How Do Stress Management and Personal Characteristics Improve the Quality of Life?

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Abstract. This paper investigates stress management and related health issues with smartphones, especially possible relationships among stress, well-being, and intention to purchase health-related apps. Using 98 valid questionnaire and GBN (General Bayesian Network), we analyzed survey data to extract meaningful lessons. First, people suffering from stress show high intention to purchase health-related mobile apps. Second, GBN is very effective in inducing rich interpretations from the experiments results.

Keywords: **S**tress, well-being, quality of life, General Bayesian Network, health-related apps.

1 Introduction

In today's daily life, stress management is a significant factor to improve personal health and work efficiency. The competitive working environment and the external and internal personal characteristics affect individuals' mental stability and well-being so that the effect of stress is critically related to the effectiveness of personal performance. Therefore, diverse perspectives were applied to research stress management in the psychological, sociological, medical and business research fields. In this study, we focus on the relationship between stress management and the personal quality of a healthy life.

Although stress was defined in the various views of past researchers, this study focused on psychological thought. This study started with the assumption that well-being is closely connected to the individual's psychological status and emotion and that well-being in modern society couldn't exist without stress management. Therefore, this study examined how stress management would improve individuals' well-being (quality of life) directly and indirectly through the general Bayesian network. In addition, we tried to identify the effect of external and internal variables on individuals' well-being, and to analyze the mutual relation with each variable. In addition, leisure activities contribute to health and well-being in the general

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population [1]. Therefore, this study tried to identify how leisure helps the stress management and quality of life.

The purpose of this study is to determine the relationship among psychological stress, demographic variables, leisure, intention of health care apps and well-being through the General Bayesian Network analysis. The specific aims of this study are (1) to examine the efficiency of health care apps in stress management and individuals' well-being, and (2) to identify how much leisure is important to improve the well-being of Koreans.

2 Background

2.1 Well-Being

Definitions of well-being and happiness can be seen from subjective and objective perspectives. The subjective definitions are grouped into three categories. First, well-being is defined by external criteria such as virtue or holiness. Secondly, well-being has come to be labeled as life satisfaction and relies on the respondent's standards to determine what the good life is. Third, subjective well-being emphasizes pleasant emotional experiences [2].

According to the World Health Organization (WHO) [3], quality of life is defined as "the individual perception of their life position in the context of the culture and value, and in relation to their goals, expectations, standards and concerns." On the other hand, social science defines quality of life as life satisfaction, morale, and happiness. However, other perspectives view quality of life as emotional well-being and life satisfaction.

2.2 Stress

Perceived stress is commonly considered a subjective appraisal of events or situations in one's life that exceed one's abilities and resources to cope with these situations [4–5]. Schwartz and Garamoni (1989) suggested the state of mind (SOM), which is divided into five categories [6]. Schwartz (1997) replaced the reformulated balanced state of mind (BSOM) measured by depression, anxiety, anger, stress, and psychological well-being (satisfaction and happiness) and showed that autonomic thought was positively related to satisfaction and happiness [7]. On the other hand, it was negatively related to anger, depression, anxiety, and perceived stress [8]. In the perspective related to the workplace, job is stress among the kinds of stress based on the burden of controlling the individual's own work and limited opportunity for cooperation and fellowship with others [9].

2.3 Leisure

Leisure activities contribute to health and well-being in the general population [1]. In past literature, leisure activities have been related to positive cognition function [10], better mental health [11], improved quality of life [12], coping with stress [13], and reduced risk of dementia [11, 14]. Coleman and Iso-Ahola's stress-buffer model [15] provides a

foundation for empirical study of leisure as an instrument for buffering stress and possibly suppressing the effect of some stressors. In addition, Hutchinson and Kleiber (2005) considered leisure as a resource for coping with negative life events that serves as a buffer from the "immediacies of stress" [16]. Recently, Bedini et al.'s (2011) research verified that leisure is associated with perceived stress and perhaps may relieve the effect of stress on quality of life in female health care workers [1].

2.4 Mobile Application

As of the end of 2011, more than 91 million Americans own a smartphone, according to a recent ComScore report [17]. In a report "Global Mobile Health Market Report 2010–2015," research2guidance, a prominent mobile research specialist, there will be an estimated 1.4 billion smartphone users in the world within five years [18]. Especially healthcare smartphone users are expected to number 500 million people in 2015. In the current apps market, 17,000 mobile health apps were launched and 74 percent of them adhere to the paid business model. Both health care providers and consumers are embracing mobile apps as a means for improving health care. If the health care apps business generally adopts the paid model, the profit in the mobile health care market will be enormous in the near future.

