying their basic needs (e.g., comfort, pleasure, and happiness), they do not clearly draw distinction between materialistic and emancipative goal [14]. However, in economically advanced conditions, people have more opportunities and therefore are motivated to pursue goals beyond basic needs [15]. They try to create their own meaning through their identifies and self-knowledge, but it is difficult to have a stable sense of meaning in life [12, 13]. They become more concerned about symbolic value, meaning, individual growth, curiosity, and justice [11] and make distinctions between conceptually opposing values [13]. Studies have found that wealthy societies showed a greater differentiation of self-growth values and society-protection values than poor societies do [13]; that is, the richer the societies are, the more negative the correlations between opposing values are. Furthermore, people and societies shifted from emphasizing survival values and collectivist attitudes to emancipative values when they become richer [15]. Similar evidence can be found in consumer culture studies. People in subsistence economy consume more goods in materialistic categories (e.g. food, clothing and footwear) whereas those in consumer cultural society consume more goods in self-growth categories (e.g.

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service, housing) [11]. A recent experimental study even showed that people might sacrifice happiness to search for life meaning when they are rich [16].

Therefore, we predict that, historically, the motivation for hedonic well-being decreases while the motivation for eudaimonic well-being increases. Furthermore, the motivation for hedonic well-being is high when people are poor. It dramatically decreases and becomes stable when income reaches at a certain level. However, the motivation for eudaimonic well-being is low when people are poor. It dramatically increases and becomes stable when income reaches at a certain level.

II. PRESENT STUDY

We will use frequencies of words related to eudaimonic and hedonic well-being in the Google Books corpus [17] to measure the changing motivation for eudaimonic and hedonic well-being respectively. Word use in books indicates motivational change in at least three ways [18]. First, language use reflects the viewpoint and thoughts of the authors, mirroring the underlying motivations for discussing particular topics. Second, books may reflect what the populations want to read in a market-driven perspective, capturing the preference and motivation changes for different topics. Third, language use in books may be a reflection of the language use of people living at that time, indicating the underlying motivation for discussion. Studies have used word frequencies in Google Books to show that people were more motivated to concern about the self in the last two centuries [19].

The Google Books corpus provides word count for each word and the total number of words appeared in the books published in a given year. By dividing the word count of a specific word in a given year over the total number of words in that year, we obtained the frequency (or the percentage) of a word appeared in a year. Because every percentage is based on a denominator of total number of words published in a year, the absolute percentage of any individual word is fairly small. However, the relative trends over time are meaningful and can reveal important social and psychological phenomena. Greenfield [19] identified long-term relationships between ecological change and cultural change, by showing that words representing individualism and materialism (e.g., "choose" and "get") appeared more often in Google Books when societies become more urbanized, technologically advanced, and wealthier. Michel et al. [17] analyzed word frequencies in Google Books and showed quantitative evidence and insightful trends in lexicography, the evolution of grammar, collective memory, the adoption of technology, and the pursuit of fame.

In the following, we describe our two studies that used word frequencies in Google Books to study the changing motivational strength to seek hedonic and eudaimonic well-being. We examined the trend of word frequencies in American books from 1800 to 2000. We first identified the keywords related to eudaimonic and hedonic well-being in past research and examined their frequencies in Google Books (Study 1). These keywords represent the conceptualization of the two types of well-being by researchers. Then, we examined the frequencies of synonyms of these keywords (Study 2). This was to increase the robustness of our findings by measuring lay people's language about the two types of well-being, and rule out the possibility that the trend found in Study 1 is due to word fashion (i.e., certain words are used frequently in a certain period because they are new words).

III. STUDY 1

A. Method

We identified keywords related to eudaimonic and hedonic well-being in past research, by focusing on literature that explicitly distinguishes the two dimensions of well-being [1, 2, 4, 20] and questionnaires that measure the two dimensions of well-being [3, 21]. This resulted in thirty keywords (Table 1).

We calculated word frequencies for these keywords in American Books from Google Books N gram database, and focused on data from 1800 to 2000. This is because past research suggested that it is the best period for research [19]. First, even though the Google Book database includes books from 1500 to 2000, the amount of book included for the first three centuries is very small [17, 19]. Second, results after 2000 are not comparable with those before 2000 due to the change of book sampling method [17]. In addition, past research suggested that it is important to use high frequency words when studying historical trends in Google Books [19] Thus, we set our minimum word frequency at 0.001%. After removing low frequency words (Keywords in parentheses in Table 1), twenty keywords were included in the analysis, including nine hedonic and eleven eudaimonic keywords.

