

Characteristics of Safety Personality

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Abstract

For high-risk organisations, it is essential that employees demonstrate safety-awareness behaviour, as a reflection of their safety personality, to avoid accidents. Several studies confirm that personality is the individual difference that is most associated with the likelihood of an accident occurring; it is therefore necessary to address the identification and expression of the characteristics of safety personality. This paper aims to present a personality questionnaire the authors have created, which was administered to employees of a large Hungarian company in the electricity supply business with altogether 1273 employees obligated to prioritise workplace safety. The final version of the questionnaire contained 59 items. Based on the statistical results, 58.08% of the variance of total variables was explained by 10 factors; the scales of the questionnaire developed are otherwise reliable. The paper also examines the validation of the scales using different psychological measures.

Keywords

safety personality, characteristics of safety personality, safety behaviour, safety-awareness

1 Introduction

It was long ago suggested that personality is the individual difference that is most associated with the likelihood of an accident occurring (Greenwood and Woods, 1919; Newbold, 1927). In safety-aware organisations, it is essential for the effective avoidance of accidents that employees exhibit safety-awareness behaviour as a reflection of their safety personality. Consequently, it is necessary to address the identification and expression of the characteristics of safety personality.

In our research, we created a questionnaire influenced by Hogan's Theoretical Framework (Hogan and Roberts, 1996), which was administered to employees of a large Hungarian company in the electricity supply business with around 1300 employees working in a high-risk organisation with a safety culture. The new scales have very strong statistical indicators and can be considered reliable.

In Section 2, we will explore which personality traits of safety culture are relevant in predicting safety-awareness behaviour. Therefore, we will describe the factors influencing the safety culture; outline the main theoretical frameworks, focusing on the Hogan - Safety Competency Model and the importance and impact of safety behaviour on these factors.

2 Literature review

Personality psychology is increasingly used to explain human behaviour in the context of workplace research (Gao et al., 2020; Madter et al., 2012). Several studies confirm that personality is the individual difference that is associated with the likelihood of an accident occurring (Clarke and Robertson, 2008; Kaplan and Tetrick, 2011; Turner et al., 2004).

A recent meta-analysis by Beus et al. (2015) confirmed that the impact of personality on accident occurrence is reflected through safety behaviour. Several researchers have found that personality traits are fundamental determinants of people's safety behaviour at work and that accidents are a direct result of safety behaviour. That is, workers' personality traits may predispose them to perform unsafely, which in turn lead to accidents (Frieder et al., 2018; Rau et al., 2020; Zhang et al., 2019).

There are three main characteristics of an injury-free workplace: Environment (equipment, and workplace atmosphere), Person (attitude, belief, and personality) and Behaviour (safety-seeking behaviour, risk management, intervention for the safety of others). These factors are interactive, dynamic and reciprocal to each other. If there is a change in one of them, the other two will also

change. Personality contributes to safety because personality determines how we behave. There are injury-prone personalities who have more accidents and which is typically considered an internal personality trait that is difficult to change; conversely, injury preventiveness which is more likely to be a state that is changeable by relevant external intervention (Geller and Wiegand, 2004).

2.1 Factors affecting safety culture

Safety culture has been identified as a predictor of workers' safety behaviour, safety attitudes and safety-awareness (Sari and Dewi, 2021). Without safety-awareness, a safety culture cannot develop in an organisation, but the continuous development of awareness has a significant impact on, and even determines, workplace safety culture. Safety-awareness is therefore a "soft" area of internal safety culture (Vasvári, 2009). The quality and level of development of the organisational safety culture has an impact on decisions arising from safety-awareness behaviour, which in turn has an impact on the safety culture. The effective operation of the "hard" elements (e.g., regulatory framework, laws, policies, legislation, control strategies, safety governance) embedded in the safety culture when making decisions about risk management depends to a large extent on the attitudes and behaviours associated with managing risks and uncertainties (Reason et al., 2001; Kertai-Kiss, 2016).

