

# Personality and Subjective Well-Being: Towards Personalized Persuasive Interventions for Health and Well-Being.

Aisha Muhammad Abdullahi<sup>1</sup>, Rita Orji<sup>2</sup>, Abbas Muhammad Rabiou,<sup>1</sup> Abdullahi Abubakar Kawu<sup>3</sup>

<sup>1</sup>Faculty of Computing, Federal University Dutse, Nigeria, <sup>2</sup>Faculty of Computer Science, Dalhousie University, Halifax Canada, <sup>3</sup>Ibrahim Badamasi Babangida University, Lapai 740005, Nigeria

## ABSTRACT

Subjective well-being (SWB) is an individual's judgment about their overall well-being. Research has shown that activities that elevate people's sense of SWB have a significant effect on their overall health. There are two dimensions of SWB: Affective and Cognitive dimensions. However, studies on SWB usually focus more on one dimension, ignoring the other dimension. Also, most existing studies on SWB focused on individuals from Western cultures. Research has shown that the influence of personality on subjective well-being is moderated by culture. Thus, to advance research in personalizing persuasive health interventions, this study focuses on Africans (n=732). Specifically, we investigate the relationship between the Big-Five personality traits and both dimensions of SWB using the constructs: Happiness, Satisfaction with Life, Social, Psychological and Emotional well-being. Our results reveal that health informatics designers who design persuasive technologies to promote SWB would need to tailor designs along personality traits and SWB constructs. Accordingly, for users high in Agreeableness, the design should be focus on promoting their feelings of Happiness and Social Well-being. For users who exhibit Neuroticism, designers should focus on designing to promote Psychological well-being and Emotional well-being. Based on our findings, we offer guidelines for tailoring persuasive health interventions to promote individuals' SWB based on their personality. We thus highlight areas that personal health informatics design can benefit.

## CCS CONCEPTS

- Human-centered computing → Personalization → HCI design and evaluation methods → User models

## KEYWORDS

Subjective Well-being, Big Five Personality Traits, Persuasive Health Applications, Personalization.

Correspondence: am.abdullahi@fud.edu.ng, rita.orji@dal.ca, mambas86@fud.edu.ng, abduallahikawu@ibbu.edu.ng

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## 1. INTRODUCTION

According to the World Health Organization, “*health is a state of physical, mental and social well-being and not merely the absence of disease or infirmity*” [1]. In 2012, the United Nations emphasized the importance of individual and societal wellbeing in achieving the Millennium Development Goals [2]. As a result, it has been advocated that health interventions focus on promoting health and well-being by targeting the individual components that contribute to them. Subjective well-being is an individual’s judgment about their overall well-being, which includes a Cognitive dimension (Satisfaction with Life and Happiness) and an Affective dimension (Social well-being, Emotional well-being, and Psychological well-being) [3]. Research has shown that there is a relationship between people’s subjective well-being and their physical health [4,5]. For example, Skaff et al. [6] showed in their study that negative emotions predicted rising blood glucose levels the next day and Black et al. [7] explains how stress leads to inflammation, which can harm health when it is chronic. It has also been found that surgical patients healed more quickly if they are high in life satisfaction [8]. This suggests that interventions that raise people’s sense of well-being may contribute to improving physical health. Thus, theories on how to promote people’s subjective well-being have been established [9,10].

Some existing personal health informatics (self-tracking) tools provide some level of personalization, but the focus is largely on the aesthetics of the tool. Most consumer products have aesthetic ways to customize the tools—both software (e.g., color, user information, a wide variety of user interface designs to choose from) and hardware (e.g., medium, form factor, and types), thereby reducing the devices prospective benefits to the user [11].

For example, during setup, Fitbit asks people to enter details for their profile, such as gender and height, from which they estimate a number of health information such as BMI (used for managing body weight). Although important, these personalization supports fall short of realizing the full potential of personalized tracking because they are applied to the secondary side of the tracking tool, not towards the subjective circumstance and lived experience of the user (such as their mood or mental state at the time of use) especially in technologies that intend to persuade or change behavior.

When self-tracking tools do not completely satisfy personalization and by implications tracking needs, people give up tracking entirely [12]. To accommodate a wide range of tracking needs, designers should identify ways to incorporate the subjective situations of users while using the health tracking tools as attempted in OmniTrack [13].

This realization has motivated a shift of PT design from the traditional one-size-fits-all approach to a personalized approach that adapts to the preferences of individuals. The personalized approach treats each user as a different entity, it assumes that a persuasive strategy that works for one user may not work for another. Therefore, persuasive health interventions need to be tailored to users to be effective [14].

As a result, research into personalizing health interventions to individual preferences has gained some attention among PT designers. Specifically, research into investigating Personality traits as

a factor that can influence individual differences attracted the attention of researchers [15,16]. This is because what constitutes well-being for one may not for another. However, most existing literature focuses on individuals from Western culture. There is limited literature on the generalization of their findings to individuals from developing countries. Research has shown that the influence of personality on the subjective well-being components is moderated by culture [17]. Also, most existing literature focuses on one dimension of subjective well-being ignoring its other dimension. Therefore, in this paper, we investigate the relationship between personality traits (*Openness, Conscientiousness, Extraversion, Agreeableness, Neuroticism*) and the two dimensions of subjective well-being (*Affective dimension and Cognitive dimension*) using distinct subjective well-being components (*Satisfaction with Life, Happiness, Psychological, Social and Emotional well-being*) in people from Africa (Nigeria specifically) to outline ways that persuasive health interventions can be personalized to be more effective for people from non-Western cultures based on their personalities.

To achieve this, we conducted an empirical study (n=732), using Structural Equation Model (SEM) analysis to develop a model showing how people of different personalities relate to various subjective well-being components. Interestingly, our results reveal that personality traits play significant roles in their various subjective well-being components. For example, to design PTs to promote SWB for people high in *Agreeableness*, designers should focus on designing to promote their feeling of *Happiness* and *Social Well-being*, while for *Neuroticism*, designers should focus on designing to promote *Psychological well-being* and *Emotional well-being*.

