



Training Report

Conscientiousness & Education

Human Resources Division

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Executive Summary

TxDOT needs an educated workforce, including those with college degrees. The National Academy of Sciences (NAS) concluded that the personality trait of *conscientiousness*, a measure of self-discipline, correlated with college success (NAS, 2017). HRD conducted an online assessment to measure the personality traits of a sample of TxDOT's maintenance and operations workforce. This research found that TxDOT maintenance and operations employees who do not have college degrees were more *conscientiousness* than average, which should encourage expectations of higher-than-average college completion in future education programs. In fact, TxDOT participants scored highest on *conscientiousness*, followed by agreeableness, neuroticism, openness, and extraversion.

- The sample yielded five-factor model scores of 31.000 for extraversion (SD=5.779), 35.404 for openness (SD=3.639), 35.742 for neuroticism (SD=5.841), 37.874 for agreeableness (SD=4.3179), and 39.967 (SD=4.093) for *conscientiousness*; all on scales of 10 to 50 (n=151; *Figure 1*).

Introduction

The Texas Department of Transportation (TxDOT) has a need for an educated workforce, especially those with college degrees. In order to identify employees who may have the skills and traits to succeed in education, TxDOT needs to assess individual employees. Today, TxDOT does not use assessments and has no means of estimating how many employees might be successful in college programs. As a result, we don't know how much we should emphasize tuition assistance or education opportunities within our workforce, or as part of our Strategy 7 goals.

This Training Report is a summary of research conducted by Workforce Development Section of the Human Resources Division (HRD). Oregon State University Professor of Civil Engineering Shane Brown co-authored the summary report and provided invaluable peer review. He may be reached at Shane.Brown@oregonstate.edu.

Background

The State of Texas has a goal that 60% of Texans will have a college degree or professional certification by 2030 (THECB, 2018). According to PeopleSoft HR, TxDOT's Human Resources Information System of record, about 6,900 TxDOT employees (59%) have no record of college completion. To help Texas meet its 2030 goal, TxDOT should encourage at least 2,200 employees to pursue education as part of their career development. Additionally, TxDOT's Strategy 7 – Value our Employees – calls for increased career development opportunities that include more training and education. That said, HRD does not know how many of the 6,900 eligible employees are capable of completing an external education program, or if it is realistic to assume that TxDOT even has 2,200 employees who can successfully complete college.

Current predictors for college success hinge on understanding three domains of individual competence: intrapersonal competencies (e.g. managing emotions to reach goals), interpersonal competencies (e.g. communications skills), and cognitive competencies (e.g. thinking and reasoning skills; NRC, 2013). The most frequently used standardized measures of these competencies are the SAT, the ACT, and the Texas Skills Initiative tests; all of which measure just the cognitive competencies. Two criticisms of these assessments are that the narrow focus on cognitive skills has caused us to neglect the other two domains of competence, and that cognitive testing is a costly means of measuring what may only be a third of what matters to college success.

Recently, a National Academy of Sciences Consensus Study Report concluded that the personality trait of *conscientiousness*, a competency characterized by an individual's self-discipline and follow-through, significantly correlated with college success (NAS, 2017). This finding is noteworthy for TxDOT, as over 1,100 employees have attended formal leadership training events that included

exposure to personality trait theory through the Myers-Briggs Type Indicator. Additionally, popular focus on the subject of “grit” – a concept related to *conscientiousness* (Credé, Tynan, & Harms, 2017) – has featured in internal employee recognition events.

The Big Five – The “Big Five,” or five-factor model (FFM), of personality is a concept of personality trait theory that measures overarching traits, sometimes referred to as broad traits, related to concepts of openness, *conscientiousness*, extraversion, agreeableness, and neuroticism (Judge, Simon, Hurst, & Kelley, 2014). Of the Big Five traits, *conscientiousness* is a relative measure of how involved an individual becomes in tasks, providing a measure for a sense of duty and follow-through (Judge & Ilies, 2002). Extraversion reflects individual sociability, or the desire to be around others (Costa & McCrae, 1992). Watson, Stasik, Ellickson-Larew, and Stanton (2015) found that underlying facets of extraversion included positive emotionality, sociability, assertiveness, and experience-seeking behavior. Agreeableness is the measurement of how likely someone is to cooperate with others and is related to communications skills and individual attitudes (Bradley, Baur, Banford, & Postlethwaite, 2013). Sub-facets of agreeableness include trust, straightforwardness, altruism, compliance, modesty, and sympathy (Matsumoto & Juang, 2012). While having negative connotations in everyday speech, the Big Five trait of neuroticism is simply a measure of caution, shyness, and self-consciousness (Paulus et al., 2016). Openness, or openness to experience, is related to fantasy, feelings, ideas, and values (Kaufman, 2013). Those who score higher on a measure of openness are seen as adaptable, flexible, and curious while those who score relatively lower are more predictable and less prone to impulsive behavior (Kaufman, 2013). When put into practice in a workplace, understanding an individual’s “Big Five” scores may help with organizational dynamics and can often shed light on individual behaviors.

