An investigation into the relationship between personality and learning styles in construction industry: As a potential tool for improving health and safety performance

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Abstract: Occupational injuries and fatalities still continue to plague the construction industry despite of the researches on the health and safety. There is little research on the key factors influencing unsafe behaviours, and accidents on construction sites. This study investigates the individual differences in learning style and personality as a fundamental factor for the prediction of construction site accidents. The individual personalities have been measured through the Big Five Factor Model and the Index of Learning Styles to assess differences in how individuals learn. Data were collected from 104 construction professionals in the construction industry through online survey. Analyses of statistical tests using SPSS revealed a number of relationships between the Big Five personality traits, learning styles and accident proneness of construction professionals. The findings revealed relationships between the Big Five personality traits, learning styles and occupational accident frequency of construction professionals. Significant relations were found between accident involvement and all Big Five personality traits. The findings cannot definitively state the overlap between personality and learning styles, which do not support the view that learning styles are fully measured by personality scales. Another finding revealed by the correlation analysis is neuroticism’s negative relationship with accident involvement in construction site accidents.

Keywords: personality, learning styles, construction industry, occupational safety.

Uma investigação sobre a relação entre personalidade e estilos de aprendizagem na indústria da construção: Como uma ferramenta potencial para melhorar o desempenho em saúde e segurança

Resumo: Apesar das pesquisas feitas em saúde e segurança no trabalho, continua a envolver os acidentes e mortes no trabalho da indústria da construção. Não há suficientemente pesquisa sobre os fatores básicos que afetam os acidentes e comportamentos inseguros no campo da construção. Este estudo analisa as diferenças individuais no estilo de aprendizagem e personalidade como um fator chave para a estimativa de acidentes em estaleiros. A personalidade dos indivíduos foi medida através do Modelo dos Cinco Fatores e o Índice de Estilos de Aprendizagem. Foram determinadas as diferenças de aprendizagem entre os indivíduos. Os dados foram obtidos através da participação na pesquisa de 104 profissionais do sector da construção. As análises de testes estatísticos usando o programa do SPSS revelaram uma série de relações entre os cinco traços de personalidade, estilos de aprendizagem e propensão a acidentes de profissionais de construção. Os resultados também revelaram relações entre os Cinco Grandes traços de personalidade dos profissionais da construção, estilos de aprendizagem e a frequência de acidentes. Significativas relações foram determinadas entre acidente e o envolvimento de todos os Cinco Grandes traços de personalidade. No entanto, não foi possível determinar uma sobreposição clara entre personalidade e estilos de aprendizagem, bem como não suportam a visão de que os estilos de aprendizagem são totalmente medidos por escalas de personalidade. Outro resultado revelado pela análise de correlação é a relação negativa entre o envolvimento em acidentes no estaleiro com neuroticismo.

Palavras-chave: personalidade, estilos de aprendizagem, indústria da construção civil, segurança do trabalho.
1. Introduction

In recent decades, organizational scholars have shown increasing attention to the analysis of factors that influence occupational safety. However, a host of studies have focused on organizational and environmental factors (Hayes et al., 1998; Cox, 2000; Parker et al., 2001; Barling et al., 2003) rather than on individual-level variables such as personality. When considering the factors that affect the achievement of safety performance, personality traits are among the most prominent ones. This implies that, personality traits would influence safety performance behavior, and affect safety outcomes, such as accidents and injuries (Neal & Griffin, 2004). Actually, there hardly exists a workplace where personality does not influence work related behavior (Lingard & Rowlinson, 2005). Therefore, researchers have called for studies to explore the role of personality in accident involvement (Clarke & Robertson, 2005). Despite this trend, however, almost no comprehensive attention has been given to how personality traits affect safety behavior and accident involvement in the construction industry.

The construction industry is well known with high levels of workplace accidents resulting in complex legal situations and legal cases. Statistics showed that the construction industry has earned the reputation of being a highly hazardous industry due to its accident rates (Smallwood & Haupt, 2008; Sertyeşilışık et al., 2010; Goetsch, 2014). Although much work has been done on the causes of accidents on the construction sites (Gadd & Collins, 2002), very few studies have focused on the characteristics of personnel involved in the accidents (Khosravi et al., 2014). Given the fact that accidents emerge due to a chain of events ultimately caused by human factors, it is important to understand the relationship between personality traits and high incidence of accidents that happen on construction sites due to human errors (Sheratt, 2014).