Our work offers four main contributions to the field of Persuasive Technology and health intervention design. First, we reinforce the need to personalize persuasive health systems by revealing that individuals of different personality traits relate differently to distinct subjective well-being components. Second, we establish that personality trait is an important characteristic for personalizing persuasive health interventions targeting African audience. So far, none of the existing works investigated the relationship between personality and subjective well-being among Africans. Third, we examine the relationship between individual personality traits and the different subjective well-being components and develop design guidelines for personalizing persuasive health applications to individuals based on their personality traits. Finally, we suggest some persuasive strategies to promote individual components of subjective well-being. This is an essential step toward developing personalized health applications that will effectively engage users and promote desired behavior change.

## 2. BACKGROUND AND RELATED WORK

In this section, we provide an overview of Personality traits, subjective well-being, and related work.

### 2.1 Personality Traits

Personality traits are the combination of habitual behaviors, cognitions and emotional patterns that make up an individual's distinctive character [18]. Psychologists argue that personality is unique to everyone [19]. Understanding your personality and what makes you different from others, can

lead to better life choices. Personality traits have been shown to play important roles in people's well-being and overall success [20]. This may be because personality traits are significant predictors of our behaviors and attitudes in life. Over the years, several tools for identifying personality traits have been developed. Among these tools are the Myers-Briggs Type Indicator (MBTI) [21], PEN Model [22] and Big Five [23]. The Big-Five personality traits— *Openness, Conscientiousness, Extraversion, Agreeableness, Neuroticism* - is the most widely used personality type. The Big Five personality traits have been shown to influence subjective well-being among other populations, for example, South Koreans [15], Taiwanese [16] and Spaniards [24]. These five components are:

1. **Openness** personality trait describes how open someone is to a variety of experiences or how concretely or abstractly someone thinks about things. Those high in this trait tend to hold unconventional values and are often creative thinkers.
2. **Conscientiousness** personality trait describes how self-disciplined, organized and goal-oriented a person is. Those high in this trait tend to be good at planning rather than being spontaneous.
3. **Extraversion** is a personality trait characterized by how sociable, energetic and warm a person is. Those high in this trait tend to be chatty and associate a lot with others.
4. **Agreeableness** personality trait describes how kind, sympathetic and cooperative a person is. Those high in this trait tend to be helpful, less competitive and friendly to others.
5. **Neuroticism** describes how emotionally unstable, nervous, distressful and fearful a person is. Those high in this trait tend to worry or be temperamental.

## 2.2 Subjective Well-being

The term subjective well-being refers to people's perception and evaluations of their lives, and well-being, including cognitive evaluation, such as Satisfaction with life and affective evaluation such as Emotional, Social and Psychological well-being [3]. People's subjective well-being has been widely acknowledged to play an important role in their overall physical and mental health. As a result, the past four decades have witnessed an explosion of research on the design for well-being [25-27].

The most widely accepted definition of subjective well-being distinguishes the Cognitive and an Affective dimension of subjective well-being [3,15,28]. The cognitive dimension is based on an overall assessment of one's life. Peoples' Happiness and Satisfaction with life are considered a Cognitive component of subjective well-being [28]. Researchers have used the Happiness scale and Satisfaction with Life scale to assess the Cognitive dimension of SWB [15]. The Affective dimension reflects the number of pleasant feelings (Positive affect) and unpleasant feelings (Negative affect) that people experience in their lives [28]. The Affective dimension of SWB brings measurement very close to assessing mental health [28]. Some researchers have used the Positive Affect scale and Negative Affect scale to assess the Affective dimension of subjective well-being [24]. However, to have broader and richer information about the Affective dimension of subjective well-being, several researchers have used the Psychological well-being, Social well-

being, and Emotional well-being scales to assess the Affective dimension of subjective well-being [29,30]. In this study, the Satisfaction with Life, Happiness, Psychological, Social and Emotional well-being scales is used to assess participants' overall subjective well-being. We discuss these five components briefly in this section.

- 1. Satisfaction with life** is defined as one's evaluation of life and how they feel about their directions and options for the future [31], or people's judgment that at least on balance, their life measures up favorably against their standards or expectations [32]. Research has shown that satisfaction with life is a predictor of health-related quality of life (HRQOL) [33]. For example, Strine et al. [33] in their study revealed that as the perceived life satisfaction of people decreased, the prevalence of unhealthy behaviors that contributes to general ill-health increases. This includes smoking, obesity, physical inactivity, heavy drinking, sleep deprivation, and chronic illnesses. Thus, persuasive technological interventions aimed at increasing an individual's well-being can target promoting their overall feeling of satisfaction with life as a way of fostering well-being.
- 2. Happiness** is defined as the momentary feeling of intense joy [34]. It has been shown that happy people are healthier [35]. Therefore, a persuasive intervention designed to increase an individual's overall happiness will likely impact on their health and well-being.
- 3. Psychological well-being** is defined as *the general perception experienced by individuals that there will be positive outcomes to events or circumstances (p. 497)* [36]. Ryff described six key-elements of Psychological well; Self-acceptance, Personal growth, Purpose in life, Environmental mastery, Autonomy and Positive relations with others [37]. These six elements are key to positive psychological well-being. Positive Psychological well-being makes people better able to deal with life's challenges which in turn promotes other desirable qualities like creativity, productivity, and vitality. A frequent experience and expression of positive psychological well-being make people more optimistic, resilient, and resourceful. Also, research has shown that people who have positive psychological well-being are healthier generally [38]. Therefore, a persuasive intervention designed to increase an individual's Psychological well-being may have a positive effect on their overall health and well-being.
- 4. Social well-being** refers to an individual's interaction and relationship with others. *"It involves using good communication skills, having meaningful relationships, respecting yourself and others, and creating a support system that includes family members and friends"* [39]. High Social well-being makes it easy for people to build and maintain positive relationships with others and their community. It has been shown that people who experience a high sense of belonging in various cultural activities and within their communities are generally healthier [40]. For example, Barton and Grant's [41] showed that people who belong to socially excluded groups have poorer health than their counterparts. Therefore, a persuasive intervention designed to increase an individual's Social well-being may have a positive influence on their overall health and well-being.

