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Completed Research Paper

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Abstract

Agile IT projects need employees who not only follow agile structures but have a specific attitude called the agile mindset. While the relevance of the agile mindset is clear, findings on when it can be developed, are very limited. Stable personality traits, like the big five, influence attitude. Providing how these traits interact with the agile mindset gives orientation regarding in which cases an agile mindset is more trainable than in other cases. To investigate these relationships, we conducted an online survey with 327 students of a project management lecture. As a result of our SEM and QCA analysis, we found three combinations of personality traits that influence the agile mindset including different extents of conscientiousness, openness, agreeableness and neuroticism. We deepen and extend the theory around the agile mindset and enable practitioners to choose data-driven cases for development activities. Limitations and future research based on these results are given.

Keywords: Agile Mindset, Big Five, Personality Trait, Project Management

Introduction

Due to rapid market changes, influenced by digitalization and globalization, organizations face enormous challenges to stay successful. To tackle this situation, organizations foster agility in their projects, innovation processes, culture, and people's mindset (Alt et al. 2020; Peña Häufler et al. 2021, Kaufmann et al. 2020). While agility has its roots in IT, it now has found its way to further domains that are becoming more and more IT driven and data intense, such as project management (e.g., Dikert et al. 2016; Hennel and Dobmeier 2020) or human resources (e.g., Zavyalova 2020). In all contexts, agility means "sensing and responding to change" (Tallon 2019, p. 218) and can be divided into "doing agile", which includes the external structure of work organization, and "being agile", which captures the internal structures of employees, such as their mindset regarding relevant behavior in a complex environment (Eilers et al. 2020; 2022). Most of the existing research as well as practical activities are centered around "doing agile", focusing on agile methods and structures. In practice, activities and convictions concerning (the importance of) "being agile" are starting to become a top priority for forerunners of agile transformations and agility in organizations (Peters et al. 2021) and seem to be one of the key factors for organizations to perform well in this ever-changing environment (Denning 2016; Eilers et al 2022; Mordi & Schoop 2020; Dikert et al. 2016). Still, research on agile mindsets as the (most) important aspect of "being agile" is still in its infancy, and a rigorous conceptualization of the agile mindset has just been published recently. Now given this existing conceptualization of the agile mindset, it still can be observed that so far only limited knowledge is available regarding the dynamics of the agile mindset and how it interacts with other constructs. The agile mindset, as an attitude of the individual regarding certain behaviors in a complex environment, refers to a positive evaluation regarding learning, exchange and collaboration with others, co-creation with customers as well as an empowered self-guidance (Eilers et al. 2022). While some researchers and practitioners state that the agile mindset can be developed, others state that it is primarily manifested (e.g., Eilers et al. 2022; Denning 2016). For leaders of agile IT projects or people development activities, it is highly relevant to know how exactly the agile mindset is manifested and in what cases they should invest in an agile mindset development and reversely where these efforts cannot lead to the desired outcomes, i.e., stronger agile mindsets of the employees. Until today this question has not been answered, and scientific findings are scarce.

To shed light on this topic, it is necessary to investigate the agile mindset in interaction with manifested personality traits. Therefore, we draw on the highly validated big five personality traits, including extraversion, openness, consciousness, agreeableness, and neuroticism, which are hard to train and highly manifested over time (McCrae & Costa, 2003). This study provides an in-depth understanding of how these character traits relate to an agile mindset. The findings are envisioned to assist in the selection of employees for agile IT projects resulting in more successful team composition and offering more tailored development activities for employees in agile IT projects. Also, our results might indicate which combinations of personality traits particularly indicate that he or she may be able to develop an agile mindset.

To close the identified research gap, this study focuses on answering the following research question:

RQ: What is the relationship between personality traits and the agile mindset?

After providing a theoretical overview regarding the agile mindset and the big five personality traits, hypotheses that examine the relationship of the agile mindset and the personality traits are developed. Online survey data with 327 participants of a project management university module offer a comprehensive basis to test the hypotheses. Afterwards, first, an analysis of the interaction between traits and the mindset with a structural equation model (SEM) is conducted. Second, to generate a more fine-grained understanding of the relevance of single trait conditions in combination with other traits and trait configurations resulting in the presence of an agile mindset, the data is further investigated with a qualitative comparative analysis (QCA). Finally, the results are presented and discussed. The study concludes explaining our contribution to theory and practice, highlighting its limitations and avenues for future research.

Theoretical Background

In the following, an overview of relevant theoretical and empirical literature to understand the agile mindset and its antecedents and outcomes is provided. For this purpose, manifest personality trait dimensions are considered, and a research model explaining their influence on the agile mindset is suggested.