Along with personality traits, learning behavior is believed to be helpful for modifying safety performance and can be successfully incorporated into safety training efforts. Learning from accidents is of a special importance in hazardous industries, which implies the acquisition of knowledge and skills from a thorough study of accidents and their antecedents (Dechy et al., 2015). Reflecting this necessity, the current research addresses the role of the learning behavior in construction accident involvement.

This study intends to contribute to the literature by analyzing the degree to which learning styles overlap with personality traits. It contributes to the debate over this relationship in the context of the construction industry. That is because the majority of studies conducted so far have focused on students from around the world. Furthermore, this study intends to contribute to the literature on understanding of the combined effects of the two variables (personality traits and learning behavior) in explaining the degree of accident proneness of professionals working in high risk sector such as construction.

2. Background Research

This study aims to investigate the relationship of personality and learning styles of construction professionals to occupational accident. The starting point was to analyze previous studies about personality, learning styles and their correlation with health and safety performance in construction industry.

2.1. Personality traits and accident involvement

Personality traits have been some of the most commonly considered individual difference predictors of occupational accidents (Lawton & Parker, 1998; Kaplan & Tetrick,
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Several pertinent questions regarding the role of personality in accident proneness, however, remain insufficiently addressed (Beus et al., 2015). Despite this, there exist enough research to believe the general relationship among personality traits and safety outcomes (Clarke, 2006; Christian et al., 2009).

Most popular approach among safety researchers for studying personality traits and individual differences in the prediction of safety outcomes such as accident involvement is the Big Five factor model (Barrick et al., 2013; Smith et al., 2015). As suggested by John and Srivastava (1999) and McCrae and Costa (1996), the Big Five dimensions have become one of the most widely used and extensively researched models of personality traits. The five broad personality traits included in the model are extraversion, agreeableness, conscientiousness, neuroticism (or emotional stability), and openness to experience. From the review of the occupational safety literature, it is possible to assume that there exists a high variety among findings. Two meta-analysis provided mix and contradictory conclusions. Clarke and Robertson (2008) found weak evidence for the relationship between each of the big five traits and accident involvement, except for extraversion, while results of Christian et al. (2009) meta-analysis revealed a significant mean correlation between safety outcomes and conscientiousness. These results suggest mix and contradictory conclusions.

In relating the agreeableness dimension with accident involvement Graziano and Eisenberg (1997) proposed that, agreeable individuals – who are motivated to be altruistic – might feel responsibility toward others within the organization, leading to more positive safety attitudes. Watson and Clark (1997) contended that highly extraverted individuals are likely to be positively related to risk taking tendencies, and therefore negatively related to safety attitudes. Neuroticism also reflects low stress tolerance, such that neurotic individuals are more likely to become flustered or frantic from job demands, resulting in a reduction in attention and focus at work (Forcier et al., 2001). Thus neuroticism is expected to relate negatively to safety attitudes (Sutherland & Cooper, 1991; Shadidi et al., 1991). Empirical studies and meta-analyses have also shown that conscientiousness is positively related to safe behavior (Beus et al., 2015; Christian et al., 2009; Hogan & Foster, 2013; Arthur & Doverspike, 2001; Wallace & Chen, 2006). One facet of conscientiousness is cautiousness (Costa & McCrae, 1992), or the extent to which individuals try to avoid mistakes (Goldberg, 1999). Thus, conscientious individuals follow rules and are aware of expected behavior in a given situation. However, there is little evidence to support the influence of openness to safety outcome either one way or the other (Clarke & Robertson, 2005).

In this study, the five-factor conceptualization of personality traits was chosen to explain personality’s associations with safety-related behavior because its dimensions parsimoniously cover the spectrum of human personality across contexts and cultures (e.g., McCrae & Costa, 1987; Tuples & Christal, 1992) and over time (Roberts & DelVecchio, 2000).

2.2. Learning styles

Over the years, learning-styles concept has been embraced by many scholars and researchers in different disciplines such as psychology, education, sociology, and management as a way to address individual differences in learning. When it comes to define learning, it is even harder to come up with one universally accepted definition [38]. Literature review reveals the plurality and the diversity of definitions. There is no
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There is no consensus among scholars as to what exactly the concept should include. This may be due to the fact that the term “learning style” is used as synonym with cognitive style, adding to the confusion in the literature (Curry, 1983; Moran, 1991; Riding & Cheema, 1991; Grigorenko & Sternberg, 1995; Rayner & Riding, 1997; Reynolds, 1997; Adey et al., 1999).

