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Forty years of research on personality in software engineering: A mapping study

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ABSTRACT

In this article, we present a systematic mapping study of research on personality in software engineering. The goal is to plot the landscape of current published empirical and theoretical studies that deal with the role of personality in software engineering. We applied the systematic review method to search and select published articles, and to extract and synthesize data from the selected articles that reported studies about personality. Our search retrieved more than 19,000 articles, from which we selected 90 articles published between 1970 and 2010. Nearly 72% of the studies were published after 2002 and 83% of the studies reported empirical research findings. Data extracted from the 90 studies showed that education and pair programming were the most recurring research topics, and that MBTI was the most used test. Research related to pair programming, education, team effectiveness, software process allocation, software engineer personality characteristics, and individual performance concentrated over 88% of the studies, while team process, behavior and preferences, and leadership performance were the topics with the smallest number of studies. We conclude that the number of articles has grown in the last few years, but contradictory evidence was found that might have been caused by differences in context, research method, and versions of the tests used in the studies. While this raises a warning for practitioners that wish to use personality tests in practice, it shows several opportunities for the research community to improve and extend findings in this field.

1. Introduction

The work described in this paper builds on previous work (Cruz, da Silva, Monteiro, & Rossilei, 2011) carried out by the authors that investigates the knowledge produced about the influence of personality in software engineering. The preliminary study showed a considerable amount of conflicting evidence, which suggests that it is an immature research field with many opportunities to be explored by the research community.

When starting the previous study, our initial goal was to collect the largest possible quantity of studies published on the subject. To our knowledge, this was the first attempt to review the literature on personality in software engineering in a systematic way. We found only one study that performed a systematic review regarding the influence of personality on pair programming (Salleh, Mendes, Grundy, & Burch, 2009). This review has been recently updated, and the entire set of studies including one replication can by found in Salleh, Mendes, and Grundy (2014). Other studies have been conducted to review the literature on different aspects of software engineering (Capretz, 2003; Pocius, 1991), but these do not use a systematic approach.

In our previous study, we analyzed 42 primary studies, 38 originating from an automatic search, and 4 from a manual search. Despite the use of a carefully designed and executed systematic review protocol, some known studies were not included in the search results. Our goal in this new review was to increase the sensitivity of the search process. To achieve a higher sensitivity, we changed the search process in two complementary ways. First, we expanded the search string to include synonyms of the search terms. Second, we added a "snowball" search strategy in the second stage of the search process to look for relevant papers in the references of the papers selected in the first stage of the search. We used a set of known relevant papers in the area to calibrate the new search string and increase the sensitivity of the automatic search. The combination of the new string and the "snowball" search resulted in the addition of 48 new papers to the 42 investigated in the first review, bringing the total number of relevant papers analyzed to 90.

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In addition to including new articles, this work adds another research question to the four exiting questions to be answered by extracting data from the primary studies, as detailed in Section 3.1. We also provide more detailed information of the context of the studies, which is necessary to establish a comprehensive understanding of the research area. This updated literature review will help managers, software engineers and interested researchers in the field to determine the current state of research about personality in software engineering.

In this article, we report the results of a systematic review of the studies published between 1970 and 2010 that addressed the problems related to the influence of individual personality in software engineering. We identified and summarized the main topics researched in the studies, as well as the research method (theoretical or empirical), the type of subjects (students or professionals) and, when applicable, the personality tests used. Further, we attempted to integrate the results showing the personality profiles of software engineers and the effects of personality in individual or team performance, although this integration was not always possible due to key differences between the studies.

This article is organized as follows. In Section 2, we present a brief conceptual background about personality theories and related work. In Section 3, we describe the review method. In Section 4, the results of the review are presented, answering our research questions. In Section 5, we discuss the implications of our results for research and practice, and the limitations of this review. Finally, in Section 6, conclusions and directions for future work are presented.