Agile Mindset

The agile mindset became a popular construct in practice for success in a dynamic and complex working context (Dikert et al. 2016, Peters et al. 2019, 2020; Eilers et al. 2021). Building on the literature review of Eilers et al. (2022) we further reviewed the literature and identified nine papers trying to capture the agile mindset on different levels. Following we offer an overview of definitions. Van Manen and van Vliet (2014) defined the agile mindset on an organizational level. Others, like Gannod et al. (2018). as a part of culture - like Gannod et al. (2018). Senapathi and Srinvasan (2013) described the agile mindset as an attitude of teams including possibility thinking, learning and growth. Denning (2016) understands the agile mindset as a holistic approach including managers, goals, work design, values and more. Miler and Gaida (2019, p.848) define the agile mindset as a "specific attitude towards the team and other people as well as a proactive and open mind of the individuals" and identified 70 elements that are part of an agile mindset such as "focus on cross-functional teams" or "not blaming each other" (p.844). Mordi & Schoop (2020; 2021) defined the agile mindset with ten elements. Ozkan et al. (2020) builds on this work of Miler and Gaida (2019) and describes the relation of agile principles as part of the agile mindset. Eilers et al. (2022) define the agile mindset on the individual level as an attitude including learning spirit, collaborative exchange, customer co-creation and empowered self-guidance.
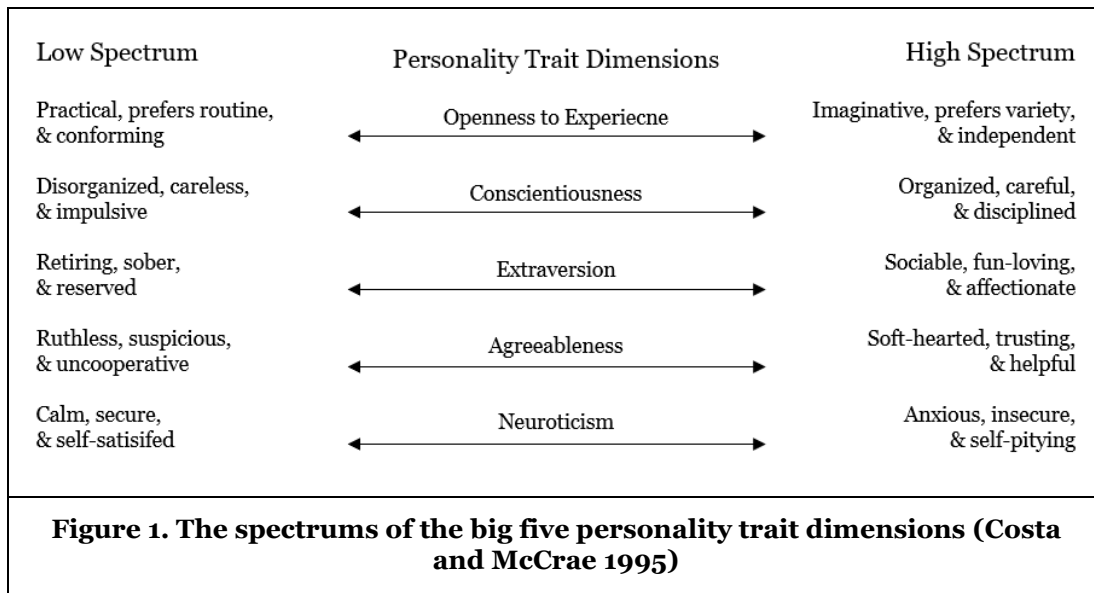
Often, previous research lacks comprehensive insights into if the agile mindset can be developed through different antecedents and how stable and manifested over time this construct is. We identified two papers addressing antecedents: Denning (2016) suggests that training, coaching and new experiences can affect the agile mindset. Van Manen and van Vliet (2014) describe in their conceptualization of the agile mindset on an organizational level that it is affected by, e.g., dedicated teams, a culture of feedback and organizational structure. While till today there is very limited research regarding the agile mindset based on quantitative methods, there are additionally some positive outcomes described in case studies and interview studies. Eilers et al. (2022) provide a relation of the agile mindset regarding strategic agility and further organizational performance. Firm success as is further confirmed by Denning (2016). Other researchers indicate successful agile expansion (van Manen and van Vliet 2014), sustained usage of agile methods (Senapathi and Srinivasan (2013) motivation, and attainment of organizational goals (Gannod et al. 2018).

The investigation of the construct stability of the agile mindset on an individual level is missing so far but would be relevant especially in case of team compositions and employee development in agile IT project management. To tackle this issue, we based our research on the conceptualization and measurement instrument of Eilers et al. (2022, p.8). The agile mindset is an "attitude of an individual within a dynamic work context that is expressed by positively evaluating how they 1) continuously seek new insights to respond to changes [learning spirit], 2) transparently share and discuss methods and results of work with others [collaborative exchange], 3) decide for themselves how to proceed [empowered self-guidance] and 4) are continuously customer oriented in a co-creation process at work [customer co-creation]". Referring to the work of Eagly & Chaiken (1992) as well as Schwarz (2007), Eilers et al. (2022) describe that attitudes are not fundamentally manifest but show a kind of stability. With the core of these facets relating to individuals and how they are contributing to agility, the facet customer co-creation captures a stronger environment perspective dependent on third-party interaction and organizational boundaries, making it more context specific. Furthermore, in practice not all employees or project members are in direct interaction with customers. Hence, we decided to exclude this facet for the investigation of the relationship between the big five and an agile mindset, keeping the findings more generally applicable.

Personality Trait Dimensions

In addition to individual attitudes, individual personality traits, which are said to be much more manifest and difficult to change over time (Schwarz 2007), are considered in to understand and predict individual attitudes and behaviors. The idea behind personality trait theories is that individual behavior and attitudes

can be predicted and explained based on someone's spectrum among these trait dimensions (Stürmer 2013, Collani 2007, Vakola 2004). Therefore, personality traits have received wide attention in business research and are often represented as a five-factor model known as the big five representing five personality trait dimensions, namely openness to experience (openness,), conscientiousness, extraversion, agreeableness and neuroticism (Costa and McCrae 1995). The big five are often used, validated and recognized as a comprehensive model of personality traits. Each of their spectrums are shown in Figure 1. In the following, each of the trait dimensions, their theoretical understanding, and previous empirical findings are considered to hypothesize their influence on someone's agile mindset based on its facets.

Low Spectrum	Personality Trait Dimensions	High Spectrum
Practical, prefers routine, & conforming	Openness to Experiecne	Imaginative, prefers variety, & independent
Disorganized, careless, & impulsive	Conscientiousness	Organized, careful, & disciplined
Retiring, sober, & reserved	Extraversion	Sociable, fun-loving, & affectionate
Ruthless, suspicious, & uncooperative	Agreeableness	Soft-hearted, trusting, & helpful
Calm, secure, & self-satisifed	Neuroticism	Anxious, insecure, & self-pitying

Figure 1. The spectrums of the big five personality trait dimensions (Costa and McCrae 1995)

Openness

Openness to experience reflects a tendency to be imaginative, open-minded and curious (Barrick & Mount, 1991). Tett and Burnett (2003) argue that this trait is likely to be expressed when individuals are presented with opportunities to be creative and contribute to a culture of innovation or are expected to learn new ways of doing things and accept the ideas of others. This argument is consistent with the belief that openness should influence employee response under uncertain conditions (Griffin & Hesketh, 2004; Thoresen, Bradley, Bliese, & Thoresen, 2004). Such conditions are characterized by changes in systems, processes, or structures as it is often the case in agile environments. It is argued that openness should predict adaptability and proactivity because these behaviors are important when inputs, processes or outputs are uncertain (Griffin et al., 2007). Openness has been found to correlate positively with creative behaviors (McCrae 1987) and opportunity recognition behaviors (Georg & Zhou, 2001). Both creative behaviors and opportunity recognition should help with problem solving in agile environments, where targets are unknown or less defined, whilst seeing knowledge gaps as opportunities rather than barriers. Previous research by Baumgart, Hummel and Holten (2015) highlights the high relevance of openness for IT developers in Scrum. Subsequently, it is suggested that openness has a positive effect on an agile mindset.

H1: Openness has a positive influence on an agile mindset.