Although there are different definitions and constructs as it is related to learning styles, the most widely accepted one is the definition by Keefe (1979), who described it as characteristic cognitive, effective and psychological behaviors that serve as relatively stable indicators of how learners perceive, interact with and respond to the learning environment. Several instruments of learning styles have been described in the literature. Coffield et al. (2004) identified several inconsistencies in these instruments. They employ a variety of learning style descriptors and are sometimes criticized as being measures of personality rather than learning styles (Romanelli, 2009). Most frequently used learning style instruments are the Myers-Briggs Type Indicator (MBTI), Hertmann Brain Dominance Instrument (HBDI), Felder-Silverman Learning Style Model (ILS) and Kolb’s Learning Styles Inventory (LSI). Although all styles classify different learning types in different manners, their aims and approaches are similar. In this study, ILS inventory is used as an instrument for assessing learning styles due to its construct validity (Felder & Brent, 2005).

2.3. Personality and learning styles

A number of researchers have investigated the interplay between learning style and personality traits. Despite this attention there is some debate as to whether or not learning style can be simply understood as a function of personality traits (Clarke & Robertson, 2005; Chamorro-Premuzic, 2006). A review of available literature reveals contradictory and confusing evidence. While some authors (Eysenck, 1978; Furnham, 1992) argued that learning style is a sub-set of personality and that there is no need to measure the two constructs separately, others have concluded that the relationship between styles and personality is unclear and difficult to conceptualize (Zhang & Sternberg, 2006) and that they are not the same constructs (Riding & Wigley, 1997; Busato et al., 2000; Zhang, 2003; Zhang, 2006; Chamorro-Premuzic et al., 2007; von Wittich & Antonakis, 2011).

Apart from empirical evidence about the relationship between learning styles and personality, there exist a few important conceptual arguments about this relationship. For example, Hashway (1998) noted that many style theories are personality based. The earlier review of the literature on the relationship between learning style and personality traits is beyond the scope of this paper and the reader is referred to Zhang (2003) and Duff et al. (2004) for a thorough treatment of the subject.

2.4. Relationship of personality and learning styles to accident involvement

The frequency and severity of occupational accidents can be different, depending on the type of industry. This is evidenced by the fact that construction industry is among the top most accident-prone sectors in the world. Therefore, occupational safety in construction has always been a significant concern for both practitioners and researchers. Various reports and articles have been published on the health and safety in construction sites. Yet, there is little research on the key factors influencing unsafe behaviors and accidents on construction sites. Occupational injuries and fatalities still continue to plague the construction industry.
Research in mainstream literature indicates that many researchers have recently focused on the relationship between accident proneness and individual personality traits. That is, people who have frequent accidents have some unique set of personality traits that distinguish them from people who rarely have accidents. However, this view is not shared by some scholars who argue that any relationship between personality variables and accident frequency is not strong. Despite this, the study of human element as a factor in accidents continues to be investigated in the occupational health and safety literature (Visser et al., 2007). Few researchers, however, have focused on personality traits and individual differences in the prediction of construction site accidents (Lingard & Rowlinson, 2005; Khosravi et al., 2014; Hosseinian & Torghabeh, 2012).

Bandura (1997) argues that if human beings are exposed to unsafe behaviors, they are likely to acquire knowledge from experiences and learning. This implies the importance of learning from failures (consequences) in order to reduce unsafe behaviors. There are some evidences in the literature showing that learning style theory can be used as a predictor for determining the learning performance (Çağıltay, 2008). Learning from incidents and accidents is important in the construction industry as it is an accident intensive industry.

Individual differences in learning style and personality have been reported a fundamental factor determining individual behavior and performance. This study aims to shed light on the relationship between the five-factor model of personality, learning styles, and the effects of these variables on accident involvement in construction.

3. Research Methods

This paper addresses the question of whether there are any significant differences in the accident performance of construction professionals across learning styles and personality. The research process commenced with a careful review of the literature. Despite considerable data supporting the importance of personality traits and learning styles, there is little knowledge about the combined effects of these two variables in explaining accident performance.