2.5 Bayesian Network

The Bayesian network (BN) is a powerful formalism to represent a joint probability distribution. Its directed acyclic graphs (DAG) allow for efficient and effective representation of joint probabilistic distributions over a set of random variables. BN can infer the probability of any combination of variables without having to represent the joint probabilities of the variables. BN can be used as a classifier when users want to determine whether the exact probability of an event is above or below a certain threshold. GBN (general Bayesian network) is a full-fledged (unrestricted) BN in which casual relationships between the class node and all other nodes are flexibly formulated using an efficient network construction technique based on conditional independence tests.

3 Research Methodology and Experiment

3.1 Measures

In order to analyze the relationship with factors affecting individual well-being, we built the questionnaire and surveyed South Koreans based on the past literature's measures and methodology. Additionally, we added the individual health status data gathered by the Healthmax Co. Cady online system (http://healthmax.co.kr). Our questionnaire comprised largely five scales that measured aspect of stress, demographics, well-being, leisure, and application usage. First, five items regarding psychological stress were adopted from a quality of employment survey [19] that measured physical and psychological stress [20]. Secondly, we used Bedini et al.'s (2011) study for measuring demographic variables – age, the level of education, and

physical health status. Third, well-being was measured by items from the Oxford happiness questionnaire [21] that are known to correlate with well-being. Fourth, leisure was adopted from leisure participation (LP) among the Bedini et al. (2011) measures. Fifth, mobile apps (health care related) purchase intention was measured by the behavioral intention used in Lu et al.'s (2005) study [22]. Lastly, to measure job, marital status, leave alone, and illness, we also used the Bedini et al. (2011) demographic profile.

3.2 Sampling and Sample Characteristics

In order to analyze the relation among the stress, leisure, mobile apps purchase intention, well-being, and some demographics variables, we gathered 98 samples from a questionnaire survey and measured some characteristics. In order to find the specialties, we categorized age and education level with four categories and gender and marital status with two categories. The general characteristics of the samples are summarized in Table 1.

Table 1. Descriptive demographic statistics

Category	Gender	Age	Education level	Job	Marital status
1	56 (57%)	7	8 (8.2)	13	95 (97%)
2	42 (43%)	66	37 (37.8)	40	2 (2%)
3		24	40 (40.8)	1	
4		0	13 (13.3)	36	
missing		1	0	8	1

Gender – 1: male; 2: female
Age – 1: 10–19; 2: 20–29; 3: 30–39; 4: 40–49
Education level – 1: high school graduate; 2: college student; 3: college graduate; 4: postgraduate degree
Job – 1: blue collar; 2: white collar; 3: housewife; 4: no job
Marital status- –1: married; 2: single

3.3 Test Result

The Cronbach's alpha indices of all variables appeared over .800 so the reliability of all variables was verified. To analyze the validity of the construct, we conducted a principal component analysis of five variables measured by more than two questionnaires. When the Eigen value became near 1, the five variables were selected. The variables represent each variable's meaning and the factor loading index appeared more than .700. All the Cronbach's alpha values are greater than 0.8, and the AVE was greater than 0.7.

According to the result of the general Bayesian network (GBN) analysis with three algorithms (K2, hill-climber, and lagged hill-climber), each algorithm showed the different causal relations among the variables. The following picture show the path models when the analysis was applied to K2, hill-climber, and lagged hill-climber algorithms.