Conscientiousness

Conscientiousness reflects the tendency to be reliable and to strive for achievement (Barrick & Mount, 1991). Tett and Burnett (2003) argue that expectations of detailed, precise work and adherence to rules and quality standards promote the expression of conscientiousness. Subsequently, conscientiousness implies a desire to do a task well and to take obligations to others seriously, which can be particularly important in agile environments with a stronger emphasis on self-organization. In addition, a meta-analysis suggested

that conscientiousness is a consistently valid indicator when it comes to interpersonal facilitation such as commitment to objectives and being a team player (Hutz and Donovan 2000). Furthermore, "every developer should be responsible for the end product" (Baumgartner et al. 2015, p.7). These aspects should positively impact someone's attitude towards empowering self-guidance and collaborative exchange, reflecting a positive valuation of self-organization and working in a team. In contrast, it can be argued that individuals rating high in conscientiousness prefer to be always well-prepared by making rigid plans and sticking to them at the expense of their personal flexibility when rating high in orderliness, a facet of conscientiousness (Roberts et al. 2005). However, setting goals autonomously, being a more active planner and showing higher commitment, as it has been observed among individuals rating high in conscientiousness (Barrick and Mount 1991), are crucial for working in an agile environment and are expected to contribute positively to an agile mindset as described before.

H2: Conscientiousness has a positive influence on an agile mindset.

Extraversion

Extraversion reflects a tendency to be sociable, gregarious and assertive (Barrick & Mount, 1991). Tett and Burnett (2003) argue that this trait is likely to be activated when required to interact with others and work in a team. Individuals with high levels of extraversion should respond by building effective interpersonal relationships with people in the workplace and generating energy and cohesion. Being more receptive to ideas and building relations has been found to correlate with extraversion (Costa McCrae, 1992; Wolff and Kim 2012; Zhao et al. 2010). These aspects are important considering that agile organization models are targeting stakeholder integration and facilitation of constant feedback loops, which are reflected in the attitude towards collaborative exchange and learning spirit of an agile mindset (Eilers et al. 2022). Subsequently, it is suggested that extraversion positively influences an agile mindset.

H3: Extraversion has a positive influence on an agile mindset.

Agreeableness

Agreeableness reflects someone's tendency to be pleasant in social situations (Barrick & Mount, 1991). Tett and Burnett (2003) argue that this trait is likely to be expressed when a person works in a team and must rely on others or has the opportunity to engage in activities that benefit the organization as a whole. Therefore, agreeableness should influence the way people interpret and respond to the actions of others. Individuals with high levels of agreeableness should respond to these cues by cooperating with their colleagues, helping other members of the organization and adapting to changes in the social context. In their study, Baumgartner et al. (2015) identified agreeableness as the trait that was mentioned most often for Scrum developers. People rating high in agreeableness are often described as altruistic, empathic, considerate, supportive and friendly (Graziano & Eisenberg 1997). This should help in interactions with team members, customers or other stakeholders, as it is particularly encouraged in agile organization models and reflected in the attitude towards collaborative exchange of an agile mindset. Therefore, it is suggested that agreeableness has a positive influence on an agile mindset.

H4: Agreeableness has a positive influence on an agile mindset.

Neuroticism

Neuroticism is reflected as a tendency towards negative cognitions, intrusive thoughts and emotional reactivity (Smillie et al. 2006). The trait dimension of neuroticism can also be represented as the reversed trait dimension of emotional stability. If a person rates high in neuroticism, the processes of trying to meet the demands of one's role, adapting to change or initiating change as often expected in agile organizations could each elicit negative cognitions and emotions. Consistent with these assertions, Tett and Burnett (2003) identified a number of factors that may elicit the expression of neuroticism. These factors include high levels of responsibility, which are often demanded due to the self-organizing characteristics of agile project teams, lack of control, high levels of risk and uncertainty as is often the case in agile environments. Individuals high in neuroticism (low emotional stability) are more likely to perceive minor frustrations as hopelessly difficult. Subsequently, knowledge gaps or failures can be perceived as more stressful for someone with higher levels of neuroticism. However, a rather positive interpretation of challenges and uncertainties as learning opportunities is reflected in an agile mindset in the attitude towards learning

spirit. Neuroticism seems to not be a predictor for performance in Scrum teams (Baumgartner et al. 2015). Furthermore, Hurtz & Donovan (2000) suggest that emotional stability is an important predictor for interpersonal facilitation, which can be relevant for attitudes towards collaborative exchange. Therefore, it is argued that neuroticism has a negative influence on agile mindset.

H5: Neuroticism has a negative influence on an agile mindset.

In summary, it is suggested that higher levels in the trait dimension for openness, conscientiousness, extraversion and agreeableness, and lower levels for neuroticism can predict higher levels of an agile mindset. The resulting factor model predicting the trait dimensions' influence on an agile mindset is shown in figure 2.


Figure 2. Conceptual model
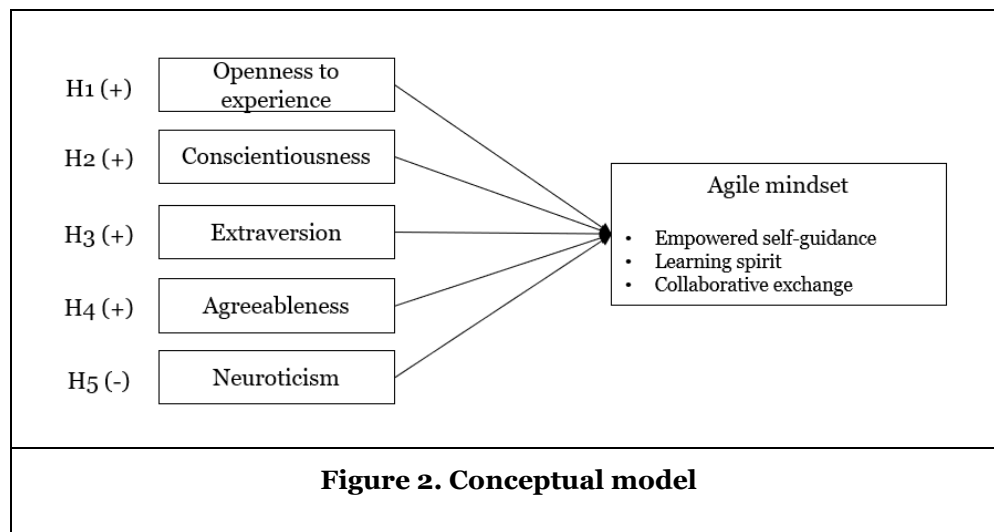
Applied methods

Especially in the field of psychology but also in information systems (e.g., Eilers et al. 2020; Chau et al. 2020), many studies are based on latent variables and linear regression models. Such models assess the individual contribution of each variable. They are usually used to compare theoretical models or frameworks with real data to test hypotheses as formulated in the previous section (Figure 2). Other studies highlight the limitation of linear approaches and suggest that it is in fact a combination of traits (instead of a single trait dimension) that predict and explain individual attitudes or behaviors (Ekehammar and Akrami 2003, Arsendorpf 2003, Roth and Collani 2007). Subsequently, this study follows a twofold approach combining a structural equation model that investigates the influence and effect size of single trait dimensions on the agile mindset, and a QCA approach that does not try to isolate the effects of individual trait variables but considers multiple causal paths including three way or even higher interaction terms, which a linear model can only support in a limited way. The QCA emphasizes the effects of the overall analysis rather than its pieces and evaluates the predictive power of different configurations of conditions (in this case personality traits). For such investigations of individual characteristics, the methodological combination of structural equation modeling (SEM) and fuzzy-set qualitative comparative analysis (fsQCA or QCA) has already proven to be a valuable approach (Navarro et al. 2020; Zhao and Yan 2020; Ferran et al. 2016). In the following sections, both methodologies are briefly explained.