At different organisational levels (managers, teams, employees), with different approaches, the concept of safety is usually a focal problem. For example, according to Fadzli et al. (2003), the personality traits of employers and supervisors have also contributed to a precarious and inappropriate work environment. Employers are less concerned about safety aspects and overlook the design or layout of ergonomic office equipment or machinery, which causes problems or major accidents in case of fire or unwanted things happening (Fadzli et al., 2003; Jusoh et al., 2014). Moreover, too simplistic an understanding of the safety culture and the options for change will not lead to the desired results. Safety culture is often associated with risk awareness, which is a personality characteristic (Kertai-Kiss, 2016).

Personality is a complex area of behavioural psychology in which it is not easy to make or formulate empirically valid generalisations. It can be said that certain personality characteristics are related to safety culture. This is in line with research showing that awareness is predictive of safety behaviour, which is an indicator of safety culture (Sari and Dewi, 2021). Khdair et al. (2012) have meanwhile stated that occupational accidents and injuries in the workplace

can be reduced if the employee has the right personality characteristics (Khdair et al., 2012; Sari and Dewi, 2021).

2.2 Theoretical frameworks

The relationship between attitudes to safety, safety culture and safety-awareness and personality is reflected not only in practice, in the frequency of accidents, but also at a theoretical level. Reason (2008) agrees that there are some people who work less safely than others, and recognises that this is related to personality (Reason, 2008). Table 1 illustrates that there are many authors on this topic, from many different high-risk industries and cultures, who have proposed theoretical models (Gao et al., 2020; Hasanzadeh et al., 2019; Hee and Ping, 2014; Sari and Dewi, 2021; Solomon and Esmaeili, 2021; Tao et al., 2021).

Most of the above models are based on the Big Five theory, which has been a very good starting point for our work.

2.3 Theoretical framework: Hogan - Safety Competency Model

Personality characteristics may be beneficial in certain work situations; however, they can also lead to unsafe behaviours. Over time, regular unsafe behaviour is likely to result in safety incidents. This reasoning has led The Hogan Research Division (HRD) to investigate the relationship between personality and safety. HRD has created a safety model consisting of six personality scales that represent critical antecedents of safety behaviour in different job roles, called the Safety Competency Model (Foster, 2010; Hogan and Holland, 2003; Hogan and Roberts, 1996; Ones et al., 2007).

First component is *Compliant*, which refers to an individual's willingness to comply with the rules. An employee who does not pay full attention and ignores the rules is more prone to accidents and injuries at work.

Table 1 Theoretical frameworks

| Name of model | Author | Industry |
|--|-----------------------------|------------------------------|
| Big Five Model | Hee and Ping (2014) | Malaysian manufacturing |
| Big Five Model | Hasanzadeh et al. (2019) | Construction |
| Big Five Model | Gao et al. (2020) | Construction |
| Big Five Model | Solomon and Esmaeili (2021) | Construction |
| Chinese version of Big Five Model (CBF-PI) | Tao et al. (2021) | Chinese nuclear power plants |
| Five-Factor Model & Structural Equation Modeling (SEM) | Sari and Dewi (2021) | Chemical |

Second scale is *Strong*, which refers to the capability to handle stress with confidence. Employees who are prone to stress may panic under pressure and make mistakes, while those with good stress tolerance tend to remain stable when faced with more difficult, risky and challenging tasks.

Next personality trait is *Emotionally stable*, which concerns anger management. Irritable individuals lose their temper easily and make mistakes, have low self-control, while cheerful individuals are able to control their temper, are balanced and less impulsive.

Fourth component is *Vigilant*, which refers to the concentration. Absent-minded individuals tend to be easily distracted and make mistakes, whereas vigilant employees remain focused.

The following personality characteristic is *Cautious*, which concerns risk-taking. Those who perform less well in this personality trait are reckless and tend to take unnecessary risks, while cautious individuals avoid risky actions.

The final element of the model is *Trainable*, which is the individual's tendency to respond favourably to training. Low performers overestimate their competence and display arrogance towards the idea of training, while good performers pay attention to training and like to learn (Foster, 2010; Hogan and Foster, 2013).

2.4 Safety behaviour

Christian et al. (2009) have explained that the effect of personality on accidents is indirect, through other person-related factors such as safety motivation and behaviour. Specifically, more complex safety performance models consider personality as distal and safety motivation and knowledge as proximal person-related factors that are associated with a variety of safety behaviours, including task-related compliance and context-related participation in volunteer safety activities (Christian et al., 2009; Laurent et al., 2020).

