
Openness to Experience and Health: A Review of the Literature

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The Five Factor Model, one of the most commonly used models for assessing personality, consists of five main universal traits: extraversion, neuroticism, agreeableness, conscientiousness, and openness to experience (McCrae & John, 1992). Recently, its application to fields investigating the role of personality on physical and mental health has been extensive, with most traits producing consistent results across studies. The fifth of the model's main traits, however, openness to experience, has produced inconsistent results. In this review, we attempt to understand why these findings have been mixed by analyzing various facets of this trait in depth. We evaluate the six facets of openness to experience: actions, ideas, values, aesthetics, fantasy, and feelings individually to better understand the implications of openness to experience on physical and mental health.

Personality can be defined as the consistent behavioral, attitudinal, and motivational patterns that differ across individuals (McCrae & John, 1992). To describe this enduring set of patterns, theorists have long sought ways to identify and categorize the basic elements of personality. One of the primary methods to identify and categorize these basic elements has been factor analysis, where thousands of personality traits are listed and then eliminated as similar traits are grouped together (McCrae & John, 1992). As the field of personality psychology has progressed, though, theorists have continually disagreed on what the basic dimensions are and how many there should be. And while there still remains wide disagreement across theorists, one recent framework has been particularly used and accepted across psychology and related fields. This model is known as the Five Factor Model.

Evidence for the Five Factor Model began to make its way into personality psychology in the early 1980s. Psychologists Paul Costa and Jeff McCrae had finished reviewing multiple personality scales and developed an integrative personality scale known as the NEO Personality Inventory Revised (NEO PI-R), which measured

five particular traits: neuroticism, extraversion, openness to experience, conscientiousness, and agreeableness (John, 2008). The appeal of their work came largely from its ability to take into account factors that were similar across different personality scales (John, 2008). For instance, extraversion, the trait describing one's propensity towards sociability and positive emotions, and neuroticism, the trait describing emotional stability, can be found in earlier personality scales such as Allport's Trait Theory, Cattell's Sixteen Personality Factors, and Eysenck's Big Three (McCrae & John, 1992). Thus, while personality psychologists frequently disagreed over what the basic dimensions were and their number, there was some agreement on certain dimensions. Following the Five Factor Model research done by Costa and McCrae and other researchers, additional personality scales measuring these five particular traits were later developed, including Lew Goldberg's International Personality Item Pool, Gerad Saucier's Big Five mini-markers, and Oliver John's Big Five Inventory (BFI) (John, 2008).

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While researchers differ in which questionnaire they may prefer to use, many of the questionnaires have proven to be reliable and only have a few discrepancies in questions and length.

The Five Factor Model, also labeled the Big Five, does not refer to a particular questionnaire, but rather a general personality framework based off of five main universal traits:

extraversion, neuroticism, agreeableness, conscientiousness, and openness to experience (John, 2008). Extraversion, as briefly mentioned above, is one of the most studied personality traits, probably due to the large role it plays in our interpersonal lives (John, 2008). It is a trait characterized by high energy, enthusiasm, and assertiveness. A behavioral example is of extraversion is an individual who makes the effort to approach strangers and begin conversation. An individual low on the trait of extraversion would be less likely to perform such an action. Less extraverted individuals often prefer to keep to themselves and engage in solitary activities. While low extraversion does not necessarily imply anti-sociality, less extraverted individuals generally have smaller social circles than their more extraverted counterparts.

Neuroticism, also briefly mentioned above, deals with emotional stability. In fact, some personality theorists such as Cattell had referred to it directly as emotional stability (McCrae & John, 1992). Like all of the Big Five traits, neuroticism is also on a spectrum. Those who are high on the trait are more prone to negative feelings such as anxiety, tension, and depression, while those who are low on the trait are calmer and more even-tempered (John, 2008). A behavioral instance of neuroticism is an individual who might get overly anxious when there is little to be anxious about and ruminate continuously about negative events that have already occurred. A less neurotic individual would relax about most situations and when faced with a difficult situation, try to see the good in it.

Conscientiousness, the third trait, describes order, discipline, and impulse control (John, 2008). It is most noted for its ability to influence the organization and direction of behavior (McCrae & John, 1992). High conscientiousness can be seen in people who are punctual, have a strong work ethic, do not get easily distracted, and take good care of their health by eating right and taking their medication (John, 2008). They are people who are focused, prepared, and

almost always have a plan. Individuals low on conscientiousness are unorganized, easily distracted, and often not as disciplined. They prefer spontaneity and are not as concerned about controlling aspects of their environment or even their own behavior.

Agreeableness is the fourth of the Big Five traits. It is similar to extraversion in that it is deeply related to interpersonal relationships. However, it is more concerned with the way one treats and deals with others, as opposed to whether or not one actively seeks relationships out. For instance, one who is highly agreeable is empathetic towards others. They are affectionate, trustworthy, and altruistic (John, 2008). Due to their kind nature, they are able to work better in groups and often have relationships with little conflict (John, 2008). Less agreeable individuals may be aggressive, rude, and look at others with contempt. Unlike highly agreeable individuals, they are not very considerate of people's emotions and might be far more concerned about themselves and their own desires. Their lack of consideration for others might result in unsatisfying relationships and numerous interpersonal problems.

The last of the Big Five traits is openness to experience, which is described by novelty-seeking, intellectual curiosity, a vivid imagination, awareness of inner emotional states, and deep appreciation for the arts (John, 2008). Individuals high on this trait seek out activities that bring meaning to their lives and allow them to think about things in a different way. They may prefer to change their routine to make things more interesting or they might seek out an opportunity to do something they have never done before. Individuals low on this trait prefer sameness and predictability and are often unoriginal and closed-minded. Overall, they are less likely to seek out activities that may enrich their mental and experiential lives, primarily because they are not interested in doing so.

Application of the Five Factor Model to Health

The comprehensiveness of the Big Five traits has enabled researchers to better use personality traits as predictors for certain types of behaviors or outcomes, and thus has been applied to numerous fields including education, industrial and organizational psychology, developmental psychology, and forensics

(McCrae & John, 1992). More recently however, the Big Five have been used in the field of health, with a large focus being placed on understanding how personality factors can affect mental and physical health. Extraversion, conscientiousness, and agreeableness for instance, have been linked to positive outcomes such as greater immune response to infection (Capitanio, Abel, Mendoza, Blozis, McChesney, Cole, & Mason, 2008; Sloan, Capitanio, Tarara, & Cole, 2008), lower probability of developing a cold (Cohen, Doyle, Turner, Alper, & Skoner, 2003), positive health perception (Jerram & Coleman, 1999), longevity (Bermudez, 1999), and positive adjustment to illness or disability (Boyce & Wood, 2011). Neuroticism on the other hand, has been linked to higher disease risk and other negative outcomes such as decreased levels of oxytocin and neuropeptide Y (Schaller & Murray, 2011).

When it comes to understanding the role of openness to experience in health, findings have been mixed, with some studies finding that high openness to experience is beneficial and others finding that it can contribute to negative outcomes. Perhaps the challenge in making sense of the relationship between health and openness to experience arises from the controversial nature of the trait itself. Most personality psychologists endorse some form of openness to experience, but throughout the history of personality psychology the trait has continued to take on different forms (John, 2008). Some have referred to it as an indicator of intellect, while others have referred to it as an indicator of creativity.