The following research questions guided this study;

- How does personality type as measured by the Big Five Indicator predict safety performance (thereby accident involvement)?
- How does the interaction of personality type as measured by the Big Five and learning style as measured by the ILS predict safety performance?

3.1. Sample and data collection

The sample consists of the professionals working in the construction industry including occupational health and safety (OHS) specialists, managers, architects, engineers and construction workers. The respondents were contacted via email and through professional and social networks, inviting them to fill in the web-based survey supported by the ITU. The online questionnaire consisted of two sections. The first section included questions on the demographic and professional factors including: age, gender, professional position, experienced period in the sector, etc. In the second section, each respondent was asked to answer three major sets of questions for the following three elements: (1) personality traits test, (2) learning preferences test and (3) accident outcomes. The subheading ‘3.2. Data measurement’ provides detailed information on the
tests covered in the questionnaire. A total of 104 responses were received as detailed under the subheading ‘4.1. Sample characteristics’. The data obtained has been analyzed via statistical analyzes including correlation and multinomial logistic regression analyses as detailed under the subheading ‘4.2. Statistical analysis’.

3.2. Data measurement

Data pertaining to personality type and learning style of the participants were collected using the Turkish translations and adaptations of the Index of Learning Style (ILS) and the Big Five Inventory online. These self-report instruments, which are widely used in the arenas of education and psychology (Harrington & O’Shea, 1993) were followed by the self-report measure of workplace accident involvement. These measures have been described below:

3.2.1. Learning styles

The ILS, developed by Felder and Soloman was used in assessing learning style of the respondents. The Turkish version of the scale was adapted by Sabanca and Keskin (2007), and the Cronbach’s alpha reliability value was .64 for the index which is translated to Turkish. which meant that the scale was moderately reliable. ILS consists of 44 statements that each 11 statements refer to one of four pairwise dimensions of learning. Scores on the four indices: active/reflective (ACT/REF), sensing/intuitive (SEN/INT), visual/verbal (VIS/VER), and sequential/global (SEQ/GLO) are coded on a scale from 1 to –11 in decrements of 2. The dichotomous nature of the ILS scales, however, makes the use of standard statistic tests difficult (van Zwanenberg et al., 2000). As the scores are complimentary, only scales for either (a) or (b) should be considered. Each of them consists of 11 items. The responses were scored for active, sensing, visual and sequential scales by assigning a value of 1 to (a) items and 0 to (b) items. Scores for the respective opposite polarities; reflective, intuitive, verbal and global can be found as a complement of 11. Responses internal consistency of reliability was computed by Cronbach’s Alpha indices of responses on each of the four dimensions (see Table 1).

3.2.2. Personality

Personality traits were assessed using a Turkish translation of the Big-Five Personality inventory, adapted by Sümer, Lajunen & Özkan (2005). It contains 40 items, that measure extraversion, conscientiousness, openness to experience, neuroticism, and agreeableness factors. Respondents indicated their degree of agreement with each item on a seven-point semantic differential scale. It is the most widely used and robust measure of personality traits with sound psychometric properties established by previous researchers (Costa & McCrae, 1987 and 1992).

3.2.3. Accident involvement

There are two fundamental practical problems in measuring accident occurrence. The first problem is that; workplace accidents appear frequently to be underreported (Chmiel, 2008). A number of empirical studies suggest that underreporting may stem not only from the perceived reaction and negative attitude of managers (Clarke, 1998), the fear of blame and punishment (Reason, 1997), but also from perceived lack of understanding the importance of safety awareness (van der Schaaf & Kanse, 2000). The second practical problem is the relatively infrequent occurrence of accidents, which requires data collection
over long periods. Furthermore, it is suggested that use of self-reports might be the preferred criterion for safety research (Thompson et al., 1998). As such, the measures of accident involvement used in this study were self-report in nature.

A purpose designed self-report scale was used to assess respondents' involvement of accident for different building modalities. They were asked to indicate the number of at-fault work-related in which they had been involved in the past three years on a 3-point scale ranging from "never" to "frequently". "At-fault" accidents were defined as any accident the participant was involved in which he/she personally was at fault. The dependent variable accident involvement has been scaled as “None (0)” which describes accident-freeness, “Sometimes (1-3 per year)” which describes semi accident-proneness and “Often (>3 per year)” which describes accident-proneness.