Based on some safety performance frameworks (Griffin and Neal, 2000; Neal and Griffin, 2004; 2006; Skeepers and Mbohwa, 2015), three manifestations of safety behaviour can be identified: safety compliance, safety participation and safety motivation. The three types of safety behaviour in the process of safety-awareness build on each other, so it can be said that without safety compliance there is no safety participation and without safety participation there can be no safety motivation among workers in the workplace environment. A recent study by Chmiel et al. (2017) confirmed this view by showing that safety knowledge mediates the relationship between safety motivation and participation. According to these authors, this finding is

consistent with the idea that workers who know how to improve safety want to participate in voluntary safety activities to benefit others and their organisation (Chmiel et al., 2017; Laurent et al., 2020).

In addition, recent research shows that safety participation is not a positive factor in itself, benefiting the organisation as a whole, but also predicts workers' safety compliance (Chmiel et al., 2017; Neal and Griffin, 2006). Thus, understanding what predicts worker safety participation is important for understanding how to make workplaces safer. Furthermore, research suggests that variables such as cognitive ability or experience better predict task behaviour, while personality variables better predict contextual behaviour (Motowidlo et al., 1997).

3 Methodology of the current study

In our study, we reveal which personality traits in a safety culture are relevant in predicting safety-awareness behaviour.

We wanted to explore safety-awareness personality traits among Hungarian employees, based on Hogan's theoretical framework.

We started our investigation by exploring the relevant safety-personality features. Therefore, we conducted interviews with first- and second-line managers ($N = 25$ people) of the management and subordinates ($N = 18$) team of a large Hungarian company within the field of investigation. In the interview, we asked them to describe the main characteristics of a safety-aware personality. Involving two work psychologists, we grouped the mentioned characteristics and created the following categories:

1. Typically, many people talked about conscientious work, such as perseverance, commitment, performance motivation, methodically, thoroughness. All these traits are known for precise work, as well as energetic, purposeful work, which is associated with high self-discipline and control.
2. Working with responsibility means that the individual realises the necessity and importance of the rules and observes them under all circumstances and expects the same attitude from his/her colleagues. This also requires a mental openness, which is necessary for a person to be receptive to new things, to changes in rules and to be open to learning. Those who are stubborn, headstrong and prone to closed thinking are arrogant and do not accept new rules and rather work from a routine.
3. In an unusual, stressful, uncertain situation, when the situational pressure on the internal tension is

strong, it is very important to maintain mental and emotional stability. In normal and extreme situations, it is essential to maintain emotional stability and to remain calm. The tension from an uncertain, unstructured situation causes unpredictable behaviour and unpredictable reactions from mentally unstable people.

4. Within the safety culture, people typically work in teams today, since they operate a technology that requires a range of knowledge and competencies at the same time. As a result, we need very cooperative people who understand what teamwork means and who can put their individual idea in the background for the sake of the team. For this, they must be socially open to others, able to work in a team, friendly and helpful. It is important to be open to the other person's point of view in a problem or conflict situation and to be able to talk with them. Competitive, unhealthy rivalry can undermine cooperation and friendship at work.
5. An individual's cognitive ability also greatly influences safety-aware behaviour. Cognition also plays a significant role in detecting incoming stimuli and responding adequately to them. Perception, problem solving, situational awareness, and active presence are crucial in these jobs in order to avoid accidents.

The items of the questionnaire were based on the criteria described above. We reviewed several already validated questionnaires and used them in developing the scales of the new questionnaire, for example: Costa and McCrae's Five-Factor Model (Costa Jr. and McCrae, 1992), Safety Competency Model (Hogan and Roberts, 1996), Bandura's Self-Efficacy Scales (Bandura, 1997), Cognitive Complexity factors (Kegan, 1980) and Connor-Davidson Resilience Scale (CD-RISC, Connor and Davidson, 2003).

Furthermore, many items and scales were compiled by us in collaboration with the two work psychologists mentioned above, based on what was said in the interviews.

We compiled the first version of the questionnaire based on these descriptions. The questionnaire was filled out voluntarily by the members of the investigated organisation, and after multiple statistical analyses, we created the final structure.

We prepared an Ethics Statement, so this research was approved by the Joint Psychological Research Ethics Committee (in Hungarian: EPKEB). The Reference number is 2021-21.