Applying a Facet Approach. In the longest and most detailed of the Big Five questionnaires, the NEO-PI-R, Costa and McCrae have made individual distinctions for each trait within their survey by assigning every trait six *facets* to better understand the trait (McCrae & John, 1992). Facets can be considered as more detailed dimensions of an individual personality trait. For instance, one may be extraverted in the sense that they are very assertive, while one may be extraverted in the sense that they are gregarious. It is not necessary for an individual who scores high on a Big Five trait to embody all of its characteristics. Thus, in this example of extraversion, Costa and McCrae divide aspects of the trait into facets, two of which are gregariousness and assertiveness.

Facets of the Big Five traits are meant to be inter-related and yet despite being grouped

under the same trait, the facets of openness to experience in particular have been argued to almost be individual personality traits themselves. The six facets of openness to experience are openness to actions, ideas, values, aesthetics, fantasy, and feelings (Coan, 1972). Openness to actions describes the drive to seek out new activities and attempt new things; openness to ideas is the desire to be intellectually curious and think about things in new and interesting ways; openness to values is the willingness to re-examine one's traditional values, be it political, cultural, or religious; openness to aesthetics describes the tendency for one to appreciate the arts; openness to fantasy is the proclivity towards deep imagination and fantasy; and the last facet, openness to feelings, describes how in tune one is with their emotional states.

While individuals who score high on openness typically score high on most of the facets of openness, the distinction of each facet makes it possible for someone to be very open in one area, but very closed in another (Coan, 1972). For instance, consider the difference between the person who seeks out exhilarating activities such as bungee-jumping and the person who prefers calmer activities such as attending art exhibits. Even if they are both high on openness, they can vary widely in the types of experiences to which they are open (Coan, 1972). Thus, it is not accurate to say that such individuals are open in the same way, even if their overall openness scores turn out to be identical.

Since openness to experience is such a complex trait, it is reasonable to take into account each facet level when approaching research on the influence of the trait on health. Many studies that have examined the influence of openness on health have looked at the trait broadly instead of at the facet level. It may be that failure to take into consideration scores on the individual facets makes results challenging to interpret. In this review, we attempt to understand what the physical and mental health implications of openness are by deeply examining the individual facets. We first group the six facets into two main categories: facets that have a strong behavioral and cognitive component, openness to actions, ideals, and values, and facets that have a strong emotional component, openness to aesthetics, fantasy, and feelings. The reason for this grouping is because facets vary in their main focus and it is simpler to discuss facets that are similar in their

focus than facets that are different. For instance, the facet of actions has a strong behavioral component because it is geared towards seeking out physical activities and is less concerned with emotion, whereas the facet of feelings has a strong emotional component because it describes how much one values their emotional experience and is less concerned with physical pursuit of certain activities. When discussing each facet we will provide a description of the characteristics that the facet entails then discuss the relevant biological correlates that have been found thus far. Next, we summarize findings on links between each facet and health, with consideration for both physical and mental disorders. Finally, we review current controversies and theoretical difficulties, then propose some future directions for research.

The Facets of Openness to Experience

Openness to actions Openness to actions is characterized by involvement in varied experiences and enjoyment of novelty. It has been considered by McCrae and Costa (1997) to be a facet of motivation to engage in novelty and complexity. While it has been found to have a strong relationship with the trait of extraversion, McCrae and Costa (1997) have argued that it reflects a pure behavioral exploratory tendency, while openness to actions takes into account a cognitive element as well. To better understand the behavioral component of openness to actions, many researchers have also examined sensation seeking (Aluja, Garcia, & Garcia, 2002). This is because extraversion and openness to actions are often positively correlated with sensation seeking. Sensation seeking has been defined by Zuckerman (1979) as "the need for varied, novel, and complex sensations and experiences and the willingness to take physical and social risks for the sake of such experience." It has been linked to the seeking of high stimulating activities such as exotic meals, various sports, as well as illegal activities. Such activities include the willingness to take various risks to experience them and thus, frequently carry with them the trait of impulsivity (Gerra, Avanzini, Zaimovic, Satori, Boochi, Timpano, Zambelli, Delsignore, Gardini, Talarico, & Brambilla, 1999).

Biological correlates of openness to actions. In investigating the biological correlates of

openness to actions, most studies have not directly assessed openness. Instead they have investigated the biological correlates of extraversion or sensation seeking. Both sensation seeking and extraversion have been linked to high levels of norepinephrine, low levels of monomamine oxidase (MAO), and variations in dopamine receptors (Cloninger, 2000). In investigating the relationship between norepinephrine and sensation seeking, it has been found that higher levels of norepinephrine may not be the cause, but rather a consequence of sensation seeking.

Norepinephrine is a catecholamine that plays multiple roles, most importantly in the stress response. While norepinephrine levels increase with higher levels of cortisol, it has been hypothesized that only increased levels of norepinephrine, and not cortisol, are directly correlated with sensation seeking (Gerra et al., 1999). However, other research findings have presented a similar hypothesis, but under the belief that high sensation seeking is linked to lower and not higher levels of norepinephrine (Zuckerman, 1995). It has been proposed that high sensation seekers are chronically under-aroused and thus through the seeking of stimulating activities, are able to raise their levels of norepinephrine (Zuckerman, 1995). Likewise, other researchers have made a similar proposal with dopamine, proposing that individuals high on sensation seeking have high scores because they have an increased sensitivity of postsynaptic dopamine receptors and that they require higher densities of dopamine to overcome the sensitivity (Gerra et al., 1999).

In examining MAO, researchers have found that there is a negative correlation with the trait of sensation seeking (Zuckerman, 1995). MAO is an enzyme that regulates monoamine levels by breaking down various neurotransmitters. The type B MAO has been particularly noted for its significance because it breaks down dopamine (Zuckerman, 1995). Since low levels of MAO are related to sensation seeking and extraversion, it is not surprising that individuals high on sensation seeking and extraversion have higher levels of circulating dopamine. Research on gender differences in MAO levels has found that men typically have lower levels of MAO. In addition, males that carry the 3-VNTR MAOA gene variant have higher levels of MAO and correspondingly, significantly lower scores in openness (Samochowiec, J., Syrek, Michal, Ryzewska-Wodecka, Samochowiec, A.,

Horodnicki, Zakrzewska, & Kucharska-Mazur, 2004).

Another enzyme partly responsible for metabolizing catecholamines that has been briefly investigated is the enzyme catechol-O-methyltransferase (COMT). Unlike the findings on MAO, high enzyme activity of COMT has been shown to be related to high levels of extraversion and sensation-seeking (Reuter & Hennig, 2003). Reuter and Hennig (2003) have vouched for the functional polymorphism of COMT, VAI158MET, as a candidate gene locus to examine further in determining biological correlates of extraversion and related characteristics and behaviors. In their experiment they found that the group with the higher extraversion scores had the VAL/VAL polymorphism (Reuter & Hennig, 2003).