**5. Emotional well-being** is defined as a feeling of relaxation and stress freeness [42]. Emotional well-being reflects how well individuals manage their thoughts, feelings, and actions to function in their everyday lives. It has been shown that people's emotional well-being influences their mental health [28]. Positive emotional well-being is key to experiencing balanced mental health and overall well-being. Research has shown that people who have positive emotional health are better able to cope with everyday stresses and problems and therefore have more stable mental health and overall well-being [43]. More specifically, the studies of Burnner [44] and Wilkinson [45] revealed that emotional distress creates susceptibility to physical illness by affecting the immune response, thus leading to poor health conditions. Therefore, a persuasive intervention designed to increase an individual's Emotional well-being will likely impact positively on their overall health.

### 2.3 Related Work

Investigating the relationship between personality traits and SWB has received some attention and has been studied extensively by previous literature [15,16,24]. For example, Ha et al [15] in their study showed that there is a statistically significant relationship between personality traits and subjective well-being. In their study of South Koreans, they explored the direct influence of personality on subjective well-being. However, the study focused on one dimension of subjective well-being (the cognitive dimension) ignoring its other dimension (the affective dimension). The cognitive dimension was measured using Happiness and life satisfaction scales. Ha et al [15] found that personality traits, particularly Emotional Stability and Extraversion, are positively associated with happiness and life satisfaction.

Similarly, Gutiérrez et al. [24] revealed that personality is an important correlate of subjective well-being. They conducted a study of Spaniards to examine the association between, personality traits and subjective well-being. Still, the study focused on one dimension of subjective well-being (the affective dimension) ignoring its other dimension (the cognitive dimension). They used the Positive Affect and Negative Affect scales. Gutiérrez et al. [24] revealed that Neuroticism and Extraversion correlate with the two components used to measure subjective well-being (Positive and Negative affect) while Openness and Agreeableness correlate with only one of the two components (Positive affect).

A recent study by Chen [16] also showed a significant and substantively important relationship between personality traits and subjective well-being. Chan [16] investigated the relationship between personality traits and the subjective well-being of online game playing teenagers in Taiwan. The study also assessed one dimension of subjective well-being (the cognitive dimension), using the Satisfaction with life scale. The study concluded that, Neuroticism and Agreeableness have significant negative influence on people's Satisfaction with life while Openness has significant positive influence on Satisfaction with life.

Also, Soto [46] showed a significant relationship between personality traits and components of subjective well-being. In his study, with Australians, he explored the relationship between

personality traits and subjective well-being using satisfaction with life, Positive affect, and Negative Affect scales. He found that individuals with more-extraverted, agreeable, conscientious, and emotionally stable personalities tend to experience higher life satisfaction, more frequent positive affect, and less frequent negative affect.

Furthermore, Costa et al. [47] carried out a study of participants from Boston, USA, focusing on one dimension of subjective well-being (the affective dimension). They found that Extraversion is positively associated with Positive Affect and Neuroticism is positively associated with Negative Affect. Another study by DeNeve and Cooper [48] used four components: Life satisfaction, Happiness, Positive affect, and Negative affect, to assess subjective well-being. They found that Neuroticism is strongly associated with Life Satisfaction, Happiness, and Negative Affect, while Extraversion and Agreeableness are strongly associated with Positive Affect.

In a similar study, Libran [49] used Life satisfaction, Positive Affect, and Negative Affect scales to assess the subjective well-being of university students in Catalan, Spain. As regards personality traits, he considered only the Extraversion and Neuroticism traits. Results from his work show Neuroticism as one of the most important correlates of the components of subjective well-being. Specifically, he found that Neuroticism is strongly negatively associated with Life Satisfaction and Positive Affect, but strongly positively associated with Negative Affect. On the other hand, Extraversion correlated positively with Satisfaction with life and Positive Affect, but not with negative Affect. His study concluded that the correlations of Neuroticism with the components of subjective well-being are higher than those obtained between these same components and Extraversion. That is, Extraversion seems to be less significant than Neuroticism as a predictor of the components of subjective well-being.

This present study differs from existing studies in three major ways: One, we investigate a developing African nation (Nigeria) which is often neglected by researchers. Two, we investigate both dimensions of subjective well-being and their relations with personality. Happiness and Satisfaction with life are used to assess the cognitive dimension while the three components of Psychological well-being, Emotional well-being, and Social well-being are used to assess the affective dimension. This provides a richer insight into subjective well-being. Three, we offer design guidelines and design considerations to inform Persuasive health intervention design especially those targeted at African audiences.

### **2.3 Health Informatics and Subjective Well-being.**

Health informatics (HI) is an area with wide applications to encompass public and personal health informatics [50]. While public health informatics refers to the systematic application of information and computer science and technology to public health practice, research, and learning [51], personal health informatics focus on the collection and use of personal data, often from trackers and life-loggers for achieving specific health goals for individuals [52].

In both realms, some sentiments infer that the current state of technologies can benefit from other dimensions of improvement, beyond software and hardware. Tracking circumstance and subjective situations could mean support towards measuring other dimensions of 'improvements'

[52] that go beyond activities, soft or hardware. This may thus include subtle dimensions like the account of SWB and personality traits. Although, this is somewhat difficult in practice [11] and can be challenging from user experience and privacy perspectives [53], we believe it may fit McCarthy and Wright's discussion of "technology as experience" [54] and their call for design to engage with the felt life.

