




A Preliminary Investigation on the Relationships Between Personality Traits and Team Climate in a Smart-Working Development Context

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Abstract. Developers collaborating with collective efforts in large-scale distributed software typically have different personalities that might play a central role in software development and in team climate. In this paper, we have investigated if personality traits are related to the perceived team climate of software developers (Computer Science master students) in a smart-working development context. In particular, we conducted a preliminary study with 53 master students of a Computer Science course conducting a project work during the Covid-19 pandemic. Participants were grouped into 19 distributed teams. We analyzed the correlation between personality traits and team climate factors and created a predictive model for Task Orientation using these correlations. Results suggest that the Extroversion personality trait (characteristic of social and easy-going people) is statistically significant. We also observed a (weak) positive correlation with considered team climate factors.

Keywords: Team climate · Personality trait · Distributed development · Smart-working · Empirical study · Covid-19

1 Introduction

Personality traits are responsible for the individual's preferences, opinions, attitudes, values, and behaviors and contribute in distinguishing each individual from the others. The Software Engineering (SE) research has been investigating the impact of personality on the quality and performance of a software project since 1960 [15, 16, 24]. Software project results are influenced by the work style of each team member who often has a different background [17]. Team members have to work together to accomplish a specific task, often while being face-to-face [14]. During the Covid-19 pandemic period, cooperation has been mainly conducted remotely, by using both asynchronous distributed development tools

and synchronous video calls. Meetings have been regularly conducted to discuss the evolution of the project and to increase the collaboration among team members, thus enhancing *team climate*.¹ The Team Climate influences not only the personal relationships within the team and the team members' satisfaction, but it also affects the project result in terms of quality and performance.

In the literature, there is a growing interest in the team's climate, the individual's personality, and the relationships between productivity and team members' satisfaction [2, 7, 21, 23]. Many studies are focused on how different kinds of team climate, such as for innovation or safety may derive specific results of the work-group outcomes (*e.g.*, oriented toward innovativeness or accident avoidance). To obtain such a result, a shared team climate has to be perceived by the team members and measured in a reliable way [4]. Although the interest of the SE community on team's climate there is a lack of studies in the context of smart-working, *i.e.*, a work arrangement in which employees do not commute to a central place of work, such as an office building. As mentioned, such a kind of work has gained in popularity during the years in software projects and obtained a further boost during the Covid-19 pandemic.

In this paper, we present the results of a correlation study—conducted during the Covid-19 pandemic—aiming at improving our body of knowledge on the personality traits and the team climate relationships in a distributed smart-working development context when developers are Computer Science students. The participants in the study were 53 master students (graduate students) in Computer Science at the University of Salerno. They were grouped into 19 teams, each of them aiming at conducting a multi-platform project in distance fashion.

The main contributions of the research presented in this paper can be summarized as follows:

- the correlation between personality traits and team climate factors in a distributed smart-working context have been empirically analyzed from the point-of-view of Computer Science master students;
- a regression model for predicting Task Orientation from Extroversion has been defined.

The remainder of the paper is organized as follows. In Sect. 2, we present background and discuss related work. In Sect. 3, we present the adopted research methodology. Results of the study are reported in Sect. 4. The threats to validity and possible implications for our results are discussed in Sect. 5 and Sect. 6, respectively. We conclude the paper with final remarks and future direction for our research in Sect. 7.

2 Background

In this section, we first introduce the adopted personality and team climate models, then we discuss related work referring to the SE studies on the relationships between personality and team climate.

¹ Team climate refers to a shared perception among the team members of the team's work procedures, practices, and members' behaviors [25].

2.1 Big Five Model and Associated Instruments

Several models have been proposed to describe personality traits. In this paper, we adopt the *Big Five Model* [11], a well-known taxonomy of personality traits. It was originally proposed in 1961. The Big Five Model identifies 5 major personality traits described in a broad dimension.