Most work on high levels of dopamine has consistently shown that it is linked to characteristics such as impulsivity, excitability, and a desire to explore (Epstein, Novick, Umansky, Priel, Osher, Blaine, Bennett, Nemaov, Katz, & Belmaker, 1996; Panksepp, 1998; Reuter & Hennig, 2003). Lower levels have been affiliated with less flexibility, but a calmer temperament (Epstein et al., 1996). The belief is that dopamine regulates the motivational component of openness similar to how it regulates extraversion (Depue & Collins, 1999). Research on Parkinson's disease has corroborated this hypothesis (Kaasinen, Nurmi, Bergman, Eskola, Solin, Sonninen, & Rinne, 2001). Patients with Parkinson's disease experience degeneration of motor movement due to the death of dopamine-generating cells in the brain's substantia nigra. Kaasinen and colleagues (2001) compared un-medicated Parkinson's disease patients and controls to see if there was a difference in sensation-seeking levels. Patients with Parkinson's disease were found to have lower sensation seeking scores than controls, although this is identified as an effect of the disease, not a cause (Kaasinen et al., 2001). Similar relationships between sensation seeking and dopamine have also been found in patients with schizophrenia, who unlike Parkinson's disease patients have abnormally high levels of dopamine and thus, higher levels of sensation seeking, as well as high openness scores (DeYoung, Peterson, & Higgins, 2003).

Epstein and colleagues examined the dopamine D4 receptor (D4DR) exon III polymorphism and found that it was linked to sensation seeking, with individuals that carry the

7 repeat allele having significantly high sensation seeking scores (Epstein et al., 1996). Okuyama and colleagues have said that the effects of the 7 repeat allele is a result of differences in ligand affinity (Okuyama, Ishiguro, Nankai, Shibuya, Watanabe, & Arinami, 2000). They have also looked at DRDR, namely a polymorphism at -521C/T, and found that individuals with the T variant of the C-521T polymorphism have reduced transcriptional efficiency (Okuyama et al., 2000). Thus, subjects with a T/T genotype had the lowest sensation seeking scores, while subjects with a C/C genotype had the highest sensation seeking scores (Okuyama et al., 2000). In addition to DRD4, Ishiguro and colleagues have also looked at the dopamine D2 receptor gene (DRD2) and found that high sensation seeking is correlated with the A2 allele. They state that this is likely a result of increased dopamine D2 receptor binding (Okuyama et al., 2000).

DeYoung and colleagues have attempted to examine possible differences between extraversion/sensation seeking and openness by proposing that extraversion is linked to dopaminergic projections to the striatum and that openness is linked to dopaminergic projections to the prefrontal cortex (PFC) and the anterior cingulate cortex (ACC) (DeYoung et al., 2003). They have argued that openness is linked to the PFC because the PFC plays numerous roles in cognitive function, particularly working memory, which is necessary for manipulating information and carrying out important executive functions (DeYoung et al., 2003). In addition, increased dopaminergic activation in the PFC has been linked to an improvement of performance on tests of cognitive ability and flexibility. Despite their proposal, however, after administering cognitive tasks such as letter randomization, word fluency, recency judgments, and spatial and non-spatial conditional association tasks, DeYoung and colleagues have found that openness to actions is the least strongly related openness facet to cognitive variables (DeYoung et al., 2003).

Health and openness to actions. Research on the links between health and openness to actions has given mixed results, with some evidence demonstrating a positive association and other evidence demonstrating a negative association. Evidence demonstrating a positive association has supported the hypothesis that individuals high on openness to actions have better physical health because they have better

mental health. Researchers in support of this proposal have argued that this is because individuals higher on openness to actions are more likely to engage in behaviors that make them happy (Salovey, Rothman, Detweiler, & Steward, 2000). This is particularly significant for individuals who are diagnosed with a serious physical illness. Seeking activities that improve a patient's mood can allow them to have greater confidence in themselves and recovery of their illness (Salovey et al., 2000). For instance, when examining patients with Parkinson's disease, it has been found that lower scores on sensation seeking have been linked to higher depression scores than controls (Menza & Mark, 1994).

Dua (1990) has found that openness to actions predicts "emotional stability, lack of depression, and positive affect, both from thoughts and from real-life experiences". In a more recent study, Garcia and colleagues found that high sensation seeking was linked to less depression (Garcia, L.F., Aluja, Garcia, O., & Cuevas, 2005). Carrillo and colleagues (2001) have also come across similar results, with openness to actions negatively correlating with the Neuroticism factor and being predictive of depression. Higher scores on openness to actions were significantly less associated with both neuroticism and depression (Carrillo, Rojo, Sanchez-Bernardos, & Avia, 2001). Similar findings have also been found in relation to gender differences. Males, who naturally have higher levels of dopamine, typically score much higher than women on openness to actions and are less susceptible to depression (Carrillo et al., 2001). Other evidence on the relationship between depression and openness to actions has also pointed to polymorphisms in the serotonin transporter, which has been linked to depression in several studies (Samochowiec et al., 2004). Women who have the short variant of 5-HTT-linked polymorphic region (5-HTT-LPR) have been found to be more susceptible to depression and have lower scores of exploratory excitability (Samochowiec et al., 2004).

Oswald and colleagues (2006) have examined the association between openness to actions and cortisol responses as indicators of stress and anxiety. Participants underwent a laboratory psychological stress test and had their cortisol levels measured before and after (Oswald, Zandi, Nestadt, Potash, Kalydijan, & Wand, 2006). Individuals who were lower on openness to actions had higher cortisol levels and individuals who were higher on openness had lower cortisol levels (Oswald et al., 2006).

Another study by Schneider and colleagues (2011) came across the same findings. This may be further evidence for the hypothesis that higher sensation seeking scores are linked to high levels of norepinephrine, but not high levels of cortisol.

While there is evidence in support of the benefits of openness to actions, such as proactive seeking of diverse experiences and a decreased risk for depression, other evidence demonstrates that high openness to actions can also be detrimental to health. Booth-Kewley and Vickers, Jr. (1994) conducted an experiment on the associations between openness to experience and health behavior. Several individuals high on openness to actions reported greater substance risk taking. Booth-Kewley and Vickers, Jr. also measured other domains of personality, but found openness to be the only significant personality domain that predicted substance risk taking (Booth-Kewley & Vickers, Jr., 1994). One common model that attempts to link personality and disease holds that personality can lead to disease through the practice of unhealthy behaviors (Friedman & Booth-Kewley, 1987). Since openness to actions demonstrates a positive association with substance risk taking due to the desire to explore and bring about pleasure, it may present a negative link with healthy behavior (Jerram & Coleman, 1999; Salovey et al., 2000).

Openness to Ideas

While openness to actions expresses the motivation behind the behavioral dimension of openness to experience, openness to ideas focuses more on the motivation behind the cognitive component. Individuals who are high on openness to ideas exhibit greater flexibility in terms of "processing information and exploring the environment" (DeYoung et al., 2003). As Batey and Furnham (2006) state, extraversion and openness to actions "predict only the quantity, not the quality of ideas". Individuals high on openness to ideas are willing to try to new things and examine and reflect on their new experiences (McCrae & Costa, 1997). Even though an individual high on openness to actions is likely to be high on openness to ideas, openness to ideas does not require the behavioral component of openness to actions. High scores of openness to ideas may or may not reflect willingness to engage in novel behaviors, but always indicate a greater

engagement in activities that have the potential to increase knowledge (Wainwright, Wright, Luciano, Geffen & Martin, 2008). The willingness to engage in activities that increase any kind of knowledge has led to findings on how openness to ideas affects intelligence and creativity (or plasticity).