### 3. METHOD

This study was designed to investigate how people of different personalities relate to the two subjective well-being dimensions (Cognitive and Affective) using five components - *Satisfaction with Life, Happiness, Psychological, Social and Emotional well-being*. This will inform the tailoring of persuasive health interventions to the personalities. To achieve this, we collected data about participant's personality traits and their subjective well-being components and conducted Structural Equation model (SEM) analysis, specifically, Path Analysis using AMOS 2.0.

#### 3.1. Sample and Sampling Technique

The sample was drawn from North-west Nigeria in 2018. Seven states were selected: Kano, Kaduna, Katsina, Kebbi, Sokoto, Jigawa, and Zamfara. 100 participants were randomly selected in all the states except for kano where 132 participants were selected. Universities, colleges, government/private offices from these states were randomly enlisted and personally visited by the research team. After a short introduction of the study to the head of each organization, participants were then randomly selected and approached. The purpose of the study was explained to them and their verbal consents were sought. A paper-pencil questionnaire was given to each respondent, the majority of the respondents completed the survey immediately (took approximately 15 minutes), a small number of the respondents were left with the questionnaire booklet and was collected after a mutually agreed period (at most after 24 hours). Random sampling was used for convenience in the selection of organizations and respondents. In keeping with the research aim, the research team deliberately selected respondents from both genders and various age groups. A total of 732 people participated in this study. Participants were drawn from several works of life in Nigeria. Participants were well distributed in terms of Gender and Age. As regards age, 21% (16-24), 19% (25-34), 17% (35-44), 13% (45-54), 13% (55-64), 11% (65-74), and 6% (above 75). With regards to Gender, 52% are Males and 48% are Females.

#### 3.2. Measurement Instruments

To determine participant's personality traits we employed the *10 Item Personality Traits (TIPI)* [55]. The TIPI scale has been widely validated and used by many researchers including [56,57] for measuring the Big Five personality traits. The TIPI scale consists of 10 items, two items measure each trait using a 7-point Likert scale, ranging from 1= Strongly Disagree to 7=Strongly Agree.

To determine participants' subjective well-being, five prior validated scales Nations, Satisfaction with Life, Happiness, Psychological, Social and Emotional well-being scales. The Happiness scale developed by Lyubomirsky and Lepper [34] which consists of 4 items is a 5-point Likert scale,

ranging from 1= Very unhappy to 5 = Very happy is used to elicits participants happiness. A sample item includes: “*If you were to consider your life, in general, these days, how happy would you say you are?*” The Social well-being scale developed by Huppert et al. [39] which consists of 14 items is a 5-point Likert scale, ranging from 1= Strongly disagree to 5 = Strongly agree is used to measures participants Social well-being. A sample item includes: “*I gladly have contact with other people via social media (Facebook, e-mail).*” The Satisfaction-with-life scale developed by Diener et al. [31] which consists of 5 items is a 5-point Likert scale, ranging from 1= Strongly disagree to 5 = Strongly agree is used to measured participants’ life satisfaction. A sample item includes: “*If I could live my life over, I would change almost nothing.*” The Psychological well-being scale developed by Diener et al. [42] which consists of 12 items is a 5-point Likert scale, ranging from 1= Strongly disagree to 5 = Strongly agree is used to elicits participants Psychological well-being. A sample item includes: “*I am competent and capable in the activities that are important to me.*” Lastly, the Emotional well-being scale developed by Diener et al. [42] which consists of 16 items is a 5-point Likert scale, ranging from 1= Strongly disagree to 5 = Strongly agree is used to measure participants Emotional well-being. A sample item includes: “*I have been dealing with problems well.*”

### 3.3 Procedure

Participants willingly volunteered to participate in this study, so no incentives were awarded to them. Paper-pencil questionnaires were handed out to participants in their workplaces, which took approximately 15 minutes to complete. No identifying information was collected. The data collection was overseen by the Federal University of Dutse’s research ethics committee.

### 3.4. Data Analysis

To analyze the data, we conducted Structural Equation Modelling SEM analysis using AMOS 20. Specifically, we employed SEM to develop a model showing how people of different personalities relate to various subjective well-being components.

### 3.5. Validation of Study Instrument

We conducted a Confirmatory Factor Analysis (CFA) to test the validity of our study instruments and tested for the model fitness. We established the Internal consistency of our constructs through their Cronbach’s Alpha ( $\alpha$ ) values. The results from the CFA show the Cronbach alpha ( $\alpha$ ) for all constructs use to measure the personality traits to be between 0.75 and 0.83, all above the recommended threshold of 0.70. Similarly, we established convergent validity from the values of the Average Variance Extracted (AVE). The results show the AVE to be above 0.5 for all the scales of subjective well-being components.

## 4. RESULTS

We conducted Structural Equation Modelling (SEM) to establish the relationship between the five personality traits and the individual components of the subjective well-being. In this section, we report results from our model. The goodness-of-fit indices shows that the hypothesized model was a good fit to the data;  $\chi^2(10) = 10.334$ , the degree of freedom (df) = 4,  $p < .001$ , comparative fit

indices (CFI) = 0.987 (CFI > .90 is the recommended value) and root mean square error approximation (RMSEA) = 0.033 (RMSEA < .08 is the recommended value).  $\chi^2/df = 2.583$  ( $\chi^2/df < 3$  is the recommended value).

### The Structural Model

The structural models determine the relations between the people’s personality traits and the individual components of the subjective well-being, Figure 1. An important criterion to measure the strength of relationships between variables in structural models is to calculate the level of the path coefficient ( $\beta$ ) and the significance of the path coefficient ( $p$ ). Path coefficients measure the influence of a variable on another. The individual path coefficients ( $\beta$ ) and their corresponding level of significance ( $p$ ) obtained from our models are summarized in Table 1.