Structural Equation Modeling (SEM)

Structural equation modeling (SEM) is an evolution of general linear modeling procedures to analyze latent variables and their linear relationships. SEM is argued to be more flexible and reliable compared to regression analysis because it allows the quantification of observational errors from measurements of latent variables (Carrillo et al. 2012). However, they do not reveal information of different possible combinations or effect paths that can lead to the same results (equifinality). Furthermore, they do not consider that variables or factors that explain a given result may not be the same as those that explain results in the opposite direction (Ragin 2008; Eng and Woodside 2012).

Qualitative Comparative Analysis (QCA)

Qualitative comparative analysis (QCA) allows an in-depth analysis of how a combination of causal conditions (observed variables) contributes to a specified outcome (dependent variable). QCA models use a Boolean logic and assume an influence of attributes on a specific outcome. The result is based on the configurations these attributes combined rather than on the individual contribution of each attribute or variable. This technique reveals different combinations of paths that can lead to the same result (equifinality) (Ragin 2008). The analysis is based on so-called necessary conditions, which are those causal conditions that must always be present for the specified outcome to be present. However, they can also be present without the specified outcome to be present. In a second step these necessary conditions are complemented by the so-called sufficient conditions, which lead to the specified outcome, although they do not always have to be present for an outcome to be present. The principle of sufficient and necessary conditions can be visualized in so-called Venn-diagrams (Figure 3). In contrast to a linear SEM that provides information about the influence and effect size for independent variables explaining a dependent variable, the QCA approach reveals configurations of specified conditions that explain the presence of a specified outcome including the explained variance (coverage) and goodness of adjustment (consistency) of the resulting configurations of conditions (solutions).

Figure 3. Venn diagrams for necessity and sufficiency
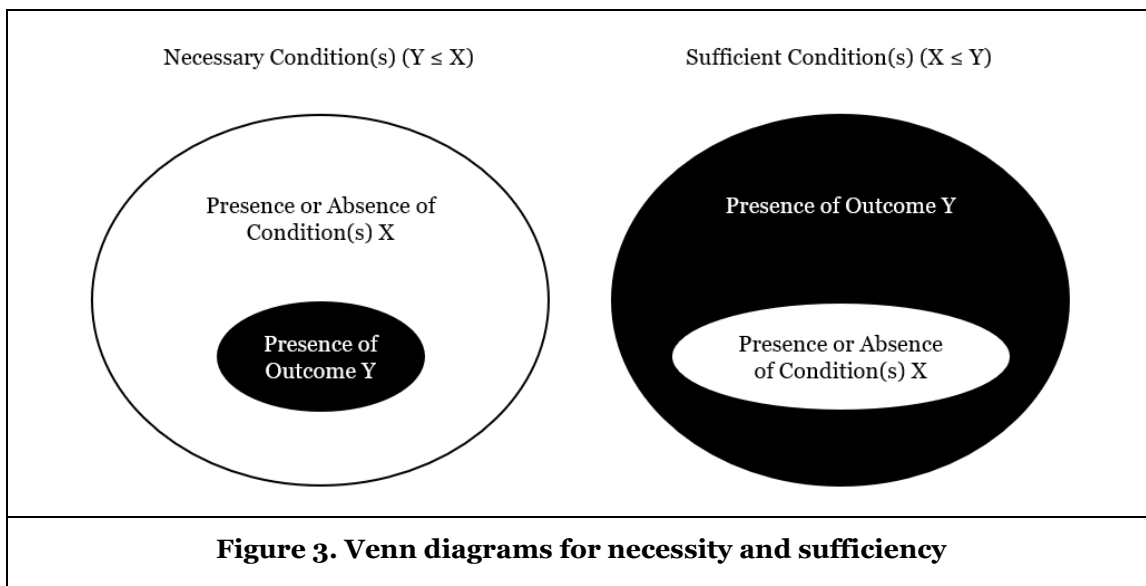
Questionnaire

A two-part survey was designed. A validated and well established 30-item short version of the big five model was translated into English by using the back translation method by Brislin (1970). To assure the validity and reliability of the translated scales, three experts applied forward and backward translations and evaluated the content validity of the new English version of the NEO-FFI30 scales originally tested and published by (Körner et al. 2008). To assess the agile mindset of the participating project team members, the scale originally developed, tested and published by Eilers et al. (2022) was adjusted to the context and applied according to our suggested framework (Figure 2). All scales and items were reviewed again by survey experts. Respondents gave the degree of their approval to the items on a 7-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree). Table 1 lists all the items, measuring their latent variable. The survey was pre-tested by running standard tests (e.g., average time of processing) and a test for comprehensiveness.

Latent variables	Items
Agile mindset (Eilers et al. 2022)	**Empowered self-guidance** AMs1: I can decide for myself how I achieve the work goal AMs2: I am good at organizing myself to achieve work goals AMs3: I use mistakes as a chance for me to adjust my work approach AMs4: I have the courage to take on new tasks for which I do not know all the requirements, yet