When first determining the characteristics associated with openness to experience, McCrae and Costa had decided that intellect was related to the trait, but that it was too broad (McCrae & Costa, 1997). Amongst the Big Five traits though, openness is the only trait positively correlated with the intelligence quotient (IQ), which is frequently used to assess general intelligence (DeYoung et al., 2003). Of the six facets, openness to ideas has appeared to capture intellect the most adequately, with individuals high on this facet demonstrating greater efficiency in processing, organizing, and reflecting on information (DeYoung et al., 2003). Alongside openness to values and aesthetics, it has been found to be heavily associated with fluid intelligence, thereby showing cognitive flexibility, and not merely knowledge of facts (DeYoung et al., 2003; Wainwright et al., 2008). Nonetheless, researchers acknowledge that openness to ideas, or openness in general, cannot be used to measure intelligence because they describe a dimension of personality as opposed to intellectual ability (McCrae & John, 1992). High openness has also been frequently linked to education level, which has made the issue of using openness to determine intelligence or intellect controversial (Tesch & Cameron, 2003).

Since a characteristic of openness to ideas is the desire to seek and engage with different types of ideas, researchers have explored the relationship between creative thinking and openness. Silvia and colleagues (in press) had college students complete measures of the Big Five and measurements of creativity, including creative cognition and creative achievement. While the Big Five is intended to be a separate measure of personality, measurements of creativity also indirectly assess aspects of personality because the two areas of creativity, plasticity and stability, are a combination of the Big Five traits. Plasticity is composed of general openness to experience and extraversion to reflect the tendency “to explore and engage flexibly with novelty, in both behavior and cognition” (Silvia, Nusbaum, Berg, Martin, & O’Conner, in press). This area of creativity in particular is argued to be a higher-order factor

relevant to openness (Silvia et al., in press). Stability is a combination of the remaining Big Five traits, agreeableness, conscientiousness, and neuroticism/emotional stability, and reflects the tendency “to maintain stability and avoid disruption in emotional, social, and motivational domains” (Silvia et al., in press). They found that the students’ levels of openness predicted their levels of creativity in several domains, ranging from arts and sciences to humanities (Silvia et al., in press). While there was a positive association though, there were a few concerns, all countering the assessment of creativity.

The first concern was regarding the plasticity dimension of creativity. Because it is composed of extraversion in addition to openness, it may not be entirely accurate. Some introverts have been found to be more open and creative than extraverts. It may be however, that introverts are more likely to have higher levels of stability due to the frequent associations between introversion and agreeableness, conscientiousness, and neuroticism. Whereas, they may have lower levels of plasticity due to the fact that it relies highly on extraversion. A second concern was regarding the finding on predicting creativity in several domains. High creativity and openness was found in students who had high interest in sciences, but if they had high interests in the arts. Other students however, such as those who exhibited interest in the math-science domain were not found to exhibit high levels of creativity. This may indicate a relation to openness to aesthetics, where intellect alone is not sufficient, and artistic creativity and interest is necessary. DeYoung, Quilty, and Peterson (2007) have proposed that openness may in fact be divided into an intellectual component and a more artistic component involving imagination, creativity, and aesthetics. Thus, while creativity can be a measure of plasticity and intellect, it may be a better measurement to use when assessing openness to aesthetics, instead of openness to ideas.

Biological correlates of openness to ideas. Little work has been done on the biological correlates of openness to ideas, with most research targeting biological correlates of intelligence to represent the facet. In one study by Duncan and colleagues (2000) PET scans of subjects were taken during tasks requiring the use of general intelligence (*g*). The tasks that required high use of *g* were found to activate the dorsolateral prefrontal cortex (PFC) as well as the dorsal

anterior cingulate cortex (ACC) (Duncan et al., 2000). It is proposed that this may be due to the PFCs role in cognitive permeability and the ACCs role in working with the PFC to monitor possible errors and reset task goals. It is also hypothesized that dopamine may regulate openness' cognitive permeability, as demonstrated in DeYoung et al.'s study on openness to actions where increased dopaminergic activation in the PFC was related to increased cognitive ability and flexibility (DeYoung et al., 2003).

Health and openness to ideas. Openness to ideas has generally been shown to provide numerous health benefits. A desire to engage in various activities and interests not only increases knowledge and keeps the brain significantly more active, but is also linked to many introspective and expressive behaviors that have the potential to raise self-esteem, flexibility, and life satisfaction (Tesch & Cameron, 2003; Wainwright et al., 2008). Individuals high on openness to ideas have been found to exhibit greater flexibility in dealing with life changes as well as changes in one's identity (Whitbourne, 1986).

Flexibility is linked to an analysis of identity exploration and a reflection on current events. Someone who is flexible exhibits the willingness to not only think about the changes that they're undergoing, but make reasonable alterations to their life (Whitbourne, 1986; Tesch & Cameron, 2003). When examining how openness to ideas was linked to personality and life change, Whitbourne found that through flexibility, individuals came to feel positive about themselves and that they had a sense of control over how to deal with different life events (Whitbourne, 1986). A previous study by Costa and McCrae (1980) had shown that there was a relationship between the occurrence of major life events and openness. Whitbourne's study came across a similar finding in which individuals who were more open were more likely to seek out experiences that increased knowledge, such as pursuing a higher education (Whitbourne, 1986).

Stephan (2009) examined the relationship between openness and life satisfaction in older adults and found that openness to ideas was positively correlated with self-reported life satisfaction, regardless of self-reported health and financial satisfaction. He concluded that greater life satisfaction was correlated with openness to ideas because open people typically search for opportunities for personal

growth and reflect on their experiences. Opportunities pursued may include a wide range of intellectual and cultural activities that can enable individuals to enhance and maintain their cognitive abilities, which can promote higher life satisfaction. People high on openness to ideas not only exhibit higher life satisfaction, but also less stress. A study by Oswald and colleagues found that after taking a psychological stress test, individuals high on openness to ideas had lower cortisol responses than individuals low on the facet (Oswald et al., 2006). The study previously mentioned by Schneider and colleagues (2011) in the discussion on openness to actions, also felt that high openness to ideas predicted lower cortisol responses.

Openness to Values

Openness to values is defined as the extent to which individuals are resistant to or receptive of change. Similar to openness to ideas, openness to values has frequently been linked to determining flexibility of thought. Individuals who are high on openness to values question conventional norms and traditions and are more likely to reject unconventional principles. Thus, it is often studied in political psychology to analyze the personality differences between "conformists" and "non-conformists". Whereas conservative individuals are less adventurous, socially conforming, and prefer rigidity and structure in society, liberal individuals are more likely to support protests and revolutions in light of accepting change (McCrae, 1996). Some research has even found that low openness to values is linked to authoritarianism and a tendency towards aggression (McCrae, 1996). Research has also shown that cultural conservatism values more traditional work ethics and conventional female roles (Van Hiel & Mervielde, 2004). While openness to values encourages independent thinking, action and receptiveness of change, low openness to values encourages protecting stability and security (McCrae, 1996). Thus, it's believed that openness to values can predict whether one prefers change in aspects of her life or not.