- *Openness to experience* indicates how strong the individual’s imagination, aesthetic sensitivity, and adventurousness are. High scores on this trait are normally interpreted as the individual being intellectual, creative, and curious; on the other hand, those who score low tend to be close-minded and conservative.
- *Conscientiousness* expresses an individual’s achievement orientation and control over their impulses. Conscientious individuals tend to be good and well-organized workers capable of planning and completing tasks perfectly and efficiently. Individuals with low scores in conscientiousness are typically impulsive and unorganized, less bound by rules.
- *Extroversion* indicates how individuals may be friendly, approachable, talkative, and active. Individuals who score high on this trait tend to be sociable, stimulated by others, and easy-going. Whereas low scores indicate the individual may be more reserved and solitary.
- *Agreeableness* represents how cooperative, trusting, or empathetic an individual may be. Agreeable individuals tend to be kind in nature, sympathetic, cooperative, and trust others more. Disagreeable individuals, instead, tend to be suspicious and antagonistic, uncompromising, or unconcerned with other individuals’ needs.
- *Neuroticism* is the measure of the individual’s emotional instability. Highly neurotic individuals tend more likely to be anxious and insecure. Less neurotic individuals tend to appear stable and calm.

For assessing personality most SE studies (*e.g.*, [6,20]) adopted the freely available International Personality Item Pool (IPIP) [12], as it gives free sets of items and psychometric scales based on the Big Five Model framework. Among the many questionnaires based on IPIP, we selected IPIP-NEO-120. It is made up of 120 items. Each item is rated by the submitter using a Likert scale varying from 1 (highly inaccurate) to 5 (highly accurate).

2.2 Team Climate Research in Software Engineering

Team climate may be defined as team member’s shared perceptions of the team’s work procedures, practices, and member behaviours [1]. To work together effectively, it is very relevant to get a positive group climate based on personal relations [27]. The concept of team climate is complex and has been decomposed into different dimensions. The Team Climate Inventory (TCI) [25,26] aims at assessing the team climate perception. It is largely adopted in SE for assessing the team climate. It has been used for evaluating team performance [18], satisfaction of the team members [2] and software quality [1]. Team climate is

commonly assessed by using the Team Climate Inventory (TCI), a questionnaire proposed by Anderson and West [4]. It is based on the following four factors:

- *Vision* shows how clear, attainable, and valued objectives are to the individual and across the team.
- *Participation Safety* measures the participation levels of members in decision-making processes and the psychological safety perceived when members would share new or improved methods.
- *Support for Innovation* measures how much the team supports the ideas of using new technologies so accepting the risks of using new and unfamiliar technologies.
- *Task Orientation* measures the team’s commitment to achieving the highest performance in their work.

The most adopted variant consists of 38 questions and was proposed by Anderson and West [4] in 1998. A five-point Likert scale from 1 to 5 (from little extent to great extent) is adopted to evaluate each item. Each factor is then calculated by computing the average of all its related items.

2.3 Related Work

Many SE studies focus on team composition and team members’ personalities, but only a few of them concern team climate. For example, Gomez and Acuna [13] conducted a quasi-experiment to assess whether developers’ personality affects team climate. They measure personality traits with the NEO-FFI Test [9] and the TCI questionnaire. Participants were 105 Computer Science students. Results suggested that the Extroversion personality factor has an influence on software quality and no relation with team satisfaction.

Soomro *et al.* [22] conducted a survey with 36 IT employees concerning the relationship between personality traits, team climate, and performance. They adopted IPIP-NEO personality and TCI tests for assessing the personality traits and team climate perception, and the performance by following the approach proposed in [8]. Extroversion was significantly related to both team climate and team performance.

Soomro *et al.* [21] performed a Systematic Literature Review (SLR) on the research studies in SE investigating the relationships between personality traits and team climate and performances. Their results revealed that at that date of the execution of such SLR, there was no significant research on the relationships between personality and team climate.

Acuna *et al.* [2] investigated the effect of personality and team climate on product quality and satisfaction in software development teams. Results were aggregated from a twice replicated quasi-experiment and revealed that there exists a positive relationship between all four climate factors and satisfaction. Also, individuals with higher Agreeableness personality factor have the highest satisfaction levels, while both Extroversion personality and Participative Safety and Task Orientation climate perceptions are positively correlated to software product quality.

Shameem *et al.* [18] proposed a framework aiming at associating personality traits with team climate factors. The authors asserted that conscious and extroverted team members have a positive influence on the team climate and may get effective team performance. Only a discussion is conducted, without the support of empirical investigations.

