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The effects of personality types on self-reported safety behavior: Focused on plant workers in Korea

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ABSTRACT

We sought to validate a safety behavior tool used in South Korean nuclear power plants, and to investigate the effects of HEXACO personality types on safety behaviors. The participants were 242 individuals employed in corporate safety management who answered the questionnaires on safety behaviors checklist, impulsiveness, affectivity, job burnout, and perfectionism. An exploratory factor analysis was conducted on the safety behavior items, and the convergent and discriminant validity were confirmed through correlational analyses with the existing related variables. To examine the individual effects of personality variables on the validated safety behavior questionnaire, we introduced control variables into a subsequent hierarchical regression analysis. The analyses revealed that the personality variables had significant effects on the subscales of the safety behavior scale. The present study is significant in that it revealed that personality, a broad construct, can predict human errors and safety behaviors, which have had previously been found to associate with only specific variables, such as stress, impulsiveness, and perfectionism.

1. Introduction

Human error is arguably the greatest factor hindering an industrial organization's efficiency, stability, and performance (Feyer and Williamson, 1988; Flin, 2003). According to a report by the International Atomic Energy Agency (IAEA), when considering data on the potential causes of, punishments for, and difficulties in publicizing the occurrence of accidents, most accidents are due to human error rather than mechanical defects or electrical problems (International Atomic Energy Agency (IAEA), 2005; Reason, 1997). Furthermore, studies have concluded that stress, excessive work, and fatigue are the major causes of human error (Dupont, 1990; Edwards, 1972; Hawkins, 1975; Johnson and Maddox, 2007; Shappel, 2000).

Human error can be caused by more than these three factors. Indeed, one potential factor is personality—namely, the continuous and consistent behavior pattern that characterizes an individual (Hogan report, 2009; Wickens et al., 1998). In fact, researchers have argued that accidents can be caused by certain people who exhibit a proneness to accidents in their personality (Greenwood and Woods, 1919). People who cause accidents in certain environments have been found to consistently cause accidents in other environments as well (Newbold, 1927). Personality is perhaps the humankind's most fundamental attribute, and refers to the characteristics of an individual that can explain the consistent patterns observed in that individual's emotions, opinions, and behaviors (Pervin and John, 1997).

Chung (Chung (2000)) research can be broadly grouped into studies that point to a close relationship between the extraverted personality type and accidents, and studies reporting a close relationship between the neurotic personality type and accidents. Clarke and Roberson (Clarke and Robertson, 2005), who analyzed 24 studies investigating accidents and injuries, argued that low agreeableness is a consistent factor relating to accidents. Similarly, Henning et al. (Henning et al. (2009)) reported that agreeableness and conscientiousness had strong associations with safety attitudes, while Wallace (Wallace (2003)) reported that conscientiousness was associated with unsafe work behaviors and accidents. Conscientiousness was also found to be associated with the likelihood of car accidents. Further, Chappelow (Cheppelow, 1989), who studied the relationship between errors made by aircraft pilots and personality, reported that extraverted individuals with high neuroticism are more likely to take risks and engage in sensation

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seeking, while introverted individuals are more likely to experience excessive arousal.

Overall, although it is difficult to conclude that personality has a consistent relationship with accident proneness, one cannot deny that it has some influence on an individual's behavior. Therefore, researchers have suggested that continuous research on the association of personality characteristics with specific unsafe behaviors, human error, and accident types will lead to important advancements in our understanding of these topics (Farmer, 1984). Similarly, the present study aims to validate an Institute of Nuclear Power Operations (INPO) (used for employees' self-checking to prevent safety accidents in South Korean nuclear power plants). Furthermore, this study similarly evaluated the associations of impulsiveness, affectivity, job burnout, and perfectionism with safety behavior compliance for convergent validity and discriminant validity. Moreover, this study examined the associations of HEXACO personality types with safety behaviors. This is to verify the incremental explanatory power of personality variables by controlling the variables related to safety behaviors. Hence, a safety behavior tool, i.e., INPO, used by South Korean nuclear power plant employees was analyzed to clarify its factor structure, and the relationships of the HEXACO personality variables with each factor of this safety behavior tool were verified.

Accordingly, to reduce human errors and determine the right people for safety management jobs, this study conducted the self-reported measurement of a performance tool that safety department employees use in real sites. After validating the tool, the predictability of risk in terms of personality characteristics was verified. These processes were intended to improve work manuals and establish an appropriate job training course.