Despite these positive findings, however some researchers have argued that there is a distinction between personality traits and moral values, and so it is conceptually invalid to claim that such differences reflect personality per se. As McCrae has argued, "traits describe what

people are like, but values refer to what people consider important" (McCrae, 1996). Traits are representative of enduring dispositions, whereas values serve as cognitive representations of enduring goals and guiding principles of how one prefers to live their life (McCrae, 1996). One study by Van Hiel and colleagues (2000) had shown that there was a relationship between conservative ideology and openness facets in Western Europeans. However, the one facet that exhibited no association was the values facet. Thus, it is not clear if psychological factors, no matter their ideological content, are linked to a liberal or conservative ideology (Hiel & Mervielde, 2004). Hiel & Mervielde argue that conservatism may be conceptualized differently across cultures, where in some cases they may be related to certain personality traits such as broadmindedness, but in other cultures, such as the Western European sample taken in Van Hiel et al.'s (2004) experiment may not.

Biological correlates of openness to values. Few investigations of biological correlations of openness to values have been performed. Those that have been done, however, have focused on cognitive flexibility, with the idea that greater cognitive flexibility is not only reflective of intellect, but also resistance to or acceptance of change. In one study by Kalbitzer and colleagues (2009), cerebral binding of plasma membrane serotonin transporter (5-HTT) was tested. Kalbitzer and colleagues (2009) hypothesized that potentiation of serotonergic transmission could effect cognitive flexibility. Using positron emission tomography (PET), it was found that subjects who had greater cerebral binding of the 5-HTT selective PET radioligand were lower on openness than subjects who had low levels of binding (Kalbitzer, Frokjaer, Erritzoe, Svarer Cumming, Nielsen, Hasemi, Baare, Madsen Hasselbalch, Kringelbach, Mortensen, & Knudsen, 2009). Interestingly, however, most of those who were low on binding were S-allele carriers. Many studies have shown increased vulnerability to various types of illness and disorders with the S-allele of the 5-HTT. However, in this case, having the S-allele seemed to have a beneficial effect. The researchers interpreted the association between low binding and high openness to change as reflecting greater cognitive flexibility. They believed that the lower binding promoted slower serotonin re-uptake at the plasma membrane so that there were higher extracellular serotonin levels (Kalbitzer et al.,

2009). Increased extracellular serotonin levels would lead to increased neural plasticity and responsiveness (Kalbitzer et al., 2009). Other studies have not followed up on these findings or proposed other biological correlates for being associated with openness to values.

Health and openness to values. Similar to investigations on biological correlates of the values facet, there has been little investigation on its relationship to health. Most studies however have demonstrated that being high on openness to values can be harmful to one's health. Jonassaint and colleagues (2007) found that individuals who were high on values were at increased risk for cardiac deaths and elevated mortality, compared to individuals who were low on values. The researchers did not interpret this result. However, it is possible that the desire to stick with familiarity and avoid accepting change may lead to a Type A personality that is frequently discussed in medical literature. Another study on the relationship between health and openness to values found that current smokers had significantly higher openness to values scores than non-smokers in the study (Terracciano & Costa, Jr., 2004). This is contrary to the belief that increased smoking would be linked to openness to change. Since findings have produced mixed results, further investigation in the area of openness to values and health needs to be done.

Openness to Aesthetics

While openness to actions, ideas, and values focus on the interaction between cognition and action, the remaining three facets, aesthetics, fantasy, and feelings focus on emotional factors. Openness to aesthetics, the first of the three more emotional facets, is described as the appreciation of different art forms. While individuals high on openness to aesthetics tend to enjoy and appreciate the arts, the facet does not apply to appreciation for a particular kind of art form (Tellegen & Atkinson, 1974). Aesthetic sensitivity carries with it a particular form of intellect that combines intelligence, creativity, imagination, and perception (McCrae & John, 1992). DeYoung et al.'s experiment, mentioned earlier, on dopamine projections and cognitive performance had examined the role of aesthetics. While the main finding of the experiment was that openness to actions was the facet least linked to cognitive flexibility and

intelligence, the role of openness to aesthetics proved to be intimately linked to cognitive flexibility and intelligence (DeYoung et al., 2003). In terms of creativity and imagination, some studies have found that higher scores on aesthetics have been significantly linked to creative activities (Griffin & McDermott, 1998).

What makes the aesthetics facet distinct from the other facets though is not its role in intellect or even creativity, but its appreciation of experience for its own sake (Bergeman, Chipuer, Plomin, Pedersen, McClearn, Nesselroade, Costa, Jr., & McCrae, 1993). While most assessments of openness to aesthetics have relied on questionnaires, some studies have looked at aesthetic markers as being a universal marker of openness to experience, which have been particularly unique to the openness trait (McCrae, 2007). Aesthetic chills are emotional responses to experiences of beauty (McCrae, 2007). The emotion experienced during aesthetic chills is similar to those felt during the emotion of elevation, in which there is a feeling of awe and deep appreciation. Thus, while the chills experienced can be similar to chills of surprise, they are not unpleasant (McCrae, 2007). They also differ from the chills of excitement that come with risk-taking, which are likely to be more apparent with high openness to actions (McCrae, 2007).

While everyone has the capacity to experience aesthetic chills, individuals who are more prone to experiencing them are those who exhibit high emotional responsivity and sensitivity. They are the type of people who pay greater attention to all kinds of stimuli, internal and external, as argued to be linked to a temperament known as Orienting sensitivity (McCrae, 2007; Evans & Rothbart, 2008). They are also the type to enjoy connecting with experiences by absorbing them and engaging with them emotionally (Tellegen & Atkinson, 1974). Thus, people high on the aesthetics facet frequently experience opposing emotions simultaneously and at high intensities, though not at the level of a clinical mood disorder (McCrae, 2007). As a result of the strong emotional component, they also tend to be high on the facets of fantasy and especially, feelings. In addition, these facets have been found to be significantly high in individuals who are low on extraversion, but high on openness to experience (DeYoung et al., 2003). Thus, the proactive seeking of breadth and depth of experiences need not merely be expressed through high scores on the actions facet, but

also on the more emotional facets (DeYoung et al., 2003).

Health and openness to aesthetics. Minimal research has been done on the health benefits of being high on openness to aesthetics. However, the few studies that have been done have examined the link between the aesthetics facet and artistic creativity because artistic creativity has been found to correlate with mood disorders (Wolfstein & Trull, 1997). In one study that explored openness to aesthetics, researchers found that the facet was most strongly related to depression (Wolfstein & Trull, 1997). As most studies have previously demonstrated, there is a significant and common association between and neuroticism. In this study, the researchers found that individuals higher on openness to aesthetics were less extraverted, more neurotic, and scored higher on depression scores (Wolfstein & Trull, 1997). The implications of these findings are not completely clear because while individuals may engage in the arts out of depression, engaging in arts may also decrease their feelings of depression. The findings on aesthetics, introversion, and neuroticism are also unclear. It is well known though that introverts are often more emotional, regardless of whether they express it or not.

Openness to Fantasy

Like openness to aesthetics, openness to fantasy is also strongly related to a person's emotional disposition. As the name of this facet implies, it encompasses the tendency to engage in fantasizing, which not only involves the development of a mental picture, but also engages high levels of creativity and several emotions. While most research on fantasizing has found that it can lead to increased risk for depression, the research also suggests that fantasizing can have both positive and negative effects, depending on the emotional investment that one puts in them, the types of fantasies that one has, and whether or not the fantasies effect everyday behavior.