B. Results

Factor analysis was conducted on the word frequencies. The KMO test and Bartlett's Test of Sphericity indicated that the data was appropriate for factor analysis (KMO=0.915, Bartlett's Test of Sphericity $p < 0.001$). A scree analysis suggested that a one-factor solution would best fit the data (four factors had eigenvalues greater than 1). By forcing one factor with principle-components analysis 19 out of 20 keywords had an absolute factor-loading value larger than 0.3(Table 2). Hedonic and eudaimonic keywords were located in the two polar within the uni-dimension, explaining 70.75%

TABLE I. KEYWORDS FOR WELL-BEING

Hedonic	Eudaimonic
pleasure, happy, enjoyment, enjoy, excited, happiness, satisfaction, benefit, joy	control, growth, real, goal, true, purpose, value, progress, meaning, freedom, aim (competence, autonomy, belongingness, fulfilment, meaningful, meaningfulness, worthwhile, actualization, relatedness, comprehensibility)

TABLE II. Factor loading for well-being keywords

Keywords	Factor Loading
pleasure	0.98
happy	0.97
joy	0.97
enjoyment	0.97
excited	0.94
happiness	0.93
satisfaction	0.90
enjoy	0.82
benefit	0.42
growth	-0.98
control	-0.94
real	-0.92
value	-0.90
goal	-0.87
meaning	-0.57
freedom	-0.53
purpose	0.90
true	0.90
progress	0.77
aim	-0.09

TABLE III. Regression of GDP on well-being in Study 1 & 2

	Quadratic B [a]	Linear B
Study 1		
hedonic	$2.80 * 10^{-14}$	$-1.69*10^{-9}$
eudaimonic	$-9.94 * 10^{-14}$	$5.76*10^{-9}$
Study 2		
hedonic	$1.25 * 10^{-14}$	$-8.15*10^{-10}$
eudaimonic	$6.91*10^{-10}$	$1.38*10^{-14}$

a. all the terms listed in the table are significant at the level of $p < 0.001$
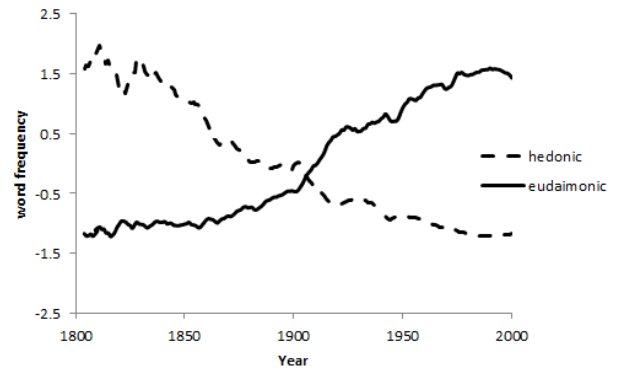

Fig. 1. The trend of motivation for eudaimonic and hedonic well-being across years
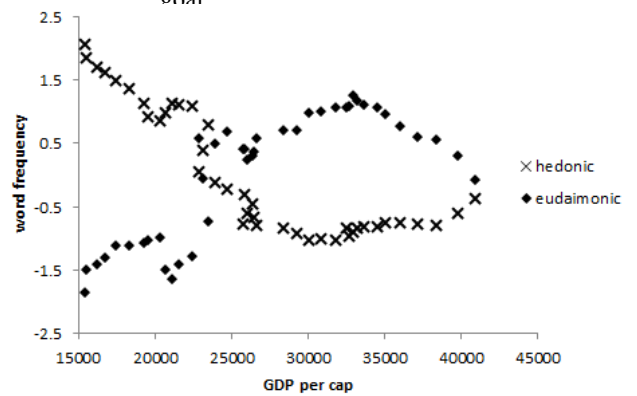
Fig. 2. The trend of motivation for eudaimonic and hedonic well-being by GDP per cap

variance. Three keywords had unexpected factor loadings (i.e., purpose, true, and progress), and one keyword had a factor loading lower than 0.3 (i.e., aim). They were excluded from further analysis.