	Learning spirit AMl5: I come up with new ideas to better complete my tasks AMl6: I like exchanging views with others about the challenges of reaching our goal AMl7: It is important to me to always learn something new AMl8: I enjoy exploring new situations at work **Collaborative exchange** AMe9: I like making my work transparent for other team members AMe10: I appreciate the different perspectives within my team AMe11: I like supporting other people in my team AMe12: I solve difficult challenges best when I work together with others in a team
Big five personality traits (Körner et al. 2008)	**Openness to experience** *B5OtE1: I find philosophical discussions boring. B5OtE2: I am fascinated by the motifs I find in art and nature. *B5OtE3: Poetry impresses me little or not at all. B5OtE4: When I read literature or look at a work of art, I sometimes feel a chill or a wave of enthusiasm. *B5OtE5: I have little interest in speculating about the nature of the universe or the state of humanity. B5OtE6: I often enjoy playing with theories or abstract ideas. **Conscientiousness** B5Con1: I keep my things neat and clean. B5Con2: I can manage my time quite well, so I finish my affairs on time. B5Con3: I try to carry out all tasks assigned to me very conscientiously. B5Con4: If I make a commitment, you can certainly rely on me. B5Con5: I am an efficient person, who always gets the job done. *B5Con6: I will probably never be able to bring order into my life. **Extraversion** B5Ext1: I like to have many people around me. B5Ext2: I am easily made to laugh B5Ext3: I like being in the centre of the action. B5Ext4: I often have the feeling that I am brimming with energy. B5Ext5: I am a cheerful, good-humoured person. B5Ext6: I am a very active person. **Agreeableness** *B5Agr1: I often get into arguments with my family and colleagues. *B5Agr2: Some people think I am selfish and complacent. *B5Agr3: I am rather cynical and sceptical about the intentions of others. *B5Agr4: Some people think I am cold and calculating. B5Agr5: I always try to act considerately and sensitively. *B5Agr6: In order to get what I want, I am prepared to manipulate people. **Neuroticism** B5Neu1: I often feel inferior to others. B5Neu2: When I am under a lot of stress, I sometimes feel as if I am going to collapse. B5Neu3: I often feel tense and nervous. B5Neu4: Sometimes I feel completely worthless. B5Neu5: Too often I am discouraged and want to give up when something goes wrong. B5Neu6: I often feel helpless and wish for a person to solve my problems.

Table 1. Overview of questionnaire and items with "*" have reversed polarization

Data Collection

The data was collected on project teams of English-speaking students who participated in a team-based project task in the form of a one semester project management module. Subsequently, the sample was composed of 327 participants from a master's module. Participants were between 18 and 30 years old and 32.4% of them were female. The project team size varied between three and four members. The participants had the task of identifying a suitable project and creating project-related deliverables with interim deadlines. To achieve their objectives, they had to interact frequently, share resources and information, and coordinate their individual team efforts. Data was collected via an online survey at two points in time. Before their randomized assignment into project teams, their sociodemographics, such as gender, age, field of studies, together with their personality traits based on the big five model, which are supposed to be stabile over time, were surveyed. Three months into their agile project, where the participants were able to make new experiences in this agile project context, information on the agile mindset was surveyed. The university

context offers many of the advantages of laboratory settings, such as an unbiased performance environment, a defined timing of variables, consistent team memberships and the ability to collect time-lagged data to avoid common method biases (Pitaru & Ployhart, 2010). It additionally resembles a real project team environment in that participants have reward implications (i.e., grades) in a "real work simulation" and a functionally broad and complex atmosphere that develops over several months (Kukenberger & D'Innocenzo, 2020).

Analytic Strategy

First, data for the big five personality trait model and agile mindset among project module participants are collected. Afterwards, exploratory factor analysis and item statistics are evaluated to test for the reliability of the measurement model. Next, an analysis with structural equation modeling (SEM) is conducted to assess the influence and effect size for single factors of the personality traits suggested by the big five model on agile mindsets as hypothesized. In a second step the qualitative comparative analysis is conducted to assess the impact of different factor combinations on agile mindsets. The fuzzy-set QCA software approach is chosen to convert our raw data, which is based on 7-point Likert scales, into fuzzy set responses. Therefore, the average of all the item measurements for every latent is calculated, representing each construct as a single factor. Then these new values are recalibrated between 0 and 1, with 0 for outside the set and 1 for inside the set. This recalibration is done considering three thresholds, a calculated average of 1 (very low in the spectrum, outside the set), an average of 7 (very high in the spectrum, inside the set) and the mid-point of the former Likert scale as the cross-over value (in the middle of the spectrum, neither in nor outside the set). Next, it is tested whether any of the factors' conditions such as their presence (trait high in the spectrum) or absence (trait low in the spectrum) are necessary conditions for the outcome of an agile mindset rating high in the spectrum. Then, a truth table for all possible configurations is created and an analysis for sufficient conditions is conducted. Finally, the resulting solutions are discussed, and conclusions including implications for theory and practice, limitations and avenues for future research are derived. An overview of the analytic strategy is shown in Figure 4.

Figure 4. Analytic strategy
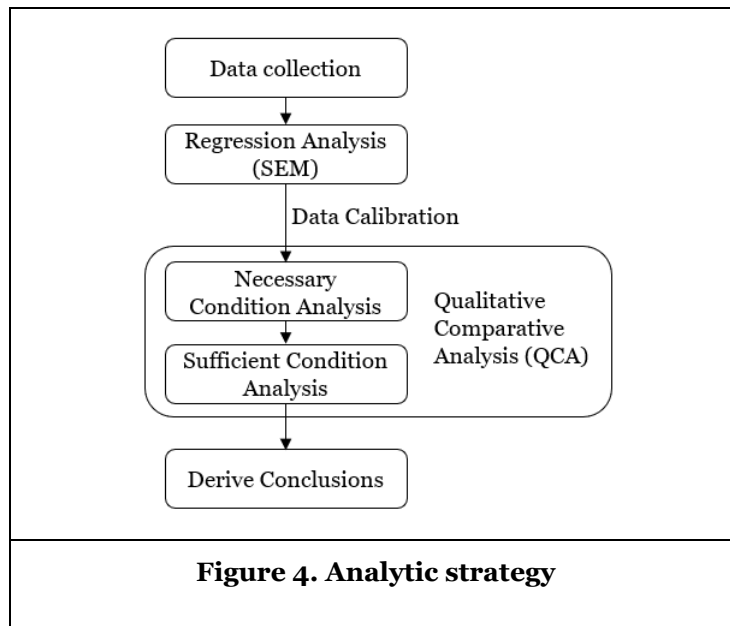
Results and Discussion

The following construct (factor) and measurement (item) analysis was conducted in SPSS (v.27), the structural equation model (SEM, path-model) was calculated with Amos (v.27) and the qualitative comparative analysis to assess trait configurations was conducted with fsQCA software (v.3.0).