Health and openness to fantasy. Returning to Wolfstein & Trull's study, as discussed in the section on openness to aesthetics, openness to fantasy is also linked to depression (Wolfstein & Trull, 1997). Wolfstein & Trull (1997) predicted that openness to fantasy could have a positive

relation with mental health since openness and self-actualization are closely linked. However, they also kept in mind that a private self-focus, a construct highly linked to openness to fantasy and openness to feelings, could be linked to depression. The Self-Awareness Theory of Depression argues that when individuals experience a type of loss or failure then they face a challenging time in dealing with the differences between their actual and ideal states (Pyszczynski, Holt, & Greenberg, 1987). This is where fantasizing can potentially play a significant role and lead to increased risk for depression and negative emotions (Wolfstein & Trull, 1997). Keeping this theory in mind, the researchers anticipated the possibility of individuals high on openness to fantasy experiencing a difficult time in dealing with their actual and ideal states (Wolfstein & Trull, 1997). While the results demonstrated that openness to fantasy was linked to depression, there was a greater link to depression if the subject was extraverted as opposed to introverted.

Another study by Garcia et al. (2005) produced the same findings, where fantasizing was more detrimental for the mental health of an extravert than an introvert. Wolfstein and Trull (1997) have hypothesized that extraverts may be more susceptible to having negative fantasies that deal with failing social relationships, whereas introverts may not engage as much in socially based fantasies, and this may explain the result. A study by Carrillo and colleagues (2001) has also examined the role of openness to fantasy in predicting depression and came across similar findings as Wolfstein and Trull. In addition to Wolfstein and Trull's findings however, they also examined gender differences and found that women scored higher in fantasy than men, and were thus more susceptible to depression than men (Carrillo et al., 2001).

In a previous study by Carrillo and colleagues it was found that fantasy predicted more than just depression, but also "neuroticism, family maladjustment, personality disorders, and a lack of positive affect" (Carrillo, Rojo, Sanchez-Bernados, & Avia, 1998). It may be that individuals who fantasize are more likely to do so because they are unhappy with reality and fantasizing gives them a sense of control over their own inner reality. It has been proposed that overly positive fantasies about the future can actually have negative effects on one's health by potentially suppressing motivation and action, thus increasing one's vulnerability to depression

(Carrillo, Rojo, & Staats, 1996). However, it is also a possibility that positive fantasies can provide one with ambition to act and change their circumstances, so long as they are within realistic bounds and are not impossible. In addressing the possibility of openness facets, including fantasy, leading to increased risk for depressing, McCrae and Costa argue that openness is not meant to lead to either positive mental health or maladjustment (Carrillo et al., 2001). They propose that an individual high on openness is able to experience and reflect on several positive and negative experiences. By undergoing a wide variety of experiences, an individual high on openness is able to find a balance of positive and negative reactions to their experiences (Carrillo et al., 2001).

In the area of physical health, there have been studies on imagination and disease contraction. One study by Sherman and colleagues (1985) examined how perceived likelihood of contracting a disease can be influenced by imagining contraction of the disease. Some participants were asked to imagine easy-to-imagine symptoms and others were asked to imagine hard-to-imagine symptoms. Afterwards, participants were asked to rate how easy it was to imagine the symptoms in the assigned condition and how likely they were to actually contract the disease (Sherman, Cialdini, Schwartzman, & Reynolds, 1985). Sherman and colleagues (1985) found that judgment of imagination as being easy or difficult reflected participants' estimates of likelihood of contracting the disease. The subjects who rated the disease as being easy-to-imagine had judged the disease as more likely to occur than subjects who rated the disease as being hard-to-imagine (Sherman et al., 1985). Perhaps for some, fantasizing is a source of motivation for changing the way they perceive a future negative event, while for others, it may be a source of depression because they might be more inclined to have negative fantasies. Regardless of whether the effects of fantasizing are positive or negative though, the influence of fantasizing appears to have significant implications because it demonstrates the power of appraisal, where thinking about a situation can influence one's perception of an event.

Openness to Feelings

Of all six facets, openness to feelings is recognized by many researchers as being the

most complex (Coan, 1972; McCrae, 2007). Individuals high on openness to feelings highly value emotions and are thus, more sensitive to emotional experiences. They also experience most emotions more intensely than individuals who are lower on the facet. Greater levels of sensitivity and intensity of emotional experience has often been noted as being potentially harmful to one's health. In certain cases, experiencing a wide range of emotions can result in frustration because an individual may be confused and overwhelmed with their emotions (McCrae, 2007). The inability to make sense of the mixed emotional states that one is experiencing may be even worse for people who frequently suppress their emotions. A lack of coherence of emotional states has the potential to lead to difficulty in effective emotion regulation. Unsurprisingly, research shows that high openness to feelings has been linked to higher experience of anxiety and neuroticism (Garcia et al., 2005). Research also shows that women tend to be higher on openness to feelings than men and that this is linked to the higher rates of anxiety and mood disorders in women (Coan, 1972). Another large body of research though proposes that emotional awareness can actually be beneficial and reduce health problems, including depression.

Biological correlates of openness to feelings.

Research on the biological correlates of openness to feelings has generally been linked to understanding the role they play in disease and psychiatric disorders. In one study it was found that a functional polymorphism of the glutathione peroxidase 1 (GPX1) gene was linked to openness to feelings, and even openness to experience in general cell (Matsuzawa, Hashimoto, Shimizu, Fujisaki, & Iyo, 2005). Glutathione peroxidases protect cells from oxidative damage by reducing hydrogen peroxide present in and around the cell (Matsuzawa et al., 2005). The three possible genotypes are Pro198Leu, Leu198Leu, and Pro198Pro. Unlike the Pro allele, previous studies have shown that the Leu allele is less responsive to added selenium and may lead to functional consequences. In this study, individuals who had the Pro198Pro allele were higher on openness to experience, and the feelings facet in particular, than any genotypes with the Leu allele (Matsuzawa et al., 2005). Matsuzawa and colleagues argue that this may have significant implications for risk of neuropsychiatric diseases and mood disorders,

especially since the Pro allele demonstrates a protective effect and is more beneficial than the Leu allele.

Other studies have looked at the brain-derived neurotrophic factor (BDNF) gene Val66Met polymorphism, particularly since it is associated with the pathophysiology of mood disorder, as is openness to feelings (Matsuzawa et al., 2005). BDNF has been heavily investigated for its role in depression, and antidepressants have aimed to increase BDNF transcription to cure symptoms of the disorder (Sen, Nesse, Stolenberg, Li, Gleiberman, Chakarvarti, Weber, & Baurmeister, 2003). Other reasons for investigating the relationship between BDNF and depression come from research on depression, hippocampal size and neurogenesis. Individuals who are depressed have smaller hippocampi and experience decreased neurogenesis. BDNF is a crucial factor in neurogenesis because it affects neuronal differentiation during development and plays a crucial role during adulthood in synaptic plasticity and neuronal survival (Sen et al., 2003). In a study by Sen and colleagues it was found that the Val allele was linked to an increase for depression and that the Met allele had a protective effect. This is because the Met allele of BDNF produces higher activity and better processing of BDNF. Individuals who were high on openness to feelings were more likely to have a homozygous or heterozygous genotype including the Met allele (Sen et al., 2003).