3.1 Participants

Data for this study was obtained from a Hungarian Electricity Company characterised as a high-risk organization (Vasvári et al., 2023). The organisation covers the entire country, as it has operational units in every part of Hungary. Altogether 1273 employees filled out the 64-item questionnaire, and all participants belonged to the same company, participating in the study anonymously and voluntarily. The questionnaire had to be filled out online, and participants were given 2 weeks to return responses. The questionnaire took approximately 20 minutes for individuals to complete.

33% of the participants have been working in the organisation for 0–5 years, 7.4% for 6–10 years, 10% for 11–15 years, 5.6% for 16–20 years, 8% for 21–25 years and 36% for more than 26 years.

The sample consisted of 3 senior managers; 36 middle-level managers; 127 team leaders; 292 administrative workers; 165 main experts, design workers; 61 workers in dispatching positions and 589 manual workers, mechanics working in the field. 635 people have been working in their current position for 0–5 years, 154 people for 6–10 years, 129 people for 11–15 years, 98 people for 16–20 years, 63 people for 21–25 years and 194 people for more than 26 years.

3.2 Measures

The preliminary scale structure was evaluated by factor analysis with Varimax rotation to minimise the correlations between components. Reliability testing of the resulting factor-structured scales was also performed. Reliability was evaluated by Cronbach's alpha coefficients of internal consistency. The initial version of the questionnaire contained 64 items, while the final version contained 59 items.

As Table 2 shows, each factor has two scales. We have defined the definitions of the factors as follows:

1. *Positive attitude towards rules*: An individual with a positive attitude towards the rules observes safety regulations and respects procedures. Employee shows a strong willingness to take responsibility for following the rules related to workplace safety. There is no difficulty for the individual to follow the orders.
2. *Positive work attitude*: In the workplace, an individual with a positive work ethic is optimistic, able to take on any task and responsibility. Employee motivates those around themselves to do their best and helps to push tasks forward when setbacks or challenges arise. Ability to continuously improve or regulate oneself in order to improve.

Table 2 In parentheses are the reliability indicators based on the results measured on our sample

| Safety personality questionnaire | |
|-------------------------------------|--|
| Factors | Scales |
| 1. Positive attitude towards rules | Stubbornness ($\alpha = 0.75$) |
| | Compliance ($\alpha = 0.63$) |
| 2. Positive work attitude | Self-discipline ($\alpha = 0.91$) |
| | Achievement striving ($\alpha = 0.81$) |
| 3. Positive attitude towards others | Self-efficacy ($\alpha = 0.83$) |
| | Openness ($\alpha = 0.84$) |
| 4. Emotional stability | Tolerance to uncertainty ($\alpha = 0.83$) |
| | Emotional stable ($\alpha = 0.63$) |
| 5. Cognition | Cognitive complexity ($\alpha = 0.78$) |
| | Cognitive failure ($\alpha = 0.71$) |

3. *Positive attitude towards others*: Social sensitivity is the personal ability to perceive, understand and respect the feelings and views of others. It refers to an individual's belief that an employee can perform the behaviours necessary to achieve a specific level of performance. It reflects confidence in the ability to exercise control over one's own motivation, behaviour and social environment.
4. *Emotional stability*: It enables the person to develop an integrated and balanced way of perceiving problems at work. Employee is able to accept situations that are ambiguous, uncertain or novel and able to work effectively in high-risk environment. Due to tolerance and self-control the individual is able to adapt to changes.
5. *Cognition*: The state or quality of a thought process that involves a number of constructs and there are many interrelationships between them. Such processing is often experienced as difficult or demanding. Cognitive complexity describes people's perception of their experiences and their environment, and their ability to analyse them. Cognitive failure is a cognitive error that occurs during the performance of a task that one would normally perform successfully in everyday life. Cognitive failure is characterised by concentration problems, memory impairment and impaired cognition.

4 Results

The questionnaire data analysis was designed to identify the contents, elements and factors of safety personality based on the related literature. Theoretical approaches in the literature of safety personality differ in respect of both the number and

the content of the explanatory categories we propose. This study attempts to investigate which factor structure covers most of the construct in a Hungarian sample.