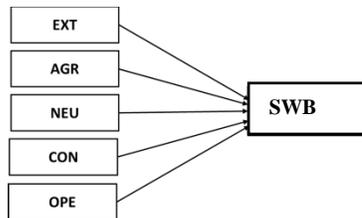


Figure 1: SEM model structure

Table 1: Path Coefficient Results

Personality traits	Subjective well-being Components				
	Path coefficient ( $\beta$ )				
	PWB	EWB	SoWB	SWL	H
Openness	0.14	0.17	0.21	-	0.32
Conscientiousness	0.15	0.12	-	<b>0.52</b>	<b>0.54</b>
Extraversion	0.18	0.27	<b>0.53</b>	0.43	0.47
Agreeableness	0.21	0.16	0.11	0.15	0.13
Neuroticism	<b>-0.44</b>	<b>-0.35</b>	-0.23	-0.15	-

Psychological well-being=PWB, Emotional well-being=EWB, Social well-being=SoWB, Satisfaction With life=SWL, happiness=H.

Relationship between personality traits and subjective well-being. Bolded coefficients are  $p < .001$ , non-bolded coefficients are  $p < .01$ , and ‘-’ represents non-significant coefficients.

### Relationship between Personality traits and Subjective well-being.

Our results show personality traits to be strong predictors of subjective well-being components. We report how each component of the subjective well-being relates to the five personality traits.

**Happiness:** Our results show that Happiness is significantly positively associated with all the personality types except for emotionally unstable people (Neuroticism) who show no significant relationship: Openness ( $\beta= 0.32, p<0.01$ ), Conscientiousness ( $\beta= 0.54, p<0.001$ ), Extraversion ( $\beta= 0.47, p<0.01$ ), Agreeableness ( $\beta= 0.13, p<0.01$ ). This means that people who are high in Openness, Conscientiousness, Extraversion, and Agreeableness are more likely to harbor a higher level of Happiness as a contributor to SWB compared to those high in Neuroticism. Interestingly, Conscientiousness has the strongest relationship with Happiness. This finding is supported by Barrick et al. [58] who found that conscientious employees achieved a higher volume of sales than their unconscientious co-workers. The feeling attached to achieving their goals makes them feel happier than their counterparts. Thus, persuasive technological interventions aimed at increasing an individual's well-being can target promoting their overall feeling of happiness as a way of fostering well-being. A plausible explanation of why Happiness is not significantly associated with Neuroticism is that people high in Neuroticism due to their inherent characteristics of being emotionally unstable, are often stressed out and nervous. This makes them incapable of appreciating beauty and deriving pleasure from simple things of life that make other people happy.

**Satisfaction with life:** Our results show that Satisfaction with life is positively associated with Conscientiousness ( $\beta= 0.52, p<0.001$ ), Extraversion ( $\beta= 0.43, p<0.01$ ), and Agreeableness ( $\beta= 0.15, p<0.01$ ). However, it is negatively associated with Neuroticism ( $\beta= -0.15, p<0.01$ ) and does not have a significant association with Openness. These results mean that people who are high in conscientious, extraversion, agreeable personality traits are more likely to be more satisfied with life in general than people who are high in openness and neurotic personality. As expected, Conscientiousness is most strongly positively associated with satisfaction with life. Our findings are consistent with those of Soto [46] who found that individuals high in Conscientiousness tend to experience higher life satisfaction. This is expected because, conscientious people like to be very organized, often avoid making impulsive decisions and abide by rules. As a result, their lives often go as planned without hitches because they try to avoid doing things spontaneously which may consequently make them feel unsatisfied with their everyday affairs and lives generally. This is followed by Extraversion, which is in line with Ha et al [15] who also found that Extraversion is positively associated with Satisfaction with Life among South Koreans. On the other hand, Satisfaction with life is negatively associated with people who are high in Neuroticism. This finding is also consistent with those of Soto [46] and Chen [16] who revealed in their work that emotionally unstable individuals tend to experience lower life satisfaction. The association between Satisfaction with life and Openness is not significant while the positive association between Satisfaction with Life and Agreeableness is weak. This implies that designing persuasive interventions to increase the Satisfaction with life of people who are open to experience (Openness), emotionally unstable (Neuroticism) and cooperative (Agreeableness) will increase their overall SWB and hence impact positively on their overall health and well-being.

**Emotional well-being:** Our results show that Emotional well-being is positively associated with all the personality types except Neuroticism: Openness ( $\beta= 0.17, p<0.01$ ), Conscientiousness ( $\beta= 0.12, p<0.01$ ), Extraversion ( $\beta= 0.27, p<0.01$ ), and Agreeableness ( $\beta= 0.16, p<0.01$ ). However, the positive association between Emotional well-being and Conscientiousness, Openness and Agreeableness is weak. Emotional well-being is negatively associated with Neuroticism ( $\beta= -0.35, p<0.001$ ). This means that people who are high in Extraversion are more likely to experience a

higher level of Emotional well-being as a contributor to subjective well-being compared to other personality types. This means that designing persuasive interventions to increase the feeling of relaxation and stress freeness can greatly improve the SWB and hence the overall health and well-being of people who are open to experience (Openness), cooperative (Agreeableness), goal-oriented (Conscientiousness) and Neurotic people.