Factor and Item Analysis

First, parallel and scree-analysis (Harman & Jones, 1966) was executed to determine the total number of factors across all items surveyed, suggesting a six-factor structure in line with the conceptual model. In addition, scree-plot analyses were executed for every construct individually, suggesting to model each as a reflective first order structure. Next, a principal component analysis for six factors with promax rotated factor structures was calculated (Kline, 2014). All items were found loading above the threshold for significance on their theorized construct (Hair et al. 2009). In the following, univariate descriptive statistics are presented in Table 2. On average, participants rated their consent above the midpoint of the scale. As a measure of internal consistency, Cronbach's alpha was calculated (Table 2). Values exceeding .70 are considered satisfactory (Moosbrugger & Kelava, 2008). The values ranged from .70 to .85. Only the scale for agreeableness (.67) is slightly below that threshold. Two items (AMs1, B5Agr5) are below the threshold for selectivity ($r > 30$) suggested by literature. All items are within the recommended range for item difficulty ($.80 > p > .80$). The highest inter-item correlation is .61. Overall, the item statistics and Cronbach's alpha indicate that all the scales reached an acceptable degree of internal consistency and reliability. Addressing the rather low factor loadings of some items, we did also run both analysis the SEM and QCA excluding all items with factor loadings below 0.5 (AMs1, AMs2, AMe9, B5Agr5) to test the robustness of our findings. The overall results considering the significant paths, effect sizes (SEM) and suggested trait configurations (QCA) remained the same. Due to the robustness of our findings we decided to include the full set of items surveyed in the presented analysis but suggest the revision of these four items in case they continue to show problematic item statistics and factor loadings in future research.

Latent Factor (Cronbach's α)	Item	Descriptive				Factor Loadings (Promax, Kappa 4)					
		M	*SD*	*r*	*p*	*1*	*2*	*3*	*4*	*5*	*6*
Agile Mindset (0.85)	AMs1	5.38	1.39	0.26	0,63	**0.36**	-0.07	0.04	0.00	-0.13	0.01
	AMs2	5.65	1.16	0.41	0,66	**0.44**	-0.28	0.62	0.04	0.06	0.00
	AMs3	5.51	1.27	0.55	0,64	**0.64**	-0.18	0.34	0.08	0.07	0.24
	AMs4	5.68	1.32	0.47	0,67	**0.55**	-0.21	0.26	0.03	-0.02	0.14
	AMl5	5.31	1.24	0.48	0,62	**0.56**	-0.10	0.33	0.21	-0.01	0.12
	AMl6	5.65	1.34	0.62	0,66	**0.73**	0.01	0.18	0.09	0.16	0.10
	AMl7	5.94	1.25	0.60	0,71	**0.68**	-0.12	0.41	0.02	0.01	0.20
	AMl8	5.64	1.31	0.62	0,66	**0.71**	-0.23	0.34	0.14	-0.06	0.14
	AMe9	5.08	1.55	0.38	0,58	**0.49**	0.07	0.04	0.25	0.35	0.02
	AMe10	5.60	1.35	0.57	0,66	**0.65**	0.06	0.25	0.06	0.36	0.22
	AMe11	5.63	1.37	0.67	0,66	**0.76**	0.09	0.17	0.10	0.30	0.10
	AMe12	5.80	1.28	0.61	0,69	**0.72**	0.04	0.22	0.11	0.22	0.08
Neuroticism (0.82)	B5Neu1	3.00	1.58	0.50	0,29	-0.06	**0.64**	-0.18	-0.10	0.03	-0.11
	B5Neu2	3.08	1.64	0.56	0,30	0.04	**0.69**	-0.20	-0.09	0.07	0.05
	B5Neu3	3.41	1.56	0.58	0,34	-0.05	**0.69**	-0.13	-0.13	-0.13	-0.02
	B5Neu4	2.64	1.72	0.65	0,23	-0.11	**0.76**	-0.33	-0.22	-0.04	0.02
	B5Neu5	2.67	1.45	0.60	0,24	-0.18	**0.70**	-0.37	-0.16	0.03	-0.08
	B5Neu6	2.49	1.42	0.63	0,21	-0.20	**0.74**	-0.40	-0.12	0.01	-0.07
Conscientiousness (0.79)	B5Con1	4.95	1.61	0.53	0,56	0.26	-0.11	**0.65**	0.04	0.19	-0.13
	B5Con2	5.03	1.54	0.60	0,58	0.17	-0.35	**0.73**	0.13	-0.03	-0.10
	B5Con3	5.69	1.25	0.55	0,67	0.30	-0.10	**0.72**	0.02	-0.01	0.10
	B5Con4	6.26	0.91	0.54	0,75	0.27	-0.26	**0.69**	0.21	0.09	0.08
	B5Con5	5.42	1.18	0.55	0,63	0.17	-0.38	**0.70**	0.24	-0.04	0.05
	B5Con6	5.91	1.50	0.55	0,70	0.22	-0.41	**0.63**	0.17	0.07	-0.14
Extraversion (0.76)	B5Ext1	4.69	1.58	0.57	0,53	0.15	-0.12	0.03	**0.74**	0.17	0.00
	B5Ext2	5.11	1.38	0.34	0,59	0.02	0.20	0.07	**0.55**	0.19	-0.07
	B5Ext3	4.16	1.57	0.49	0,45	0.07	-0.11	0.06	**0.64**	-0.29	0.07
	B5Ext4	4.32	1.46	0.53	0,47	0.22	-0.34	0.24	**0.66**	-0.15	0.18
	B5Ext5	5.62	1.13	0.52	0,66	0.11	-0.12	0.12	**0.70**	0.15	0.07
	B5Ext6	5.19	1.38	0.54	0,60	0.07	-0.38	0.28	**0.67**	-0.05	0.08
	B5Agr1	4.91	1.74	0.38	0,56	0.19	-0.16	0.17	-0.13	**0.54**	-0.15

Agreeableness (0.67)	B5Agr2	5.39	1.47	0.51	0,63	0.12	-0.02	0.18	0.01	**0.69**	0.00
	B5Agr3	4.41	1.66	0.44	0,49	0.10	-0.21	0.02	0.16	**0.61**	0.03
	B5Agr4	4.90	1.80	0.45	0,56	0.07	0.02	-0.03	0.28	**0.67**	0.02
	B5Agr5	5.39	1.32	0.22	0,63	0.21	0.16	0.30	-0.10	**0.33**	0.36
	B5Agr6	5.13	1.61	0.37	0,59	0.07	0.11	0.02	-0.09	**0.58**	0.00
Openness to Experience (0.70)	B5OtE1	5.41	1.70	0.50	0,63	0.05	-0.12	-0.14	0.04	-0.08	**0.65**
	B5OtE2	4.72	1.69	0.49	0,53	0.11	0.08	0.01	0.07	0.01	**0.68**
	B5OtE3	4.27	2.01	0.40	0,47	0.04	-0.08	0.02	0.06	0.06	**0.60**
	B5OtE4	4.83	1.71	0.49	0,55	0.16	0.15	0.00	0.08	0.08	**0.71**
	B5OtE5	5.58	1.61	0.34	0,65	0.16	-0.16	0.06	-0.01	-0.01	**0.50**
	B5OtE6	4.66	1.75	0.39	0,52	0.15	-0.09	-0.05	0.02	-0.28	**0.58**

Table 2. Overview of items statistics and measurement model

Path-Model (SEM)