Factor analysis was applied, not only to reduce numbers of variables but to reveal underlying connections between variables. Additionally, based on the results it is possible to attempt to describe and explain the perception structures of participants. Our aim for grouping items was to identify a meaningful factor structure.

Sampling adequacy was measured with the Kaiser-Meyer-Olkin index, which resulted in 0.953 ($p = 0.000$), high above the commonly recommended value, and thus suitable for factor analysis.

Explanatory factor analysis was applied to the total sample of 64 items. Initial Eigen values showed 10 factors, which explained 55.5% of the variance of the total variables.

It would appear, then, that these factors cover the variables' structure relatively consistently.

These factors therefore seem to cover the structure of the variables in a relatively consistent way. Although only the first 4 of the 10 factors are really valid. Together, the 10 factors explain about 58% of the total variance, but the first 4 factors explain the vast majority of it (about 41%). In other words, $41/58 \rightarrow 70\%$ of the total variance belongs to the first 3 factors, and all the other factors are negligibly weak (see Fig. 1).

Based on the statistical results, our primary goal was to develop a more consistent factor structure. Hence, based on the results of the explanatory factor analysis, 7 items were eliminated because some failed to meet the minimum criteria of communality values (0.3).

After the explanatory factor analysis because of insufficient value of primary factor loading one factor (Competition) was eliminated. The result of the KMO index was 0.913 ($p = 0.000$), high above the commonly recommended value and suitable for factor analysis. 58.08% of the variance of total variables was explained by 10 factors:

1. First factor: *Self-discipline*. This is the one of the most important factors in the factor structure which indicated the largest reliability value contains 8 items, each with factor loadings between 0.694–0.719. This factor explains 24.65% of the variance. The factor is about energetic, persistent work, about the fact that the work must be done with care and precision. "*I like to do everything thoroughly and methodically.*"
2. Second factor: *Achievement striving*. The second most important factor in factor structure indicated second

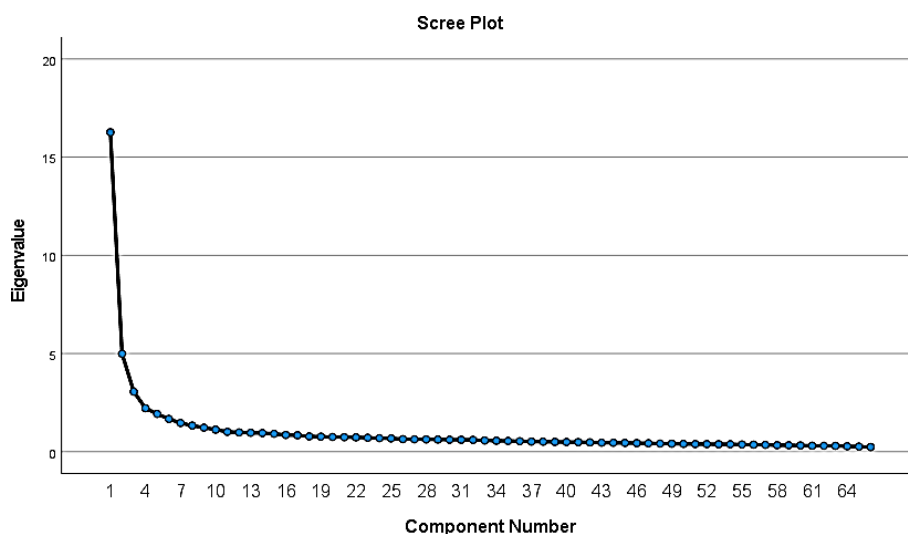


Fig. 1 Result of factor analysis of Eigen-values in Scree Plot

largest reliability. It contains 4 items, each with a factor loading between 0.558 and 0.619. This factor explains 9.4% of the variance. The items refer to high-quality work: *"I like to set high standards for myself."*