Vishnubhotla *et al.* [23] studied the relationships between the five-factor model personality traits and the factors related to team climate within the context of Agile teams working in a Telecom company. Participants were 43 software professionals. Their results revealed that the Agreeableness personality trait has a significant positive relationship with the perceived level of team climate. The authors also defined regression models for predicting team climate factors from Agreeableness.

User studies in the context of (distributed) smart-working are lacking. We conducted the study presented in this paper to better understand personality-team climate relationships in a distributed smart-working development environment due to the current pandemic context. We also provided a linear regression model for predicting Task Orientation.

3 Study Design and Planning

3.1 Goal

Many software companies, in their software development process, use remote cooperation among team members, for example, both asynchronously by using distributed development tools and synchronous by video calls. This was why we were interested in studying the relationships between personality traits and team climate when members work in a smart-working context. Therefore, the goal of our study, using Goal-Question-Metric (GQM) [5], can be defined as follows:

Analyze personality traits and team climate for the purpose of understanding their perception and correlation with respect to the development of multi-platform applications for smart devices from the viewpoint of the developer in the context of distributed smart-working development teams composed of Computer Science students.

3.2 Participants

The participants were 53 students of a master degree (*i.e.*, graduate) in Computer Science at the University of Salerno. Students were enrolled in the Enterprise Mobile Application Development (EMAD) course for the a.y. 2020/2021. This course was delivered in Italian Language. The students enrolled in the EMAD course were 23.06 years old on average ($\sigma = 1.24$), 3 were female (6%), and the remaining were male (94%). Students were grouped into 19 teams according to their preferences; 15 teams were composed of three members and 4 by two. All the students had web programming experience (average score of object-oriented programming, web programming, and database courses was higher than

24/30) and, before the EMAD course, they did not know React Native, NodeJS, and Firebase, namely the technologies presented in that course.

As a laboratory activity of the EMAD course, the students were asked to accomplish a software project in groups. Each course project consisted of the development of a multi-platform application for smart devices with both front-end and back-end. The teams were asked to develop the front-end by using React Native, while the back-end with NodeJS or serverless technology, like Firebase. We asked the participants to use Microsoft Teams for F2F meetings and Github for distributed version control and source code management. Although we did not impose any restriction on the communication language, the communication took place in Italian. The development lasted from the beginning of October 2020 to the end of February 2021. The participation in our study was voluntary and all the students of the EMAD course took part to it.

3.3 Data Collection

The course started on September 15th 2020. After one week, the lecture of the course (one of the authors) sent an email to each student asking if they would like to participate in our study. If she was willing to participate, she first filled in a consensus form, and then she filled in the IPIP-NEO-120 questionnaire. Both in the email and survey we stated the purposes of our research and assured students that their data would be used only for research purposes and treated anonymously. To alleviate any possible concerns, we guaranteed anonymity to each participant and assured that none other than members of the research group would have access to the data collected. All 53 students complied with these terms and submitted the first survey. Each survey was tagged with a unique id (such as M1, M2...). The participants had to fill in the IPIP-NEO-120 questionnaire by October 15th. All 53 students submitted the TCI questionnaire by February 15th 2021. Participants filled in a consensus form. Following the approach adopted by [23], the IPIP-NEO-120 answers of all members were entered by one of the authors into an online version of the IPIP-NEO questionnaire,² which compares the given responses with responses given by individuals of similar age and gender. These numerical scores are in percentile form. The individual reports give further information as it classifies the given scores as low, average, or high.

3.4 Data Analysis Procedure

We used the R statistical environment³ to perform our data analysis according to the following steps:

² Dr. John A. Johnson, Professor of Psychology, Penn State University, Short Form for the IPIP-NEO (International Personality Item Pool Representation of the NEO PI-R®), <https://bit.ly/3nHo8tK>.

³ <https://cran.r-project.org>.