4. Results

The findings of the study reported here, establish a number of interesting relationships between the Big Five personality traits, learning styles, and accident involvement in differing construction project types.

4.1. Sample characteristics

Responses to these questions provide a brief information about general characteristics of facing population. According to the answers given to the demographic questions in the survey, men’s involvement with 70 people is dominant than women’s with 32 of total 102 individuals. In addition, it can be concluded that, the population includes generally young participants such as; 41% of 20-29 ages, 39% of 30-39 ages, 16% of 40-49 ages, 2% of 50-59 ages and 2% of 60+ ages among construction industry professionals. Same part of the questionnaire shows profession dissociation. According to this part, the sample consists of; 23 managers, 21 architects-engineers, 16 OHS specialists and 42 construction workers.

Data on the population further reveal that younger professionals are generally conducting civil engineering or design in architecture fields rather than occupying managerial positions. Data reveal that the sample group is experienced mainly in residential, office, hotel and shopping mall project rather than in bridge, road or airport projects.

4.2. Statistical analysis

Three research questions were addressed in this study related to the predictive effects of personality type and learning style, in isolation and collectively, on accident involvement in the context of construction.

4.2.1. Descriptive statistics

Table 1 represents the means, medians, standard deviations and internal consistency alphas for the study variables. According to the table, none of the ILS scales reached or even approached the usual recommended minimum standard of alpha 0.8 for psychometric instruments (see, e.g. Kline, 2000). Extraversion and conscientiousness surpass the standard benchmark of 0.70, openness produced a low reliability of 0.68. Participants were assigned to high and low categories based on a median split of their subscale scores from the Big Five personality inventory. As an example, the median extraversion score was 4.75; consequently, participants scoring ≤4.75 were assigned to
the low extraversion group (n=53), while those >4.75 were assigned to the high extraversion group (n=51).

Table 1 - Means, standard deviations and Cronbach Alpha Coefficients

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Median</th>
<th>Standard Deviation</th>
<th>Cronbach Alpha Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personality</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extraversion</td>
<td>4.29</td>
<td>4.75</td>
<td>1.61</td>
<td>.74</td>
</tr>
<tr>
<td>Openness</td>
<td>4.43</td>
<td>5.00</td>
<td>1.64</td>
<td>.68</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>4.59</td>
<td>5.37</td>
<td>1.69</td>
<td>.83</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>3.19</td>
<td>3.12</td>
<td>1.13</td>
<td>.84</td>
</tr>
<tr>
<td>Agreeableness</td>
<td>4.56</td>
<td>5.12</td>
<td>1.71</td>
<td>.74</td>
</tr>
<tr>
<td>Learning Styles</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Active/Reflective</td>
<td>5.81</td>
<td>6.00</td>
<td>2.25</td>
<td>.76</td>
</tr>
<tr>
<td>Sensing/Intuitive</td>
<td>7.10</td>
<td>7.00</td>
<td>2.21</td>
<td>.65</td>
</tr>
<tr>
<td>Visual/Verbal</td>
<td>8.59</td>
<td>9.00</td>
<td>2.11</td>
<td>.63</td>
</tr>
<tr>
<td>Sequential/Global</td>
<td>5.61</td>
<td>5.00</td>
<td>2.32</td>
<td>.68</td>
</tr>
</tbody>
</table>

\[a\] Maximum score = 7.00, \[b\] Maximum score = 11

4.2.2. Inferential statistics

In this study, two statistical tests were conducted to examine the relationships between learning styles and personality dimensions on occupational accident tendencies of construction professionals. Firstly, Pearson’s zero-order correlation matrix was computed. Secondly, the data were analyzed with Multinomial Logistic Regression Analysis, using the scale scores as covariates.

Correlation analysis

Correlation analysis, with Pearson’s correlation coefficients for the two constructs, indicated a number of significant relationships in Table 2: (a) As the correlation matrix indicates, all personality dimensions exhibited a small-to-moderate significant negative correlation with accident involvement; (b) Extraversion, Openness, Conscientiousness and Agreeableness were correlated with all learning styles except visual/verbal subscale; (c) Neuroticism was significantly correlated only with active/reflective style; (d) A significant positive correlation between sequential learning and accident involvement was found.