**Social well-being:** Our results show that Social well-being is positively associated with Openness ( $\beta= 0.21, p<0.01$ ), Extraversion ( $\beta= 0.53, p<0.001$ ), and Agreeableness ( $\beta= 0.11, p<0.01$ ). On the other hand, Social well-being is negatively associated with Neuroticism ( $\beta= -0.23, p<0.01$ ) and is not significantly associated with people who are high in Conscientiousness. Extraversion emerged as the personality with the strongest positive associated with Social well-being. This may be due to their inherent nature, Extraversion tends to attach so much importance to having strong social networks, connecting and interacting with people. This is further supported by Kendra [59] who describes extroverts as people who tend to feel isolated when they spend much time alone, hence, they tend to prefer to spend most of their time being around people. This is also supported by Wido et al. [60] who found that extraverts participate in greater amounts of social activity compared to other people since they tend to enjoy it. The positive association between Social well-being and Agreeableness is weak. This means that people who are high in Extraversion and Openness are more likely to harbor a higher level of social well-being as a contributor to subjective well-being compared to those high in Conscientiousness, Neuroticism, and Agreeableness. Thus, designing persuasive interventions to increase the sense of belonging and social connectedness can greatly impact the sense of SWB and hence overall health and well-being of goal-oriented people (Conscientiousness), Emotionally unstable (Neuroticism) and cooperative (Agreeableness).

**Psychological well-being:** Our results show that Psychological well-being is positively associated with all personality traits except Neuroticism: Openness ( $\beta= 0.14, p<0.01$ ), Conscientiousness ( $\beta= 0.15, p<0.01$ ), and Extraversion ( $\beta= 0.18, p<0.01$ ), Agreeableness ( $\beta= 0.21, p<0.01$ ), and Neuroticism ( $\beta= -0.44, p<0.01$ ). The negative association of Neuroticism with Psychological well-being is expected since people high in Neuroticism tend to experience strong negative affect more often than other personalities. The positive association between Psychological well-being and Openness, Conscientiousness, and Extraversion is quite weak. This means that people who are high in Agreeableness are more likely to maintain a higher level of psychological well-being as a contributor to subjective well-being compared to those high in Openness, Conscientiousness, Extraversion, and Neuroticism. This implies that designing persuasive interventions to increase Psychological well-being will greatly impact the sense of SWB and hence overall health and well-being of people who are open to experience, Agreeable, Conscientiousness, and emotionally unstable (Neuroticism).

## 5. DISCUSSION

This study presents the results from investigating the relationship between personality traits and distinct components of subjective well-being in an African country where such a relationship has not been empirically confirmed. In this section, we discuss the results in relation to personality traits.

**Extraversion** is a personality trait characterized by the tendency to associate with others and seek excitement. Our findings show that Extraversion is weakly positively associated with psychological well-being. This means that people high in Extraversion do not involve themselves in activities that give them a high sense of Psychological well-being. This implies that persuasive interventions designers targeted at promoting the overall health and well-being of people who are outgoing and enthusiastic can achieve that by designing their interventions to promote the Psychological well-being component. This finding suggests that the overall health and well-being of people from African Nations who are extroverted can be significantly improved if their Psychological well-being is enhanced. **Therefore, we recommend that persuasive intervention designers targeted at promoting health and well-being among people who are outgoing and enthusiastic (high in Extraversion) could focus on designing to enhance their Psychological well-being to boost their SWB and hence overall health.**

Several techniques can be used in PT design to promote the psychological well-being of individuals. For example, feeling secure about the future, being hopeful, being positive, being enthusiastic have been shown to promote the sense of Psychological well-being [36]. Therefore, persuasive strategies such as *Reward* and *Praise* for small achievements have the power to evoke some feel-good emotions while *Self-monitoring* and *Simulation* that track and project the impact of an individual's micro efforts towards achieving the desired behavioral change can raise the anticipation of positive results hence promote Psychological well-being.

**Conscientiousness** is a personality trait that describes an individual's tendency to be self-disciplined, result-oriented, and goal-oriented. Our findings show that Conscientiousness is weakly positively associated with Emotional well-being and Psychological well-being and does not have a significant association with Social well-being. This means that people high in conscientious tendencies harbor low Emotional well-being, Psychological well-being, and social well-being. One possible explanation of why Social well-being is not significantly associated with conscientious people is that their goal-oriented and result-driven nature may make them too focused and unable to spare time to socialize with people around them. They are more likely to set strict goals and targets that make them conscious of how they spend their time, hence, they may not involve in social activities that are not an explicit part of their goals. This implies that persuasive intervention designers targeted at promoting overall health and well-being of people from African Nations who are result-oriented and strict on following norms and rules to achieve their goals can achieve that by designing their interventions to promote these three components of subjective well-being. **Therefore, we suggest that persuasive technology designers aimed at promoting health and well-being among people high in Conscious tendencies could focus on designing to promote their Emotional well-being, Psychological well-being and most especially the Social well-being.**

Several techniques can be used in PT design to create opportunities for an individual to interact and relate with others (Social well-being). For example, persuasive techniques from the social support category of the Persuasive System Design (PSD) framework [61] such as the *Social comparison*, *Cooperation*, and *Competition* which provides opportunities for people to share and compare information about their behavior, interact and work together with other people, and

compete with others could be employed by designers to promote an individual's sense of social well-being.

Similarly, some techniques can be used in PT design to promote Emotional well-being. For example, activities that make people experience serenity, love, support, the company have been shown to promote people's sense of Emotional well-being [42]. Consequently, persuasive strategies such as *Social facilitation*, *Cooperation*, and *Social learning* could be implemented to provide opportunities for users to discern that other people are performing the behavior (along with them) and offer some social support could be employed by designers to promote Emotional well-being and hence overall health and well-being of individuals. The strategies also give them the motivation and boost to continue the behavior change task,

**Neuroticism** is a personality trait characterized by the tendency to often be nervous, fearful, anxious or emotionally unstable. Our findings show that people high in Neuroticism tendency are negatively associated with Emotional well-being, Psychological well-being, Satisfaction with life, and Social well-being and do not have a significant association with Happiness. This means that people high in Neuroticism are usually not Satisfaction with their lives, and experience negative Social well-being, Emotional well-being, and Psychological well-being with very low Happiness. A possible explanation of why Satisfaction with life is negatively associated with people's high Neuroticism is that due to their distrustful and pessimistic nature, they may find it hard to see the positives in most life situations and hence tend to be unsatisfied with life. Another possible explanation is that people high in Neuroticism may be too fearful to explore a variety of experiences that add meaning to life and therefore tend to limit themselves to a certain lifestyle that they may not be satisfied with.