Model-fit indices (Iacobucci 2010) revealed an overall satisfactory fit of the conceptual model. X²-ratio (2.09), RMSEA (.058) and SRMR (.076) reached target values (X²-ration < 3, RMSEA < 0.08, SRMR < 0.08) indicating good model fit, only CFI (.777) and TLI (.762), both designed for rather complex models and exploratory approaches, did not reach target values (CFI > 0.95, TLI > 0.95). In summary, the overall model fit can still be considered as satisfactory. Generally, the path analysis resulted in an expected pattern validating the suggested model. The big five personality trait model's latent variables of openness to experience, conscientiousness and agreeableness correlated positively with the agile mindset and were successfully tested for significance. However, no significant effects were found for extraversion and neuroticism. Overall, the significantly tested correlation magnitudes observed are moderate to low with the biggest effect size for conscientiousness. Subsequently, single trait dimensions seem to explain rather little variance of the agile mindset. Scholars investigating the influence of traits have been suggesting that it is rather a combination of traits that predict certain attitudes and behaviors. An overview of all effect sizes and significant paths is provided in Figure 5. Therefore, the following qualitative comparative analysis is conducted to identify trait configurations explaining high ratings in the spectrum for agile mindsets.
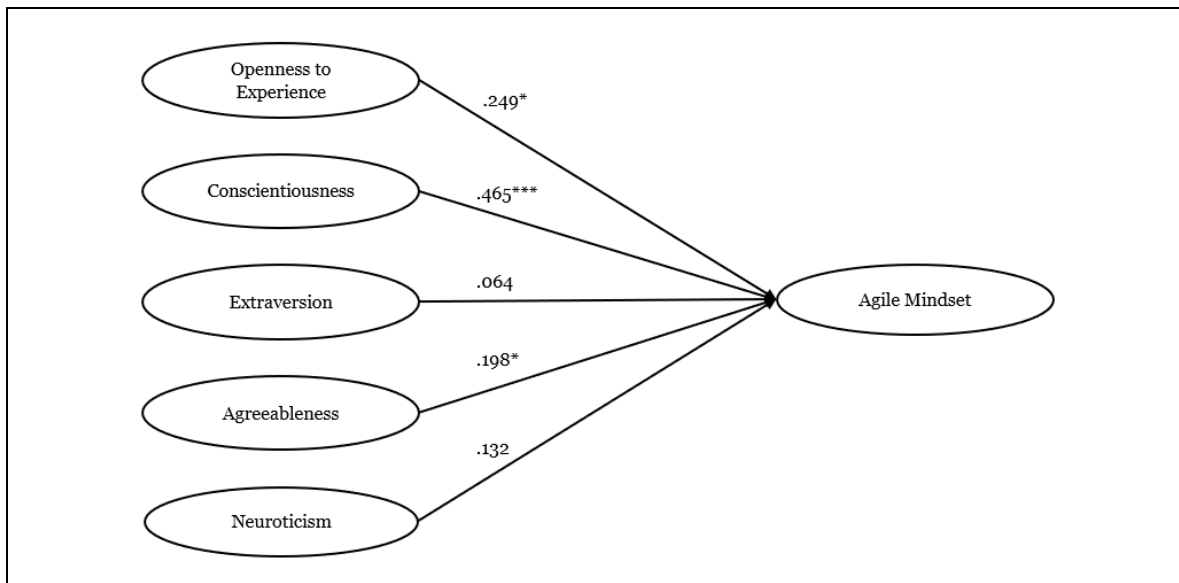

Figure 5. Path model and estimated effects. *p < 0.05, ***p < 0.001.

Trait Configurations (QCA)

Before the analysis, the raw data of the latent variables were re-calibrated into fuzzy sets, as previously described when presenting the analytic strategy. In the following, the first step is testing whether any of the conditions are necessary conditions for the presence of an agile mindset. The second step is the analysis of sufficient conditions for the presence of an agile mindset.

Necessary conditions

Based on the calibrated data, the necessity for each of the single trait variables was tested. The consistency value indicates the percentage of cases (datasets) that include that condition among the datasets with the desired outcome of an agile mindset. The ideal value for a necessary condition is 1.0, as data sets with the desired outcome are supposed to be a subset of the datasets with the necessary condition as shown in Figure 3. For applications of large datasets, a consistency value higher than 0.90 is suggested to indicate a necessary condition (Greckhamer et al. 2018). With 0.92 for high levels of conscientiousness near the suggested threshold, the presence of conscientiousness (C) can be considered a necessary condition for an agile mindset. The consistency values for the presence or absence ("~" indicates absence) of the other single trait condition variables openness (O), extraversion (E), agreeableness (A) and neuroticism (N) are below the suggested threshold for necessity.

Sufficient conditions

For the analysis of sufficient conditions, first, a so-called truth table for the presence of an agile mindset, representing all possible configurations and their number of representations among the calibrated dataset, is created. The QCA software analyzes the distribution of cases over the truth table rows and checks whether cases belonging to the same configuration display as the outcome. Thereby, it identifies the basic configurations of conditions that are sufficient for the outcome. Before the analysis of sufficient conditions, the recommended raw consistency value cutoff at 0.8 for the agile mindset as an outcome is set. In addition, when applying large-N data samples to QCA, it is suggested to limit the considered data to 80% of the total sample, excluding theoretically possible configurations that are not represented (Greckhamer et al. 2018). Subsequently, a frequency cutoff on 9 was set, excluding configurations that have less than 9 occurrences. Next, sufficient condition analysis was conducted, resulting in three suggested solution configurations for both the complex and intermediate solution models equally, as shown in Figure 6. Both indicate three configurations of causal conditions that can promote the presence of an agile mindset. According to Eng & Woodside (2021), in fsQCA, a model is informative when the consistency is above 0.74. The coverage (0.811766) and consistency (0.96457) of the three configurations seem adequate. The sufficient conditions (trait configurations) explain 81% of the empirical evidence (Woodside 2014). All three suggested configurations include the presence of conscientiousness. This is in line with the previous finding for presence of conscientiousness as a necessary condition. In the first resulting solution configuration the presence of conscientiousness is combined with the presence of agreeableness and the absence of neuroticism as a sufficient condition combination (C*A*~N; raw coverage: 0.71; consistency: 0.97). For the second solution the presence of agreeableness is replaced by the presence of openness (C*O*~N; raw coverage: 0.67; consistency: 0.97), and for the third solution the presence of conscientiousness is combined with the presences of both openness and agreeableness (C*A*O; raw coverage: 0.68; consistency: 0.98). The resulting configurations of the big five trait dimensions explaining the presence of an agile mindset are summarized in Figure 6. The raw coverage ideally is no higher than 0.65, which is slightly exceeded by our suggested solutions.