Table 2 - Correlations between personality traits, learning styles and accident performance

<table>
<thead>
<tr>
<th>Extraversion</th>
<th>Active/Refl.</th>
<th>Sensing/Intul.</th>
<th>Visual/Verbal</th>
<th>Sequ./Global</th>
<th>Accident</th>
</tr>
</thead>
<tbody>
<tr>
<td>-.268**</td>
<td>-.211*</td>
<td>-.129</td>
<td>-.452**</td>
<td>-.195*</td>
<td></td>
</tr>
<tr>
<td>-.316**</td>
<td>-.279**</td>
<td>-.165</td>
<td>-.426**</td>
<td>-.310*</td>
<td></td>
</tr>
<tr>
<td>-.370**</td>
<td>-.199*</td>
<td>-.067</td>
<td>-.416**</td>
<td>-.291**</td>
<td></td>
</tr>
<tr>
<td>-.196*</td>
<td>-.038</td>
<td>-.038</td>
<td>.141</td>
<td>-.215*</td>
<td></td>
</tr>
<tr>
<td>-.339**</td>
<td>-.240*</td>
<td>-.194</td>
<td>-.403**</td>
<td>-.336*</td>
<td></td>
</tr>
<tr>
<td>.195</td>
<td>-.106</td>
<td>.101</td>
<td>.216**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[*p<.05, \quad **p<.01\]
**Multinomial Logistic Regression Analysis**

In addition to the correlation results, regression analysis was conducted in an effort to investigate the degree to which the five personality factor could be used to predict accident involvement. In this study, the Multiple Logistic Regression (MLR) was performed to test the relationships between the personality types defined by the Big Five-Factor Inventory, the learning styles defined by the ILS Inventory as the independent variables and accident involvement as the dependent variable. The MLR model, which is an extension of binary logistic regression model provides a solution to the question of identifying which among personality traits and learning styles is more important in differentiating the three categorical outcomes, namely accident-free, semi-accident prone and accident-prone. Since the categorical dependent variable has more than two outcomes then MLR requires the definition of a baseline or reference category (Giritli et al., 2013). In this study, the “accident-prone” was chosen as the reference group for comparison. All results are based on the P-values, Beta Coefficients and the Exponential Beta Coefficients. Accident-prone is treated as the reference group and therefore models are estimated for accident-free and semi-accident prone outcomes relative to accident-prone.

MLR analysis findings were respectively presented in the tables below. In Table 3, the case processing summary provides details concerning sample size, its exposure to accidents and its composition. There exists missing data in the study, which is referred to as item nonresponse where participants submit a survey but do not give a response to every item (Schlomer, 2010).

Table 4 presents model fitting information. In the model fitting information, \(-2\) log likelihood value is the intercept only of the model and the chi-square is the difference between the intercept-only and the final model. Since the observed significance level was calculated as \((p<0.001)\), the existence of a relationship between the independent variables and the dependent variable was supported.

In Table 5, the Pseudo R-Square provides the Cox and Snell R-Square and the Nagelkerke R-Square values which provide an indication of the amount of variation in the dependent variable explained by the model. This analysis reveals that between 31.3% and 35.6% of the variability in the dependent variable is explained by this set of variables.
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Table 5 - Pseudo r-square: personality traits + learning styles

<table>
<thead>
<tr>
<th>Pseudo R-square</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cox and Snell</td>
<td>.313</td>
</tr>
<tr>
<td>Nagelkerke</td>
<td>.356</td>
</tr>
<tr>
<td>McFadden</td>
<td>.177</td>
</tr>
</tbody>
</table>

Table 6 presents the prediction accuracy test of the estimated Multinomial Logistic Regression Analysis model, the final test of this method. The columns are the predicted values and the rows are the actual or the observed values. The result shows that an overall 56.9 percent (57/102) of all valid cases is correctly classified into their original rating classes. However, as it is seen from the table, the “accident prone” group had a higher level of accurate prediction at 76.6% compared to the other two groups. The usability of this model was done by computing the proportional-by-chance accuracy rate of the classification. The chance accuracy rate is the marginal percentages of the dependent variable shown in the case-processing summary in Table 3. These are squared and added up to get the proportional-by-chance accuracy rate of the existing data. A 25% improvement over this chance rate has been set as an acceptable standard (Petrucci, 2009) Using the marginal frequencies provided in the case processing summary, we get the following equation for the proportional-by-chance accuracy rate to determine a 25% prediction improvement: (0.2842+ 0.2552+ 0.4612=0 .358), then (1.25 × 0.358 = 0.448). Since 56.9%> 44.8%, then the model improves on chance by 25% or more and is considered adequate.