2. Literature review

2.1. Safety behavior

Considerable investments are being made to reduce human error and improve safety in manufacturing and facility management. In the nuclear power industry in particular, system safety and the prevention of human errors are being increasingly emphasized, more so than in other industries, given that the nuclear power system is highly complex, comprising a non-injury/irreversible safety system, a tightly coupled technology system, and a high-reliability system (Lee and Yoon, 2012). It is also because of the considerable anxiety regarding nuclear leakage accidents, which can arouse negative opinions about nuclear energy in people. This was confirmed in a report by IPSOS, wherein negative perceptions of nuclear energy were found to have increased since the Fukushima nuclear power plant disaster (Butler et al., 2011). Accordingly, the nuclear industry has since systemized the use of "human performance tools," which should be followed by nuclear plant employees in order to prevent human errors. From these tools, a set of safety behavior guidelines have been formulated and followed.

The safety behavior guidelines in South Korea were formulated by translating the human performance tools (INPO, 2006), which were established through interviews conducted with 95 nuclear power employees worldwide, and adding items that best reflect the South Korean context. These guidelines have been used for the past 10 years.

The guideline items address various behaviors that must be followed by nuclear power plant employees before, during, and after work. Furthermore, with the exception of certain items, most of these items are applicable to safety management in other industries. At the time of development, the guidelines had a rather unclear categorization system of items, which has since been improved by experts through a comparative analysis with other industries, surveys, and interviews (Lee et al., 2011); nevertheless, several items still address the same concept or single items can sometimes address several behaviors at the same time. Therefore, additional improvements to the guidelines must be made through statistical analyses in order to ensure the validity and reliability of their categories.

2.2. HEXACO and safety behavior

The association between personality and employee Behavior has been theoretically suggested by numerous researchers. For instance, Hogan Assessment Systems reported the results of an analysis of data collected using the Hogan Personality Inventory (HPI), which was based on the Big Five personality traits (Hogan report, 2009). However, although the HPI has been long used by corporate organizations, almost no study has empirically confirmed its factor structure. Further, the HPI re-categorizes the factors and suggests a number of factors specific to certain occupational groups (e.g., manager) or positions through consideration of certain criterion variables, as this has been shown to reduce the possibility of lawsuits and facilitate decision-making (Biddle, 2010; James and McIntyre, 2010; McPhail, 2007).

HEXACO is another scale based on the Big Five personality traits; it comprises six personality dimensions, and has been translated into numerous languages. The six-factor structure has been repeatedly confirmed across multiple studies; furthermore, it has incremental explanatory power for certain criterion variables, in addition to the Big Five personality traits (Marcus et al., 2013). Importantly, most studies formulating scales based on the Big Five personality traits used vocabulary obtained from Cattell's (Cattell, 1943) adjective list, which could have led to repeatedly finding the same factor structure. Moreover, when using factor analyses, researchers might have combined synonyms and thus damaged the representativeness of categories. HEXACO, in contrast, overcomes these limitations (Block, 1995; Lee et al., 2003a, 2010).

The biggest difference of HEXACO from other scales is its inclusion of the sixth personality dimension, honesty-humility (Lee et al., 2003a). Honesty-humility is defined as frankness, modesty, greed, and guile. It has been found to be associated with Machiavellian personality and anti-sociality, which are not related to any of the other Big Five personality traits but are related to exploitation and manipulation of others (Ashton et al., 2000). The specific facets of the honesty-humility dimension include sincerity, fairness, greed avoidance, and modesty (Yoo et al., 2004). Emotionality, the second dimension, comprises the facets of fearfulness, anxiety, dependence, and sentimentality. In other words, the neurotic facets of the Big Five personality traits, such as temper and anger, are not included in the concept of emotionality; conversely, courage, confidence, anxiety, sensitivity, and sensibility, which are not important, include, and role facets of the Big Five personality traits, are included (Yoo et al., 2004). The agreeableness dimension of HEXACO comprises the facets of forgiveness, gentleness, flexibility, and patience. It further includes anger and temper (i.e., the neurotic variables of the Big Five personality traits) as well as gentleness, patience, and flexibility; anger and temper have been found to have inverse associations with the other three facets (Yoo et al., 2004).

Although the honesty-humility, emotionality, and agreeableness dimensions of HEXACO contain different facets from those inherent to the Big Five personality traits, the other three personality dimensions are similar to the Big Five personality traits. In particular, the facets of the extraversion dimension include expressiveness, social boldness, sociability, and liveliness; the conscientiousness dimension includes organization, diligence, perfectionism, and prudence; and the openness to experience dimension includes aesthetic appreciation, inquisitiveness, creativity, and unconventionality. These dimensions all show high correlations with and are similar to the extraversion, conscientiousness, and openness to experience dimensions of the Big Five personality traits, respectively (Lee et al., 2010; Yoo et al., 2004). It is difficult to a conclusion that personality type is inseparably related with weakness to accidents. However, we cannot deny that personality affects behaviors.

Meanwhile, De Radd et al. (De Raad et al., 2010) performed a series of pairwise comparisons to examine the factors expressed in diverse languages, and concluded that only extraversion, agreeableness, and