Configurations (Solutions)	S1	S2	S3
Opennes	●		●
Conscientiousness	●	●	●
Extraversion			
Agreeableness		●	●
Neuroticism	⊗	⊗	
Consistency	0.97	0.97	0.98
Raw coverage	0.67	0.71	0.68
Overall solution consistency	0.96		
Overall solution coverage	0.81		

● Presence (High Spectrum)
⊗ Absence (Low Spectrum)

Figure 6. Suggested QCA solutions

All trait conditions among the suggested configurations are in line with our hypothesized effects on an agile mindset. Furthermore, conscientiousness is not only the strongest predictor according to the SEM method but also suggested as a necessary condition for the presence of an agile mindset (cases rating high in agile mindset are a subset of the cases rating high in conscientiousness). Subsequently, conscientiousness is necessary but not sufficient for the presence of an agile mindset. This can also be explained from a theoretical point of view. Revisiting the argument that besides many positive tendencies in favor of an agile mindset such as reliability and working more autonomously (Barrick and Mount 1991). Individuals rating high in conscientiousness are also suggested to be more organized (Roberts et al. 2005), assuming a stronger urge to always be prepared, higher persistence and favoring rigid plans. Therefore, it makes sense that the required flexibilities towards other team members' actions or content changes of project tasks, which are necessary to achieve agility, can be explained through combinations with other trait dimensions. Rating high in agreeableness or openness can result in a higher willingness to adjust to someone's personal agenda. Emotional stability (the absence of neuroticism) can also be helpful to cope with such flexibility demands and uncertainties, which cannot be avoided in agile project management. Therefore, only the combination of conscientiousness with high ratings in other trait dimensions such as openness, agreeableness or emotional stability is sufficient to explain the presence of an agile mindset. Overall, the findings suggest that there are three different trait combinations (personality types) that can manifest an agile mindset. Single trait dimensions explain 29% of the variance of the agile mindset, according to the SEM method. Hence, the QCA model complements these findings by highlighting three trait configurations explaining a substantial proportion (81%) of the cases with the presence of an agile mindset.

Contribution

In conclusion, this study provides evidence that individual personality traits such as conscientiousness, agreeableness, openness to experience and neuroticism can explain an agile mindset, highlighting conscientiousness as the strongest single predictor and as a necessary condition among all trait configurations for the presence of an agile mindset. Based on the QCA results, three archetypes of personality traits have been suggested (C*A*~N, C*O*~N, and C*A*O) to rate high on the spectrum for an agile mindset. The big five trait dimension extraversion has been found irrelevant for both predicting the agile mindset and explaining higher levels of agile mindset in combination with other traits. The study has demonstrated the usefulness of combining different methodologies assessing theorized phenomena when it comes to socio-psychological determinants following a more typological approach highlighting the relevance of trait combinations rather than isolated personality dimensions of individuals.

Theoretical Implications

For the first time the agile mindset got investigated in relation to personality traits to evaluate the possibility for agile mindset development. While quantitative studies regarding the agile mindset, theory regarding the agile mindset development and its relation to personality traits are scarce, this study offers relevant insights to contribute to those research gaps and extend the agile mindset theory in project management. By doing so, this study offers quantitative outcomes which offer conscientiousness as a necessary condition for agile mindsets and three further archetypes of trait combinations (C*A*~N, C*O*~N, and C*A*O) for agile mindsets. Because personality traits are stabile over time, these results provide preconditions for agile mindset development and project team staffing.

Furthermore, we methodologically expand knowledge regarding the investigation of attitudes and traits. Scholars have long been studying the influence of personal traits on individual attitude (e.g., Pramatari and Theotokis, 2009; Thatcher and Perrewé 2002), mostly by using SEM. Highlighting the role of trait combinations (personality types) in contrast to single trait dimensions (Ekehammar and Akrami 2003, Arsendorpf 2003, Roth and Collani 2007), our QCA results explain a substantial proportion of the observed cases, supporting such an approach. Furthermore, none of the suggested conditions among the suggested trait configurations contradicted our SEM findings, which was in line with the hypothesized effect based on related literature. Finally, the resulting comparison highlights both the usefulness of the mixed method approach combining SEM and QCA and the consideration of trait combinations rather than single trait dimension analysis explaining attitudes.

Practical Implications

Scholars suggest that a person–organization fit (P–O fit) through hiring and people development is key towards a workforce with the necessary commitment to confront challenging environments (Bowen Ledford & Nathan 1991; Bridges, 1994; Howard, 1995) in IT projects as well. Personal attitudes such as an agile mindset are suggested to be just as critical for the success of an agile organization and project management as the application of agile tools and methods (Eilers et al. 2020; Peters et al. 2020).

Therefore, this study suggests results for managers and people development departments to be better able to assess which employees are more likely to benefit from agile mindset development than others. Employees in IT projects with a high rate of conscientiousness are more likely to develop an agile mindset. To get an even deeper insight, the results show that three combinations of personality traits with conscientiousness of employees in IT projects manifest the agile mindset: 1) high conscientiousness and openness as well as absence of neuroticism, 2) high conscientiousness and agreeableness as well as absence of neuroticism, and 3) high conscientiousness, openness and agreeableness. If an employee offers one of these combinations, it is more probable that actions of managers and people development departments for developing an agile mindset are successful. This is important for the team composition of agile IT project teams.

Limitations and Avenues for Future Research

Although this study exploited a large dataset and considered a mixed method approach, revealing valuable insights into how personality traits can manifest an agile mindset, it has notable limitations.

One limitation of this study concerns the use of questionnaires, although they are a common tool in research, they can lead to biases due to social desirability. To avoid these, we clearly communicate that the participation has no consequences for the students and that the survey data is anonymized. Furthermore, an analysis of trait configurations explaining the absence of an agile mindset remains desirable, since the number of participants with very low levels in the agile mindset did not allow for robust investigations explaining the absence of an agile mindset. However, we assume that the correlations that were established between single traits and the agile mindset follow largely uniform processes. Further research should expand the nomological network around the agile mindset, like the environment in which the participants normally interact. Subsequently, it is suggested to investigate how personality traits and attitudes impact the individual person–organization fit, considering the organizational differences between traditional and agile project management environments. In addition, research for concepts how to develop the agile mindset in different contexts and over several points in time, is expected to provide further insights for agile

transformation processes and project management. Considering the exclusion of customer co-creation in this study, we suggest future research assessing the role and facilitation of this facet in agile projects.

Despite these limitations, this study offers a new and precise look into the relationships of different traits influencing an agile mindset. The findings of this study provide evidence how single traits and trait configurations can explain and contribute to the manifestation of an agile mindset.

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