Table 6 - Classification

<table>
<thead>
<tr>
<th></th>
<th>Predicted</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Accident free</td>
</tr>
<tr>
<td>Observed</td>
<td></td>
</tr>
<tr>
<td>Accident free</td>
<td>12</td>
</tr>
<tr>
<td>Semi-accident prone</td>
<td>6</td>
</tr>
<tr>
<td>Accident prone</td>
<td>5</td>
</tr>
<tr>
<td>Overall percentage</td>
<td>22.5%</td>
</tr>
</tbody>
</table>

Table 7 shows the estimated coefficients (B) and related statistics of the Multinomial Logistic Regression Analysis. Coefficients of the Multinomial Logistic Regression revealed that extraversion scale seems to be a good predictor for safety behavior (B-value=-.874, p=.032). The negative value of B of the extraversion scale in column 3 of Table 7 indicates that professionals in the construction industry with the extraversion personality trait tend to be accident-free; but less likely to be in the group of survey respondents who are accident prone. This means that, for quantitative variables, parameters with significant positive (or negative) coefficients increase (or decrease) the likelihood of that response category with respect to the reference category. Similarly, the positive (or negative) value of B of the active/reflective learning style corresponding to “semi-accident prone” group indicates that any increase (or decrease) in variable value of the active (or reflective) style would increase (or decrease) the likelihood of practicing accident involvement compared to the reference category of “accident-prone”.

Pseudo R-square

Cox and Snell .313
Nagelkerke .356
McFadden .177
5. Discussion

Despite considerable data supporting the importance of personality traits and learning styles, there is little knowledge about the combined effects of these two variables in explaining accident score. Thus, the initial purpose of this study was to enlighten the potential relationship of personality and learning preferences on accident involvement in order to prevent occupational accidents in construction workplace. Three different statistical methods were applied to test the relationships.

Results from the zero-order correlation revealed a number of interesting relationships between the Big Five personality traits, learning styles and occupational accident frequency of construction professionals. Significant relations were found between accident involvement and all of the Big Five personality traits. Each of the relations was negatively associated. These findings are partly consistent with previous researches on the matter field. Firstly, the findings for agreeableness and conscientiousness are in line with some empirical studies that have found individuals who score high on agreeableness and conscientiousness are less likely to have been involved in workplace accidents (Celler et al., 2001; Wallace & Vodanovich, 2003). More specifically, individuals high in conscientious tend to follow rules and procedures related to safety and also work more carefully. More agreeable individuals tend to behave in a way that stimulate and preserve positive and meaningful relationships with others, because safety is collaborative effort that can be compromised by the actions of single person. Mount et al. (1998) also noted that agreeableness was significantly related to job performance in occupations involving team-base working such as construction. This implies that teams composed of highly agreeable individuals would be more effective in terms of safety-related outcomes.

As pointed out in the result section, negative relationship has been supported between openness and accident involvement. Openness is one of the least studied of the ‘big five’ personality dimensions in terms of accident involvement, compared to the other personality dimensions. Individuals scoring low on openness tend to focus on the task in hand, therefore, are less likely to become accident involved (Clarke & Cooper, 2004). As such, the findings suggest that low agreeableness and low openness could be interpreted as significant predictors for occupational accidents within the context of construction industry (Costa & McCrae, 1992; Cellar et al., 2004).

In respect to the negative relationship between extraversion and accident involvement, this finding is in contrast with the contentions of others (Beus et al., 2015; Barrick et al., 2013), that extraverted individuals may be more likely to work unsafely by ignoring safety rules to gain a competitive advantage over coworkers. That is individuals higher in extraversion are more likely to engage in unsafe behavior than individuals lower in extraversion. Despite these consistent findings of a positive association between