One study by Jonassaint and colleagues examined how the various facets of openness to experience were linked to inflammation. They found that the feelings facet had the most significant effect. Similar to the above findings they also found that higher openness to feelings had beneficial effects. Individuals higher on openness were found to have lower mean C-reactive protein (CRP) levels. They proposed that this was related to high emotional awareness and can have a protective effect against disease. This is unlike low emotional awareness, which they suggested can lead to excessive stress-induced sympathetic activation and affect circulating inflammatory markers (Jonassaint, Boyle, Kuhn, Siegler, Copeland, & Williams, 2010). The challenge of identifying feelings and failing to allow oneself to fully experience them has been linked to greater physiological arousal (Jonassaint et al., 2010). Thus, low emotional awareness may lead to increased risk of inflammation and

cardiovascular disease (CVD). The researchers also proposed that low emotional awareness can lead to negative affective states that have the potential to elevate CRP.

Another study by Jonassaint and his colleagues (Jonassaint, Boyle, Williams, Mark, Siegler, & Barefoot, 2007) also came to the same conclusion: that low openness to feelings can increase risk for illness. They found that low openness to feelings led to cardiac trends and that there was a protective effect of scoring higher on this facet (Jonassaint, 2007). They propose that this is due to low emotional awareness and alexithymia-blunted affect. Low emotional awareness can lead to increased physiological arousal and predispose individuals to behaviors like social isolation and substance abuse and increase the experience of affective states including “depression, somatic complaints, and anxiety” (Jonassaint, 2007). Alexithymia-blunted affect can also lead to diseases through “physiological, behavioral, social, or cognitive mechanisms”. What is interesting to note though is that the individuals high on openness had experienced positive and negative emotions more intensely, which can also be another risk in itself.

Health and openness to feelings. Some studies have examined how various types of emotion regulation and appraisal can influence health. Such findings are significant because both extreme emotional suppression and extreme emotional expression have been linked to emotion in disease onset and progression, affecting the endocrine, immune, and autonomic systems (Gross, 1989). For instance, in one study it was found that frequent suppression of negative emotions predicted increased risk for myocardial infarction (MI) (Denollet & Brutsaert, 1998). In another study it was found that individuals who suppressed their emotional thoughts were also more susceptible to general illness (Petrie, Booth, & Pennebaker, 1998). They showed a significant decrease in CD3T lymphocyte levels, CD8 (T suppressor) cells, and total lymphocyte numbers (Petrie et al., 1998). They also had poorer natural (NK) cell activity. However, the researchers also found that those who had done emotional writing and were high on openness to aesthetics had increased levels of circulating CD4 (T helper cells) and the total number of lymphocytes (Petrie et al., 1998). This protective effect has been seen in other studies, where writing about thoughts and emotions has proven to be

therapeutic for individuals (Cameron & Nicholls, 1998). Writing always leads individuals to take different approaches to their experiences and think of ways to resolve potential conflicts. The worry though is that while some individuals might use writing to continuously ruminate on stressful events instead of taking the time to develop effective coping strategies (Cameron & Nicholls, 1998). Thus, it is not necessarily the intensity of emotional experience that can be costly, but the way one deals with their emotions.

Whether or not openness to feelings is beneficial seems to depend significantly on appraisal since appraisals guide emotional experience and action (Schneider, 2008). As an indirect measurement of the effects of appraisal, researchers have examined how and if stress responses are linked to openness to feelings. This is because the way one deals with stress involves changes in appraisals, emotion, and task performance (Schneider, 2008). Appraisal describes how one deals and interacts with a situation in the environment (Lazarus, 1999). Primary appraisal begins with an evaluation of whether or not a stressor is relevant to an individual. A secondary appraisal evaluates the resources that are available for coping with the stressor. If an individual thinks of the situation as a challenge that they are capable of overcoming, it might reasonably be predicted that they would experience a greater level of confidence in their ability to cope with the situation. However, if an individual sees the situation as a threat then they are likely to feel overwhelmed and fail to deal with it effectively (Lazarus, 1999).

In a study on the effects of appraisal on affect and performance, Schneider (2008) found that challenge appraisals led to greater positive affect and that threat appraisals led to greater negative affect. She also found that openness in particular was what drove this effect and that extraversion, which is often expected to be related to appraisals, was not (Schneider, 2008). When presenting subjects with a task, they found that performance was also associated with openness, with those higher on openness to feelings performing better (Schneider, 2008). A study specifically looking at stress regulation and openness found that higher openness to feelings was also linked to increased positive affect (Williams, Rau, Cribbet, & Gunn, 2009).

In terms of chronic illness onset and progression, higher openness to feelings has been linked to better health outcomes. It has been linked to decreased cardiac death and

lower all-cause mortality (Williams et al., 2009). Researchers have also found that individuals higher on openness have blunted cortisol responses and experience higher parasympathetic activity and decreased sympathetic activity (Williams et al., 2009). The belief is that this results from effective reappraisal of negative emotional stimuli and the possibility that more open people are higher on mindfulness when it comes to emotion labeling. Thus, even when confronted with difficult situations, individuals who are high on openness to feelings may engage in more adaptive and flexible coping mechanisms (Williams et al., 2009). This type of mindfulness may even extend to coherence of narratives from psychotherapy experiences, allowing individuals to engage in meaningful reflection on their experiences. Some evidence for this is linked to prefrontal cortex functioning, which is linked to general cognitive abilities, as discussed in the section on openness to actions. In addition to playing a role in cognitive abilities, the PFC also plays a role in stress-dampening self-regulatory activity. Thus, the PFC's role in executive functions, which is typically more active in people high on openness, also includes inhibitory control.

The ability for high-open individuals to engage in more effective emotion regulation and see things as being more rewarding than threatening has extended to research on openness and life satisfaction (Williams et al., 2009). Stephan has examined the relationship between openness and life satisfaction in older adults. He found that openness to feelings was positively correlated with self-reported life satisfaction, while controlling for health and financial satisfaction (Stephan, 2009). When it came to the benefits of openness to feelings, Stephan believed that this resulted from open individuals adjusting how they felt in response to experiencing new ideas or situations (Stephan, 2009). Thus, the inability to adjust or cope effectively can in fact lead to greater vulnerability to the effects of stress for low-open individuals and provide a protective effect for those who are high on openness to feelings (Williams et al., 2009).

Openness to Experience: A Good Thing?

Personality plays a key role in our lives because of the significant impact it has on the decisions we make such as the activities that we choose

to pursue and the way we choose to perceive and deal with events in our lives. The pursuit of understanding what the core elements of personality are remains as different theories continue to arise. As the field of personality psychology continues to grow though, some aspects of personality gain wide acceptance. The Five Factor Model is an instance of this. Its comprehensive integration of past research and personality scales has helped further the understanding of personality. Even though there are multiple questionnaires that adopt the theory, they adopt the same five main traits: extraversion, neuroticism, agreeableness, conscientiousness, and openness to experience, and have been to produce similar results. Only recently has application of this model been extended to fields beyond personality psychology, in hopes of gaining a more extensive understanding of human mind and behavior. Instances of this can be seen in fields exploring health such as psychology and medicine, where fields that once appeared to be unrelated are now relying significantly on each other.