Similarly, a possible explanation of why Psychological well-being is negatively associated with people high in Neuroticism is that they tend to be pessimistic and hence may find it hard to cope with anticipated negative results or outcomes. This feeling of insecurity or negativity may result in low psychological well-being. An explanation for this finding is well captured in the statement of Ankrum [62] "*that anxiety is a response to an unknown threat.*" These findings are also in line with the study of Chamberlain [28] who shows that Neuroticism is negatively associated with mental health. A plausible explanation of why Emotional well-being is negatively associated with people high in Neuroticism is that due to their nervous and sensitive nature they are often vulnerable to anxiety [63]. Again, Social well-being is negatively associated with people high in Neuroticism because due to their distressful and fearful nature, they often avoid or decline any opportunities to socialize and integrate with other community members. Finally, a possible reason why Happiness is not significantly associated with Neuroticism is that due to their inherent characteristics of being emotionally unstable, they are often stressed out and nervous. This makes them incapable of appreciating beauty and driving pleasure from simple things of life that make other people happy. This means that persuasive interventions designers targeted at promoting overall health and well-being of people from African Nations who are high in Neuroticism can achieve that by designing their interventions to promote all the five components of subjective well-being. However, neuroticism is most strongly associated with Emotional well-being and Psychological well-being. This implies that the overall health and well-being of people from African Nations who are high in Neuroticism can be more promoted if activities that give them

more sense of Emotional well-being and Psychological well-being are enhanced. **Therefore, although designers aimed at designing persuasive intervention to promote health and well-being among people who are high in Neuroticism could focus on designing to promote their satisfaction with life, Happiness, and Social well-being, they should focus more on designing to promote their Emotional and Psychological well-being which are the strongest determinants of their SWB and hence their overall health and well-being.**

Some techniques can be used in PT design to promote Happiness. For example, activities and strategies such as expressing gratitude, acts of kindness, savoring, optimism, committing to one's goals have been shown to promote people's feeling of Happiness [10] [64]. Therefore, persuasive strategies such as *Rewards* which give individuals credit for performing the target behavior and *Praise*, in recognition of good behaviors can be employed by persuasive intervention designers to promote health and well-being. Self-monitoring and simulation can also be used to enable the user to see the projected and accumulated benefits of their tiny efforts towards achieving the desired behaviors as a way of promoting Happiness and hence overall Health and Well-being.

Likewise, some techniques can be used in PT design to promote Satisfaction with life. For example, activities such as setting and achieving goals, attaining status, gaining respect, have been shown to promote people's Satisfaction with life [33] [65]. Consequently, persuasive strategies such as *Goal setting* which provides people with opportunities to set their goals and *Feedback* which evaluates peoples' performance and provides them with information about their progress and achievements could be employed to promote a sense of achievement and fulfillment for people. Similarly, the *Recognition* strategy which provides opportunities for people's achievements to be publicly recognized could be employed by designers to make people experience feelings of pride and satisfaction with life and hence promote their SWB and overall health and well-being.

**Agreeableness** is a personality trait characterized by the tendency to be kind, sympathetic and cooperative. Our findings show that Agreeableness is weakly positively associated with Social well-being, Emotional well-being, Satisfaction with Life, and Happiness. Surprisingly, this finding contradicts Chen's [16] work among Taiwanese, in which he found that Agreeableness is negatively associated with satisfaction with life. One possible explanation for this contradiction is the influence of cultural differences in the target audience, as explained by Schimmack et al. [17] who found that the influence of personality on the Cognitive component of subjective well-being is moderated by culture. These findings suggest that people high in Agreeableness do not naturally engage in activities that give them a high sense of social well-being, Emotional well-being, Satisfaction with life and Happiness and hence harbor less of these components of SWB. This implies that persuasive intervention designers targeted at promoting the overall health and well-being of people from African nations, who are helpful, less competitive and friendly can target promoting these four components of subjective well-being. **Thus, we recommend that persuasive intervention designers aimed at promoting health and well-being among people who are high in Agreeableness should focus on designing to promote their Social well-being, Emotional well-being, Satisfaction with life, and Happiness as a way of promoting their SWB and hence overall health and well-being.**

**Openness** is a personality trait characterized by the tendency to be open to a variety of experiences. Our findings show that Openness is weakly positively associated with Emotional well-being and Psychological well-being and does not have a significant association with Satisfaction with life. A possible reason why the association between Satisfaction with life and Openness is not significant is that people who are high in Openness tend to explore a variety of life experiences, therefore, they may be overwhelmed if their life does not measure up favorably against their standard. They are more interested in exploring different life experiences. Interestingly, these findings contradict Chen [16] who found a significant correlation between Openness and Satisfaction with life. As explained earlier, this contradiction could be due to cultural differences in the target audience. This means that persuasive intervention designers aimed at promoting the overall health and well-being of people from African Nations who are open to experience can do so by targeting these three components of subjective well-being. **Therefore, although designers aimed at promoting health and well-being among people who are high in Openness could focus on designing to promote their Emotional well-being and Psychological well-being, they should emphasize more on their Satisfaction with life.**

Persuasive strategies such as *Reward*, *Praise*, and *Recognition* for micro-behaviors could be employed in persuasive interventions for promoting health and well-being to improve individuals' Satisfaction with life in line with positive reinforcement.