Factor scores for eudaimonic and hedonic well-being were calculated by averaging the word frequencies belong to the factor. Figure 1 shows the historical trends of word frequencies for the two types of well-being words. As expected, the word frequencies for hedonic well-being decreased, while the word frequencies for eudaimonic well-being increased.

To understand the relationship between income and motivational strength, we used GDP to predict the motivation for the two types of well-being. As expected, GDP significantly predicted well-being in a quadratic function (Fig. 2). As shown in Table 2, for hedonic well-being, the linear term ($t(48) = -8.23$) and the quadratic term ($t(48) = 8.40$) of GDP were both significant. GDP explained a significant proportion of variance in motivation for hedonic well-being, $R^2 = 0.61$, $F(2, 46) = 35.53$, $p < 0.001$. For eudaimonic well-being, the linear term ($t(48) = 8.78$) and the quadratic term ($t(48) = -9.53$) of GDP were also both significant. GDP explained a significant proportion of variance in motivation for eudaimonic well-being, $R^2 = 0.69$, $F(2, 46) = 51.69$, $p < 0.001$.

The above results support our hypothesis that the motivational strength for hedonic well-being is high when people are poor and it dramatically decreases and becomes stable when income reaches at a certain level. In contrast, the motivational strength for eudaimonic well-being is low when people are poor, and it dramatically increases and becomes stable when income reaches at a certain level.

IV. STUDY 2

A. Method

First, we searched two online dictionaries (i.e., Merriam-Webster.com and Thesaurus.com) to identify synonyms for the keywords used in Study 1. Twenty-four synonyms of eudaimonic wellbeing keywords and seventeen synonyms of hedonic wellbeing keywords were found. Then, we aggregated the word frequencies for the two types of well-being.

B. Results

We found similar word frequency trend as those in Study 1. In addition, GDP significantly predicted the well-being scores. For hedonic well-being, the linear term ($t(40) = -8.77$) and the quadratic term ($t(40) = 7.45$) of GDP were both significant. GDP explained a significant proportion of variance in motivation for hedonic wellbeing, $R^2 = 0.82$, $F(2, 38) = 88.17$,

$p < 0.001$. For eudaimonic wellbeing, the linear term ($t(40) = 4.17$) and the quadratic term ($t(40) = 4.60$) of GDP were both significant. GDP explained a significant proportion of variance in motivation for hedonic wellbeing, $R^2 = 0.45$, $F(2, 38) = 15.66$, $p < 0.001$. Overall, these results confirmed the pattern found in Study 1.

V. Discussion

Past research suggests that well-being has two dimensions, hedonic and eudaimonic well-being. In this study, we examined motivational strength for the two dimensions of well-being through the analysis of word frequencies in American Google Books. Our results show that hedonic motivation decreases while eudaimonic motivation increases over the years. Furthermore, when people are poor, their motivation for hedonic well-being is relatively high. The hedonic motivational strength dramatically decreases and becomes stable when income reaches at a certain level. In contrast, people have relatively low motivation for eudaimonic well-being when they are poor. The eudaimonic motivational strength dramatically increases and becomes stable when income reaches at a certain level.

Our research has important theoretical contributions. First, it distinguishes two dimensions of well-being through quantitative analysis, and explains why rising income is not inevitably associated with increasing well-being. It provides new empirical evidence supporting the theory that people are more likely to suffer from a lack of meaning in life when they are rich than when poor [12, 13]. Second, existing research on hedonic and eudaimonic well-being is mainly cross-sectional. Our research is the first to reveal longitudinal change of motivation to seek hedonic and eudaimonic well-being.

Our research has important practical implications. So far, the discussion of improving societal well-being has centered on economic policies. However, it is critical to understand that the motivation for hedonic and eudaimonic well-being can change due to one's economic status. Our research provides empirical evidence for policymakers to formulate and implement policies that not only improve the income to temperately lift the mood, but address the need for meaning in life to generate positively long-term effect on well-being. In addition, existing research on measuring well-being through social media analysis mainly relies on positive and negative emotions [22]. Our study identified a list of keywords that can be used to assessing two dimensions of well-being, and improve methods for assessing well-being in social media.

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