The 2017 Consensus Study Report was based on the research of 21 committee members and represented the official position of the National Academies regarding the identification of individual competencies relevant for college success. That said, just like the limitations of the SAT, the conclusions of the study report leave much room for future research and TxDOT recognizes that using personality traits as a direct predictor of college success is an imperfect approach. However, by using *conscientiousness* as a proxy for college completion potential, TxDOT may have a low cost and low impact means of assessing college success without resorting to traditional college placement exams or other costly equivalents.

Problem Statement, Purpose of the Study, & Significance

It is not known how many of the 6,900 eligible TxDOT employees could be expected to successfully complete an external education program. There is also no data available about the personality traits of the transportation maintenance and operations workforce in Texas or elsewhere, which represents a significant gap in our understanding of the TxDOT workforce. As a result, this quantitative study was designed to determine what percentage of a sample of the target population

had an average or higher level of *conscientiousness* in order to estimate how many employees could be expected to successfully complete education programs. This study provided a better understanding of TxDOT's workforce in order to better establish and judge Strategy 7 program targets. Notably, this research also provided the first contemporary view of five-factor model personality traits among TxDOT's maintenance and operations workforce.

Research Questions

For this study, the goal was to answer this research question: Of the TxDOT employees who have not completed college, what percentage of that population has an average or higher level of *conscientiousness*?

Research Methodology & Design

A valid and reliable instrument was used to measure the “Big Five” personality traits, Goldberg's 50-item self-assessment, which includes *conscientiousness* alongside the traits of openness, extraversion, agreeableness, and neuroticism (Goldberg, 1992). A valid and reliable instrument is one that has gone through rigorous development and testing processes to ensure that the questions accurately represent the trait being measured and that questions have been worded in such a way that a participant's answers would not change from one reading of the question to the next. As noted earlier, *conscientiousness* is associated with self-discipline and follow-through. Those with high openness are viewed as adaptable, flexible, and curious; while those with lower openness are more predictable and less prone to impulsive behavior (Kaufman, 2013). Extraversion reflects individual sociability, or the desire to be around others (Costa & McCrae, 1992), while agreeableness is an indicator of how likely someone is to cooperate with others (Bradley et al., 2013). The last major trait of neuroticism is a measure of caution, shyness, and self-consciousness (Paulus et al., 2016).

Certain items of the 50-item assessment were modified to match common terminology used at TxDOT (e.g. “chores” became “tasks”). Based on social science conventions for exploratory research, a reasonable sample size to answer the research question with 80% confidence and a margin of error of 5% was determined to be 161 valid responses (Survey Monkey, 2018). The survey was open between August 9 and September 12, 2018 and yielded 151 useable surveys. Participants consented to participation and completed a Survey Monkey version of Goldberg's 50-item assessment. Participant demographics were solicited by asking the same demographic questions asked on the biennial Survey of Employee Engagement in order to better characterize the attributes of the sample and to provide context for decisionmakers. No identifying information was solicited and participants were allowed a “Prefer not to answer” option. After data collection,

descriptive statistics were examined and scores for each of the “Big Five” personality traits were recorded. The results for the *conscientiousness* construct was used to answer the research question. Due to the lack of comparative data for the target population, we assumed that values at or above the midpoint scores for each construct (30 out of 50) represented the “average and higher” threshold set in our research question. This approach was based on the exploratory research findings of the 2017 Consensus Study Report, which relied on literature reviews of 49 articles; citing 61 studies related to social-psychological interventions that included research using similar self-reported “Big Five” inventories and literature research related to more traditional experimental interventions (NAS, 2017).