<table>
<thead>
<tr>
<th>Accident Category</th>
<th>Variable</th>
<th>B</th>
<th>Std. error</th>
<th>Wald stat</th>
<th>Sign.</th>
<th>Exp. (B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accident-free</td>
<td>Intercept</td>
<td>-1.449</td>
<td>2.316</td>
<td>.391</td>
<td>.532</td>
<td>.532</td>
</tr>
<tr>
<td></td>
<td>Extraversion</td>
<td>-0.874</td>
<td>.409</td>
<td>4.575</td>
<td>.032</td>
<td>.417</td>
</tr>
<tr>
<td>Semi-accident prone</td>
<td>Intercept</td>
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<td>2.510</td>
<td>7.239</td>
<td>.007</td>
<td>.532</td>
</tr>
<tr>
<td></td>
<td>Active/Reflective</td>
<td>.312</td>
<td>.160</td>
<td>3.831</td>
<td>.050</td>
<td>.732</td>
</tr>
</tbody>
</table>

*The reference category is: accident-prone. Bold numbers indicate that coefficients are statistically significant.
extraversion and accident involvement, some contradicted findings also revealed that, extraversion has no influence on accident involvement (Clarke & Robertson, 2005).

Another interesting finding revealed by the correlation analysis is neuroticism’s negative relationship with accident involvement. Contrary to expectations, neuroticism was negatively rather than positively related to accident involvement. Although neuroticism has been found to be positively related to risk taking behavior and accident involvement (Sutherland & Cooper, 1991; Frone, 1998; Hansen, 1989), research is lacking regarding reasons why this relationship exists (Robertson & Clarke, 2002). According to Eysenck (1970), individuals high in neuroticism tend to be more accident-involved. Lajunen (2001) also found in his study that both high and low neuroticism might be related to accident prone. Hence, results about relationship between neuroticism and high accident rate have been rather mixed. One explanation might be the assumption about linear relationship between the variables stated; for example, the more neurotic an individual is, the more likely she/he is to be accident-free (Glendon et al., 2016). Other possible interpretation is that neuroticism has a very strong biological basis. Using an MRI, a study by DeYoung et al. (2010) showed that, neuroticism was associated with increased volume of brain regions associated with threat, punishment and negative emotions. This possible alternative interpretation, however, is not fully supported by developmental behavioral genetics research of personality traits (Gardini et al., 2009). The reported results of correlation analysis should be, however, interpreted with caution given the relatively low magnitude of the correlations.

As presented in Table 2, the correlation coefficients among the scales from the two inventories replicates the correlations reported by Furnham (1992) and show the overlap between personality and learning style. Extraversion, agreeableness, conscientiousness and openness are significantly related to three of the ILS scales, whereas neuroticism correlates only with active/reflective style (how information is presented).

Regression results suggest that, one personality factor may be useful for helping to predict accident involvement in the construction site. The findings from the Multinomial Logistic Regression appear to be consistent with those who found high in extraversion are more likely to engage in unsafe behavior (Clarke & Robertson, 2008; Cellar et al., 2004; Smilie et al., 2006). In addition, only the active/reflective dimension significantly predicted safety behavior. Of the individual differences examined, extraversion seems to play the greatest role in predicting safety attitudes and could be useful in the employee selection process to reduce workplace accidents within the context of construction industry. Another conclusion drawn from this study’s finding is that, visual/verbal style may be general and independent of personality traits of construction professionals.

6. Conclusions and Recommendations

The major contribution of this paper is to untangle the relationship between personality traits and learning styles in occupational accidents in the context of construction industry. Based on theories which suggest that learning style and personality traits are linked, the results of a questionnaire survey were analyzed and significant empirical evidence was found to support this claim. The results of the study are constrained by the sample size and the measures adopted to gage personality traits and learning style. Thus, some caution should be noted.
Many of the conclusions drawn from the research are significant, however, not only because of the contribution that they can make to a better understanding of the relationship between personality traits of construction professionals and their preferred learning styles, but also for the insights that they may bring to the combined effects of these two variables in explaining the degree of accident proneness of professionals working in a high risky sector such as construction. The current results highlight the independence of learning approaches from most personality traits.

The value of this research also lies in the fact that, once relationships between personality, learning style and safety behavior are established, personality and learning style inventories may then be used to predict individuals who are more likely to behave safely. Furthermore, such information would also have important implications for developing behavior based safety training programs in construction organizations.

The results of this study confirmed the knowledge of the associations among personality traits, learning styles and accident involvement. The findings extend the body of knowledge of personality traits and learning styles in the Turkish construction context. Further research is recommended to be carried out in different countries enabling comparison among different cultures and analyzing their impacts on workplace safety.

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7. References


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