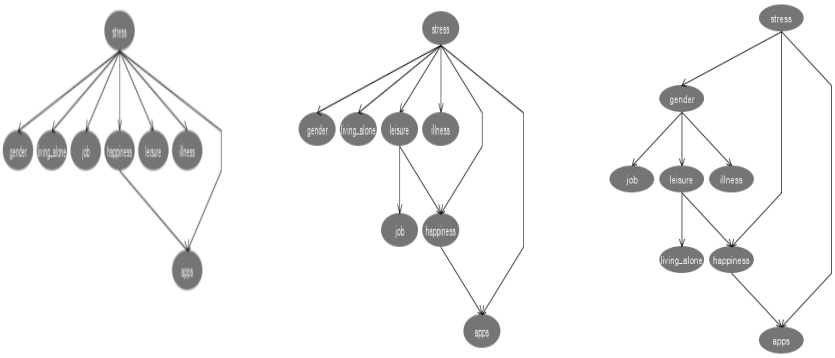

Fig. 1. Three types of GBN results

Comparing the model fit indices of analysis results, hill-climber was verified as the best model. Therefore, this study would describe the test result based on results of the hill-climber algorithm (see Table 2). First, the analysis result of the Bayesian network showed the following causal relation: stress directly affected illness, gender, leisure, happiness, living alone, and intention to purchase health-related smartphone apps. At the same time, stress indirectly affected intention to purchase health-related apps via happiness and job via leisure. To identify the significance of the causal path, we used the Warp PLS 2.0 program. In the path analysis, the P values of average path coefficient (APC), and average R-squared (ARS) were less than 0.05 and average variance inflation factor (AVIF) index showed much less than 5, so that the model using the hill-climber algorithm satisfied the model fit index. Among the path relations, the direct influences from stress to happiness, illness, and intention to purchase health-related apps were-0.518, 0.297, and 0.225, respectively. Each significance showed less than 0.05. Therefore, on the 95% confidence level, the direct path effects were verified as significant. In addition, the coefficient and significance from leisure to happiness showed 0.228 and 0.015, respectively, so leisure affected happiness significantly.

Table 2. Path analysis result- Hill-climber

variables	stress		happiness		leisure	
	coefficient	P value	coefficient	P value	coefficient	P value
happiness	-0.518	0.000			0.228	0.015
apps	0.225	0.013	-0.053	0.275		
illness	0.297	0.002				
gender	0.132	0.071				
living alone	-0.039	0.303				
job					-0.069	0.260
leisure	0.000	0.475				

**Note: APC=0.154, P=<0.001, ARS=0.064, P=0.012, AVIF=1.184, Good if < 5.*

3.4 Discussion

This study primarily tried to find how stress affects well-being and the consumer's intention to buy health-related mobile apps. Simultaneously, our aim was to identify the effect of leisure on the people's well-being. Therefore, we tried to find eight variable relations with various Bayesian algorithms and finally chose three algorithms to analyze the causal relation among the variables empirically.

First, stress was verified to decrease personal well-being and increase the extent of illness. This negative relationship between stress and well-being corresponds to the past [1, 8, 23]. The positive relation between stress and illness also was supported by prior researchers [24–25].

Second, leisure also was verified to affect individual happiness. This result also corresponds to the previous literature's empirical result [10]. However, even though leisure is an important factor to decrease stress and recent research also showed that leisure was associated with perceived stress and reduced the effect of perceived stress on the quality of life [1], this study result couldn't find any relation between stress and leisure via the general Bayesian network analysis.

Third, stress was identified to affect intention to buy health-related apps directly and indirectly. This reflects that mobile phone users, who have high stress in their daily life, are interested in the health-related application contents. The mobile phone is a handheld tool, which people carry all the time, so it is the easiest and fastest way to find the solution to get rid of stress and have fun.

4 Concluding Remarks

Stress management is very significant to the current population's exposure to the fast-moving and competitive environment. Diverse products are provided related to stress management and well-being in the food, cosmetic, health, and other industries in the main cities all over the world. South Korea is one of the fastest transforming areas, and especially mobile telecommunication technology is developing at the highest rate in the world. For this reason, this study examines stress management and health-related mobile apps.

In order to find the relation among stress, well-being, and other variables, we adopted the general Bayesian network. Based on the path gotten set by the Bayesian network analysis, we tested each path's relation empirically. According to the test result, stress affected illness positively, well-being negatively, and the purchase intention of health-related mobile apps directly and indirectly at the same time. This reflects the importance of the relationship between stress and well-being, and finally the significance of mobile apps through smartphones. This result especially means that stressed people have high intention to buy health-related mobile apps if they are exposed to the various health management apps. Additionally, this research showed leisure affected people's well-being.

However, the relationship result couldn't show the optimal path among variables so that some causal relations appeared insignificant even though they are important in the general thought. Therefore, it would be useful to analyze the relationship among

the variables through a different methodology and then compare it to the result of the general Bayesian network in future research.

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