Descriptive Data

The target population was a subset of TxDOT employees with job titles that included key words related to highway maintenance and operations functions who did not have college completion recorded in TxDOT’s HR information system (Appendix A, n=5,721). The sample population was a convenience sample of 151 volunteers self-selected from among the target population. These participants acted on an original e-mail solicitation or a reminder e-mail to four separate e-mail lists of 300 employees each between August 9 and September 12, 2018. From this solicitation of 1,200 employees, Survey Monkey recorded 204 respondents. Of the 204, 16 did not provide consent, three did not continue past the consent screen, and nine did not continue past the demographics screen. Because TxDOT’s education information for all of its employees is not completely accurate, participants who self-reported college completion in the demographics screen were removed, reducing the sample size from 176 to 153. Finally, 2 participants who chose “Prefer not to answer” for the “highest education completed” question were removed, yielding a sample size of 151. Examining responses, there were four missing values, one for each of four trait constructs and all from different respondents. Based on guidance from the International Personality Item Pool, a psychometric collaboration based out of the University of Oregon, the value of “3 – Neither agree nor disagree” was substituted for these missing values.

While the target sample size of 161 was not reached, we assessed the guidance posted by Survey Monkey was a very conservative generalization, so a post hoc analysis using G*Power was computed with settings for a point correlation exact test for a bivariate normal, two-tailed, post hoc power analysis with a type I error of $\alpha = .05$, a moderate effect size of .30, and using the sample size of 151. This yielded a type II error of $(1-\beta)$ of .9699 – well in excess of the .80 accepted for most social science research (Faul, Erdfelder, Buchner, & Lang, 2009). As such, we concluded that our results were statistically acceptable and that the results we found for this sample would be similar to what we would expect in similar studies under similar conditions. While imperfect, we believe it is reasonable to generalize our results to the larger population of 6,900 TxDOT maintenance and operations employees.

Based on the demographic questions, we generalized (majority percentages in parentheses) that the average TxDOT maintenance and operations employee for this sample identified as a white (77%) male (87%) with some college (61%), earning between \$35-50K per year (43%) who was between 50 and 59 years old (43%) with more than 16 years of service (46%) – but not eligible for retirement within the next 2 years (72%) – and not in a non-supervisory role (74%). He hasn't been promoted within the last 2 years (63%), but received a merit increase (75%), and plans to be here next year (96%).

Results & Findings

The purpose of this study was to use a “Big Five” personality inventory to determine what percentage of TxDOT employees who have not completed college have an average or higher level of *conscientiousness*.

As stated in the background section, the “Big Five” model of personality is a concept of personality trait theory that measures overarching traits related to concepts of openness, *conscientiousness*, extraversion, agreeableness, and neuroticism (Judge, Simon, Hurst, & Kelley, 2014). There are no “correct” scores when measuring the “Big Five” and most interpretations of personality traits require much additional context. Personality trait research refers to the “Big Five” traits as “broad” traits for this reason – the “Big Five” traits simplify much more subtle sub-facets of traits that may not be measurable with impersonal questionnaires or with the simplified questions that comprise current valid and reliable tools.

- The sample yielded Big Five scores of 31.000 for extraversion (SD=5.779), 35.404 for openness (SD=3.639), 35.742 for neuroticism (SD=5.841), 37.874 for agreeableness (SD=4.3179), and 39.967 (SD=4.093) for *conscientiousness*; all on scales of 10 to 50 (n=151; Figure 1).

Based on the sample data, we observed the average *conscientiousness* score was 39.967, on a scale of 10 to 50, with a Standard Deviation of 4.093 (n=151). This is generally equivalent to saying that about 95% of the employees in this study answered “Neither Agree nor Disagree”, “Agree”, or “Strongly Agree” to all questions related to *conscientiousness*, with a peak of answers centered on the “Agree” response (Figure 1). In other words, participants in this sample only “Disagree[d]” or “Strongly Disagree[d]” 6 out of 1,510 times for the *conscientiousness* items.