In summary, our findings show that people high in Extraversion are most strongly positively associated with all the five SWB components. This means that in general, they experience a higher sense of SWB compared to other personality types. On the other hand, people high in Neuroticism are most strongly negatively associated with the SWB components. This suggests that they harbor a low sense of SWB when compared to other personality traits. Hence PT designers should pay special attention to how to design to promote SWB among people high in Neuroticism.

## 6. LIMITATIONS

One limitation of this study is that we used self-report measurements to assess people's Personality traits and Subjective well-being. Although this is still the standard practice, we acknowledge that it may be biased

## 7. CONCLUSION

This paper presented the results of a large-scale study of 732 participants from a developing African country investigating the relationship between Personality traits and distinct subjective well-being components. Interestingly, our findings show that the relationship between personality traits and subjective well-being of Africans (predominantly Nigerians) are to some extent similar to those of other nations. Consistent with other studies, our results show that there are statistically significant relationships between the Big Five Personality traits (*Openness*, *Conscientiousness*, *Extraversion*, *Agreeableness*, and *Neuroticism*) and the distinct components of subjective well-being (*Happiness*, *Satisfaction with life*, *Psychological well-being*, *Emotional well-being*, and *social well-being*). Specifically, our results show that people high in Extraversion are weakly associated with Psychological well-being. We also uncovered that people high in

Conscientiousness are weakly positively associated with Emotional well-being and Psychological well-being and have no significant association with Social well-being. Our study also uncovered that people low in Neuroticism are strongly negatively associated with Emotional and Psychological well-being. Furthermore, our study revealed that Openness is weakly positively associated with Emotional well-being, Psychological well-being, and does not have a significant association with Satisfaction with life. Finally, we found that Agreeableness is weakly positively associated with Social well-being, Emotional well-being, Satisfaction with Life and Happiness.

Findings from this study imply that the interplay between personality traits and subjective well-being could play an important role in health informatics design. This study suggests that health informatics designers who seek to promote the health and well-being of individuals of different personality traits could target promoting specific components of the subjective well-being that an individual is weak on or negatively associated with. We suggest some design guidelines and persuasive strategies for promoting different subjective well-being components in persuasive intervention design depending on the target user's personality.

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## **APPENDIX: PERSONALITY TRAITS AND SUBJECTIVE WELL-BEING MEASUREMENT INSTRUMENT**

### **PERSONALITY TRAITS**

On a scale of 1 to 5 (1= Strongly disagree to 5 = Strongly agree), to what extent do you agree with the following statements.

I see myself as someone who:

1. is reserved.
2. is generally trusting.
3. tends to be lazy.
4. is relaxed, handles stress well.
5. has few artistic interests.
6. is outgoing, sociable.
7. tends to find fault with others.
8. does a thorough job.
9. gets nervous easily.
10. has an active imagination.

### **HAPPINESS SCALE**

On a scale of 1 to 5 (1= Very unhappy to 5 = Very happy), please circle one number that corresponds to your response to each question.

1. If you were to consider your life, in general, these days, how happy or unhappy would you say you are?
2. Compared to most of your peers, you consider yourself?
3. Some people are generally happy. They enjoy life regardless of what is going on, getting the most out of everything. To what extent does this characteristic describe you?

4. Some people are generally not happy, although they are not depressed, they never seem as happy as they might be. To what extent does this characteristic describe you?
5. Please, list things that make you happy (you can list up to 10)
6. please, list things that make you unhappy (you can list up to 10)

### **SATISFACTION WITH LIFE SCALE**

On a scale of 1 to 5 (1= Strongly disagree to 5 = Strongly agree), to what extent do you agree with the following statements.

1. In most ways, my life is close to my ideal
2. The conditions of my life are excellent.
3. I am satisfied with my life
4. So far, I have gotten the important things I want in life.
5. If I could live my life over, I would change almost nothing.
6. All things considered, I am satisfied with my life these days.
7. Please, list things that give you satisfaction in life (you can list up to 10 things):
8. Please, list things that make you unsatisfied with life (you can list up to 10 things):

### **SOCIAL WELL-BEING SCALE**

1. I have close contact with my direct neighbors
2. I think it's important to be a member of an association
3. I'm content with my social position
4. I'm content with the relation to my neighbours
5. People in my neighbourhood handle each other in a positive manner.
6. I see myself as a part of society
7. I gladly have contact with other people via social media (Facebook, e-mail)
8. There are enough people with who I feel strongly connected
9. I gladly help other people if they need my help
10. I'm content with the composition of the population in my neighbourhood.
11. I feel accepted in my neighbourhood
12. I trust in the people in my surrounding
13. I gladly participate in activities in my neighborhood
14. My work situation contributes to my well-being.
15. I gladly spent time with online gaming with other people
16. I'm content with my surroundings.

### **PSYCHOLOGICAL WELL-BEING SCALE**

1. I lead a purposeful and meaningful life.
2. I am engaged and interested in my daily activities.
3. I am competent and capable in the activities that are important to me.
4. I am a good person and live a good life.
5. My material life (income, housing, etc.) is sufficient for my need
6. I am satisfied with my religious or spiritual life.
7. I am optimistic about the future.

8. I have no addictions, such as to alcohol, illicit drugs, or gambling
9. People respect me.
10. I have been feeling optimistic about the future.
11. I actively contribute to the happiness and well-being of others.
12. I generally trust others and feel part of my community

**EMOTIONAL WELL-BEING SCALE**

1. I have been feeling useful.
2. I have been dealing with problems well.
3. I have been thinking clearly.
4. I have been feeling close to other people.
5. I have been feeling confident.
6. My social relationships are supportive and rewarding
7. I have been interested in new things.
8. I have not been feeling depressed.
9. I have not been feeling sad.
10. I have not been feeling afraid.
11. I have been feeling contented.
12. I have been feeling positive.
13. I have been feeling joyful.
14. I have been feeling cheerful.
15. I have been able to make up my mind about things.
16. I have been feeling loved