To better understand physical and mental health, researchers have begun to acknowledge the important role of personality and thus, have adopted the popular Five Factor Model into many of their studies. Researchers have stumbled across several correlations between the Big Five traits and aspects of health such as health perception, health behavior, risk for disease, and disease progression. While the traits of extraversion, neuroticism, agreeableness, and conscientiousness have produced consistent results across numerous studies, findings on the influence of openness to experience on health have remained mixed and heavily disputed. In this review, we proposed that the mixed findings may have been due to the complexity of the trait and thus, proposed that the trait be examined in more depth, instead of being examined broadly. Openness to experience, the most controversial of the Big Five, can describe a wide array of people such as those who appreciate the arts, those who enjoy traveling and trying new foods, and those who love to fantasize. Since people can be open in a myriad of ways, we suggested that a detailed look at individual levels of the main Big Five traits might give a clearer understanding of openness to experience as well as its implications for health.

To gain an accurate understanding of the actions facet, we first examined the similarities

and differences between openness to actions, extraversion, and sensation-seeking, finding that the actions facet not only had a strong behavioral component, like the other two personality constructs, but also a strong cognitive component. We identified some potential biological correlates including norepinephrine, MAO, and variations in dopamine receptors (Cloninger, 2000). In our investigation of its effect on health, we found that scoring high on the facet had the potential to be beneficial to one's health because it was associated with a greater experience of positive emotion (Carrillo et al., 2001). This was also true for those who were diagnosed with an illness. Openness to actions appeared to form a buffer against depression because it encouraged one to pursue activities that brought them joy, regardless of their current state (Salovey et al., 2000). At the same time, openness to actions has the potential to be costly to one's health. One who pursues dangerous activities such as substance abuse may be experiencing a lot of positive emotion, but also face many health risks (Booth-Kewley & Vickers, Jr., 1994). Future studies should identify what other unhealthy behaviors may be linked to openness to actions besides substance abuse.

In our analysis of the openness to ideas facet, we found that individuals scoring high on the facet felt more positive emotion and were more satisfied with their life (Stephan, 2009). The suggested reason for this is that the brain is kept active and that individuals are more flexible in thinking, as supported by some studies on the role of dopamine in cognitive flexibility (Duncan et al., 2000). Thus, not only do individuals get joy out of increasing their knowledge, but they are also able to better cope with challenges they encounter because they make the effort to think about them positively (Whitbourne, 1986; Tesch & Cameron, 2003). While these findings are linked to cognitive flexibility, researchers must be careful not to confuse the facet with intellect or intelligence. Much of the debate that has come about regarding what openness is as a trait has come about from the cognitive characteristics related to this facet.

Unlike our findings on the actions and ideas facets, we did not come across positive outcomes linked to the values facets. The few studies that have been done on its role in health have found that it is linked to increased risk for cardiac deaths as well as elevated mortality (Jonassiant et al., 2007). No interpretation of these results was provided by the researchers

behind this study. Other studies however, indicated that this may be linked to decreased cognitive flexibility, which is effected by serotonergic transmission. A primary concern regarding the openness to values facet is where to draw the line between one's values and one's personality. It is not entirely clear how holding onto one's traditional values can have a negative influence on their health, especially if they are content with those values and use them to structure aspects of their life.

Similar to the values facet, we found minimal research on the role of the aesthetics facet in health. However, we reviewed related research similar to the aesthetics facet. Research on artistic creativity had shown that it was sometimes associated with mood disorders. In one study, it was found that just like increased artistic creativity, a higher score on the aesthetics facet was linked to increased risk for depression (Wolfestein & Trull, 1997). While we did not find any studies that looked at biological correlates of the aesthetics facet, perhaps it would be useful to look at the role of BDNF and the GPX1 gene, which have been found to increase risk for depression. Biological correlates aside though, it is challenging to determine whether engagement of the arts is a result of depression or if it helps to decrease depression. At the same time, the aesthetics facet is not entirely equivalent to artistic creativity since the aesthetics facet need not entail engaging in the arts, but simply appreciating the arts.

Just as we did not come across any findings that examined biological correlates of openness to aesthetics, we also did not find any that were related to the facet of fantasy. We did however, come across similar findings to the aesthetics facet in that the fantasy facet was also linked to depression (Carrillo et al., 1996; Wolfestein & Trull, 1997). Some studies indicated between-group differences though, finding that extraverts high on the fantasy facet were more susceptible to negative outcomes than introverts. The researchers behind the study proposed that this may have been due to differences in fantasy content, namely that extraverts may have more negative socially-based fantasies. Further investigation should be done on how extraversion might play a role in fantasizing and more generally, how the content of one's fantasies can influence their health and well-being. Just as we proposed in our discussion on the facet, it may be that for some fantasizing is a

source of motivation and hope, while for others it may be a source of depression and loss of hope.

The last facet we examined was the feelings facet, which was the most unclear in its implications for health relative to the other five facets. On one hand, we found that some of its biological correlates such as the GPX1 gene and the BDNF gene increased risk for neuropsychiatric diseases and mood disorders. On the other hand, we found that low scores on the facet were linked to decreased risk of inflammation and contraction of cardiovascular disease (Jonassaint et al., 2010) as well as decreased cardiac death and greater life satisfaction (Williams et al., 2009). It may be beneficial to be aware of one's emotions, but emotional awareness does not automatically imply that one knows how or even wants to deal with her emotions. For instance, one may ruminate continuously or suppress their emotions, both of which can be harmful to one's health (Gross, 1989). In this case, it appears to be more beneficial to be less emotionally aware. Future studies need to investigate the relationship between emotional awareness and emotion regulation, and ultimately, how this relationship impacts one's health.

When examining the effects of openness to experience on health, our analysis of each facet enabled us to understand why the trait of openness was so complex. We suggest that a facet approach be taken by empirical researchers and that they use the Big Five questionnaires that contain facets as opposed to using the more condensed questionnaires because the questionnaires with facets are more detailed. Beyond the obstacles that come with understanding the role of each facet level in health though, there is another obstacle that arises with the independence of the trait itself. Openness to experience has been continuously challenged for not being an independent trait even though psychometric tests have demonstrated that it is a very distinct trait (Garcia et al., 2005). For instance, the actions facet is frequently linked to extraversion, the ideas facet is often correlated with agreeableness, and the values facet tends to be related to neuroticism.

Related to the independence of openness is the independence of the other Big Five traits themselves. The Five Factor Model may be a comprehensive and widely used model to assess personality, but it is not the only way to assess personality. It has been criticized for being too broad and failing to take into account

aspects of personality that go beyond the main five factors (McCrae & John, 1992). It has also been criticized for its questionnaire approach, which puts a limitation on personality. There is the risk of bias on the part of the participant because individuals are more likely to report positive traits on questionnaires as opposed to negative traits. At the same time, personality is dynamic and operates through a variety of situations. Even though certain patterns are consistent, questionnaires cannot capture this dynamic and can only provide one side of the picture. Detailed approaches such as narratives should be examined in addition to questionnaires because they are likely to offer a different perspective in understanding personality. Through a narrative, one is able to provide descriptions that give explanations for why they may have acted or felt a certain way. Unfortunately, a structured questionnaire with questions that have been written by researchers does not offer free responses.

If researchers hope to understand the role of openness to experience in health, it is imperative that they look at how the individual aspects of the trait influence health and attempt to separate openness from the other Big Five traits when doing so. More importantly however, they should consider multiple ways of assessing personality because the Five Factor Model, as any personality model, will have its limitations. Given that the field of personality psychology is complex and ever-changing though, researchers should keep in mind that the results will be ever-changing as well.

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