3. Third factor: *Self-efficacy*. The third factor contains 7 items with factor loadings between 0.446 and 0.686. This factor explains 7.565% of the variance. The items are about confident behaviour in social situations, influencing others, efficiency, *"I arouse enthusiasm in those I work with."*
4. The fourth factor: *Tolerance to uncertainty*. It contains 5 items, with factor loading between 0.417 and 0.723. This factor explains 3.361% of the variance. The items with higher factor loading were related to tolerance of tension from an uncertain situation, *"I feel tense in new, unfamiliar situations for me."*
5. The fifth factor: *Emotional stable*. It contains 5 items, with factor loading between 0.493 and 0.585. This factor explains 3.361% of the variance. The items with higher factor loading were related to feeling emotionally stable and balanced, *"I dwell on negative feedback about me for a long time."*
6. The sixth factor: *Openness*. It contains 7 items, with factor loading between 0.466 and 0.68. This factor explains 2.531% of the variance. The items with higher factor loading were related to attention to colleagues, willingness to help, participation in group work, *"I like to spend time getting to know the people I work with."*
7. The seventh factor: *Stubbornness*. It contains 7 items, with factor loading between 0.461 and 0.673. This factor explains 2.22% of the variance. The items with

higher factor loading were related to his own stubborn belief that he never needs help, *"If I think I'm right, I don't care if others agree with me or not."*

8. The eighth factor: *Cognitive complexity*. It contains 7 items, with factor loading between 0.378 and 0.604. This factor explains 2.019% of the variance. The items with higher factor loading were related to complex way of seeing, examining the phenomenon from several perspectives, situational awareness, *"I like to examine the same thing from several angles."*
9. The ninth factor: *Cognitive failure*. It contains 5 items, with factor loading between 0.489 and 0.612. This factor explains 1.706% of the variance. The items with higher factor loading were related to lack of attention, persistent concentration, which leads to delusion, *"Sometimes I forget something so much that I don't notice when someone is talking to me."*
10. The tenth factor: *Compliance*. It contains 4 items, with factor loading between 0.502 and 0.609. This factor explains 1.537% of the variance. The items with higher factor loading were related to compliance with rules, *"If I want to be effective, I have to maneuver between the rules."*

In summary, based on the final factor analysis – it identifies up to 10 factors, of which only the first 4 are really valid. However, based on the factor loadings we were able to interpret the other factors. In a forthcoming publication, we would like to relate these scales we have developed to other safety factors and thus perform content validity. We also want to ask people who have been involved in an accident or near-accident to fill in our questionnaire.

5 Discussion

In this article, we explore the question of what personality traits an individual working in a high-risk safety culture should have. The focus of the study is a large Hungarian organisation in the electricity supply business.

Among many theorists and authors (Bandura, 1997; Connor and Davidson, 2003; Costa Jr. and McCrae, 1992; Kegan, 1980) Hogan's theory (Hogan and Hogan, 2007; Hogan and Holland, 2003; Hogan and Roberts, 1996) was considered as basic literature, some traits of which are also found in our questionnaire. An example of such a component is *Compliant, Emotionally stable, Strong, Vigilant or Trainable*. An exception is the trait of *Cautious*, because in our study this characteristic of reckless did not appear.

6 Limitations

Our study focuses on one Hungarian organisation and the employees working in it, but we have worked with a large sample of items.

The organisation under study has a culture of safety, but it was not the aim of this article to prove this, nor would the space limitation have allowed it. In this article we do not address the validation of the scales; our plan is to validate these scales with different psychological measures. We have the means, the tools and the data is available, but we can present this in a future article.

6.1 Implications

In our study we managed to work from a large Hungarian sample size.

We interviewed people at different levels in the organisational culture on the subject and developed our questionnaire based on the literature, theories and models already mentioned.

The scales of the questionnaire developed are reliable and can be used in a number of areas. In the selection and integration process, allowing a more successful and efficient selection and integration of a person into the community.

It can also play an important role in the development of those already working in the organisation, as the results can provide a more complete picture of the employee's personality and attitude. This allows us to provide the development he or she needs.

In addition, if the organisation wants to initiate a survey in the field of development or change management, this questionnaire can be a good starting point to get to know the personality of the employees.

Knowing the results of the questionnaire can be a great help to team leaders on how to manage their people and how to build a team in which each subordinate has a role that suits his or her personality.

Finally, learning about the results is essential not only from the managers' point of view but also from the subordinates' point of view, because if employees were given feedback on their results, their self-awareness and safety-awareness would increase. In addition, they would know what traits, qualities they can or should work on to perform their tasks more safely, efficiently, and effectively.

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