2. Background and related work

There are many definitions of the term *personality* as established by various psychologists; these definitions generally include the basic elements that make up the theoretical conceptualization of the construct. However, it seems that there is no perfect definition of personality, and also no consensus on the issue in the field of psychology. While a deeper debate about nomenclature and conceptual definitions is out of the scope of this paper, we need some definitions in order to guide the review process. In this section, we provide such definitions, briefly describe five related works, and discuss how this article improves on the preliminary results published by Cruz et al. (2011).

2.1. Concepts and definitions

Personality is generally viewed as a dynamic organization, inside the person, of psychophysical systems that create the person's characteristic patterns of behavior, thoughts, and feelings. Ryckman (2004) defined personality as "the dynamic and organized set of characteristics possessed by a person that uniquely influences his or her cognitions, motivations, and behaviors in various situations". We use these definitions because they are general enough to allow the inclusion of studies covering a wide range of personality theories and research methods. The definitions clearly separate personality from other constructs like cognition, motivation, and behavior, which are not the central interests of this review.

The study of personality has been developed over the years to include an abundance of theoretical traditions in the field of psychology. These traditions are organized around seven perspectives on personality, which are frequently labeled as (1) dispositional, (2) biological, (3) psychoanalytic, (4) neoanalytic, (5) learning, (6) phenomenological, and (7) cognitive self-regulation (Carver & Scheier, 1988). The dispositional perspective encompasses the traits and types theory, which is one of the most used theories in organizational psychology (Anderson, Ones, Sinangil, & Viswesvaran, 2002) and in studies on personality in software engineering. The present review focuses on this personality perspective.

The trait and type approach assumes that personality consists of stable inner qualities that differ between individuals and influence behavior. Traits are defined by the American Psychiatric Association as enduring patterns of perceiving, relating to, and thinking about the environment and oneself that are exhibited in a wide range of social and personal contexts. People are assigned a specific personality type based on the classification psychological differences. Types can be distinguished from traits in that the latter can be manifested in different levels or degrees, whereas types are discrete.

Most studies on personality in software engineering use personality tests to identify differences among individuals. In psychology, there are two major categories of personality tests: projective and objective. Projective tests assess individual personality through responses from ambiguous stimuli, with the assumption that personality is unconscious and that an individual's responses will reveal his or her inner characteristics. Objective tests measure personality by self-assessment questionnaires, with the underlying assumption that personality is primarily conscious and can be directly accessed.

The studies included in this review use various forms of objective personality tests. The reason for this is twofold: firstly, objective tests are considered more reliable and valid than projective ones, and secondly, objective tests are easier to administer, thus giving the (false) impression that they can be used by researchers without a deeper background in psychology and psychometrics. While this is true for the initial administration of the test, McDonald and Edwards (2007) warn that interpretation of the results and analysis of their practical implications are not straightforward and require properly trained professionals.

2.2. Related work

We found five studies that review the literature on personality in software engineering. The review presented by McDonald and Edwards (2007) surveyed published articles in software engineering that focus on the application and interpretation of personality tests. The authors reviewed 40 papers published between 1984 and 2004, also conducting an in-depth analysis on 13 distinct empirical studies using personality tests. The aim of this analysis was "to identify whether reliable and valid instruments have been used, whether the test chosen is appropriate for the purpose, and the extent to which the personality testing process used is explicitly reported and discussed" (Mcdonald & Edwards, 2007). The authors placed great emphasis on determining whether the testing process, including interpretation of the results, was carried out directly or in consultation with qualified professionals.

The analysis of the primary studies posed several methodological problems with respect to reliability and validity of the test instruments, and with respect to the incomplete and sometimes incorrect interpretation of the results. The authors conclude the review with several recommendations for potential participants in testing processes, academics conducting tests, and practitioners that wish to interpret results from published work.

The review presented by Hannay, Arisholm, Engvik, and Sjoberg (2010) and Salleh et al. (2009) surveyed published articles that investigated the impact of personality in pair programming, a practice where two programmers work together on the same programming task using one computer and one keyboard. Each of the studies reviewed 10 papers, together totaling 14 distinct articles, as 6 studies were included in both reviews. In general, their findings are quite diverse. While some studies reported that individual