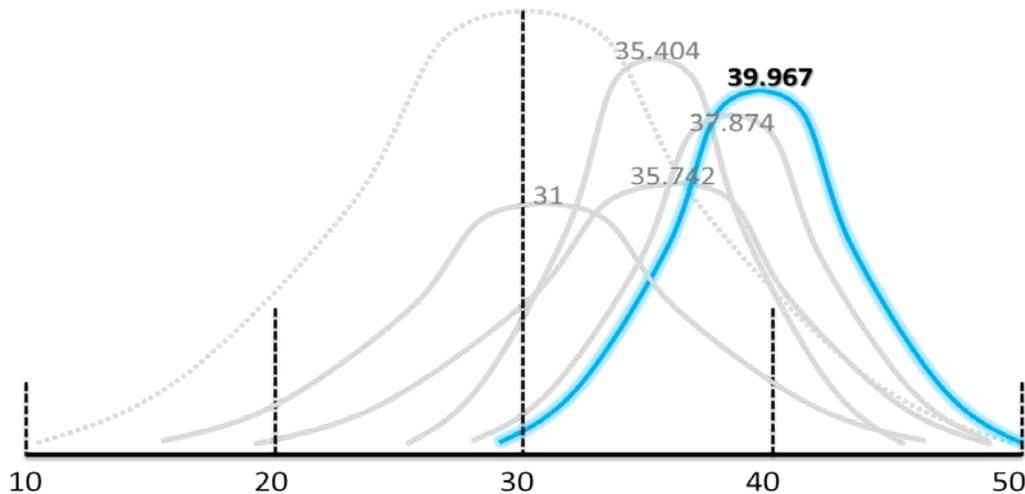


Figure 1. The strongest five-factor personality trait for the average TxDOT operations employee in this sample was *conscientiousness*, followed by agreeableness, neuroticism, openness, and extraversion.

Summary, Conclusions, & Recommendations

This research concluded that TxDOT maintenance and operations employees who do not have college degrees appear more *conscientiousness* than average (i.e. a score of 30 or more out of 50), which should lead to expectations of higher-than-average college completion for future internal education programs. Extrapolating further from this research, TxDOT might conclude that almost all of the 5,900 operations employees could have higher-than-average *conscientiousness*.

Overall, TxDOT participants scored highest on *conscientiousness*, with agreeableness, neuroticism, openness, and extraversion all being above average. These results seem to confirm HRD’s anecdotal understanding that TxDOT roadway employees are dutiful and “gritty” (Credé, Tynan, & Harms, 2017), while not being particularly extraverted. TxDOT now has a better view of the personality traits ascribed to a key segment of its workforce, which should inform HR operations.

This research also provided a clearer understanding of the demographics of our current operations workforce, which may enable us to better address TxDOT’s – and the transportation industry’s – diversity and inclusion challenges. Demographic questions also revealed that over 61% of the sample reported they had completed some college. This fact, coupled with the high *conscientiousness* scores, may reveal a phenomenon among our operations workforce: We can assume that some of our employees – individuals who do not like leaving things undone – may think that “stopping out” of college was a personal failure, or at least unfinished business. That said, we don’t know if the target population had employees who were close to graduating and “stopped out,” or if they were employees who never considered college as an option. We believe

these issues represent two different populations that were not delineated within this sample. More information about attitudes towards education, economic achievement, and other social factors may help us understand these issues better at TxDOT and in Texas.

Notably, this research provided the first contemporary view of “Big Five” personality traits for TxDOT’s maintenance and operations workforce. TxDOT encourages other Departments of Transportation and industry partners to replicate this study and provide a better understanding across local and state lines as to whether we have as homogenous a workforce as we may suspect.

For further questions about this report or the research, please contact the Workforce Development Section of the Human Resources Division at: training@txdot.gov.

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Appendix A

Process for Target Population Identification:

Education Description Query output (.xls) from PeopleSoft

Total employee count: 12,579 (includes summer hires)

1. Filtered report column G and “selected all” except titles with “summer” and “high school coop” in them, n=11,903
2. Filtered report column B and selected only the 25 Districts plus operations Divisions of BRG, CST, DES, MNT, TRF, and FOD; n=9,980
3. Filtered report column N and selected B-M and O-R (all school up to Bachelor’s but without completion. Excludes blank fields and “needs updating” fields), n=5,908

Limitations – Because degrees are often used as level cutters, blanks and “needs updating” fields are more likely to represent non-degreed employees. Regardless, “needs updating” and blanks were excluded.

4. Filtered report column G to include job titles that include words: Maintenance, General Transportation, Bridge and Bridge Inspection, Ferry, Construction Inspection, Design, Equipment, Electronics, Electrician, Fleet, General Engineering, General Maintenance, ITS, Laboratory, Resource Specialist, Material/Process Inspection, Inventory, Machinist, Pavement, TXMAP, Permit, Special Jobs, Special Projects, Utility, Vegetation, Metal Fabrication, Radio, Traffic, Sign, Striping, Survey; while “Coordinators” were included, positions that appeared to be office-based positions in nature, like Office Tech or Admin Tech were excluded. n=5,271

Delimitations – this research is focused on Maintenance and Operations personnel, who are principally based in Districts and Fleet Operations Division.

Limitations – based on data entry concerns, sample could include those who have college degrees and haven’t reported them. Similarly, we may exclude people from the population who had information entered in error. Mitigation – during data analysis, consider demographic information and exclude those who record college completion.