- **Descriptive analysis.** We show the data distribution of the two questionnaires by using boxplots. We also report descriptive statistics, *i.e.*, median, mean, and standard deviation, and Coefficient of Variation (CV). CV is a dimensionless measure defined as the ratio of the standard deviation and the mean. It represents the variability in relation to the mean of the population. It is useful to perform a relative comparison of two measurements with different units of measure.
- **Data Aggregation.** To analyze overall team view it is needed to aggregate the scores of individual subjects. The aggregation of individual data is only justified if there is consensus among team members, which must be measured using some form of inter-rater agreement. To this aim, generally, the ICC(1) index is computed. This requires that the ICC(1) index be over 0.20. ICC is based on the assumption that data are normally distributed.
- **Correlation analysis.** We decided to perform correlation analysis to measure the relationships between personality traits and team climate factors. We planned to use the Pearson correlation test. To apply this kind of analysis, we verified the normality of data by using the Shapiro-Wilk test [19] on the TCI and personality trait scores by setting a 95% confidence interval ($\alpha = 0.05$). A p -value smaller than α allows us to reject the null hypothesis and to conclude that the distribution is not normal. In this case, we exploited the Spearman non-parametric test by fixing α equals to 0.05 as for all the other statistical tests used in our data analysis. Thus, to reject the null hypothesis (samples are uncorrelated) the p – value must be less than 0.05. When either the Pearson correlation test or the Spearman non-parametric test allowed us to reject the null hypothesis that samples are uncorrelated, we further studied that significant correlation. As for the meaning of the correlation, we consider the interpretation provided in Table 1, *e.g.*, if the correlation value is in the interval $[0.20, 0.39]$ the correlation is then considered weak and positive.
- **Regression analysis.** By following the approach adopted by [23], we used linear regression for assessing whether some personality trait variables explain some team climate factors. Linear regression may be performed when specific requirements are held. Samples have to be normally distributed, check performed during the correlation analysis. The relationship between the independent and dependent variables to be linear. The linearity assumption may be tested by examining the scatter plots. We also verified the normality of the residual errors by using the Shapiro-Wilk normality test on the residuals, requiring p – value ≥ 0.05 . The absence of auto-correlation was verified by using the Durbin-Watson test, passed for results in the $[1.5, 2.5]$ range. The homoscedasticity in our residuals was tested with the Breusch-Pagan test, passing for p – value ≥ 0.05 .

4 Results

In this section, we present the results of our data analysis.

Table 1. Correlation Intervals

Correlation intervals	Strength of the correlation
0.00 to 0.19 (−0.19 to 0)	Very weak positive (negative)
0.20 to 0.39 (−0.39 to −0.20)	Weak positive (negative)
0.40 to 0.69 (−0.69 to −0.40)	Moderate positive (negative)
0.70 to 0.89 (−0.89 to −0.70)	Strong positive (negative)
0.90 to 1 (−1 to −0.90)	very Strong positive (negative)

4.1 Descriptive Analysis

In Table 2, we report the descriptive statistics to the answers to the IPIP-NEO questionnaire according to the five personality traits: Openness, Extroversion, Agreeableness, Conscientiousness, and Neuroticism. The answers to this questionnaire are graphically summarized by the boxplots shown in Fig. 1. In these boxplots, we also show three thresholds, so delimiting the scores for personality traits as: low, average, and high. For example, a score is average if it is in between 30 and 70. All the medians reported in Table 2 and shown in the boxes in Fig. 1 are in the average area and the highest median value is for Agreeableness (65). This is a relevant aspect for team working: it represents the tendency to be altruistic, kind, trustworthy, and cooperative. Also, Conscientiousness has a high median (61). This factor denotes that team members generally are careful and diligent. As for Neuroticism, which is a negative quality, the medial value is equal to 50. The lower median value can be observed for Openness, which means that team members tend to be less creative, imaginative, and adventurous.

Table 2. Distribution of personality traits’ scores.

Personality trait	Mean	Median	Std. Dev.	CV
Openness	39.15	37	21.99	56%
Extroversion	52.43	50	24.35	37%
Agreeableness	60.92	65	26.08	43%
Conscientiousness	60.42	61	22.50	37%
Neuroticism	46.26	50	25.09	54%

In Table 2, we report also the values of the Coefficient of Variation (CV) for each personality trait. Openness is the personality trait with the greatest CV value (56%). This means that Openness has the biggest dispersion around the mean. Neuroticism has also a relatively high CV (54%). CV values less than 50% can be observed for the other traits. In addition, for Conscientiousness and Agreeableness high mean values can be observed. Therefore, we can safely assume that most of the participants are cooperative and kind, due to the high

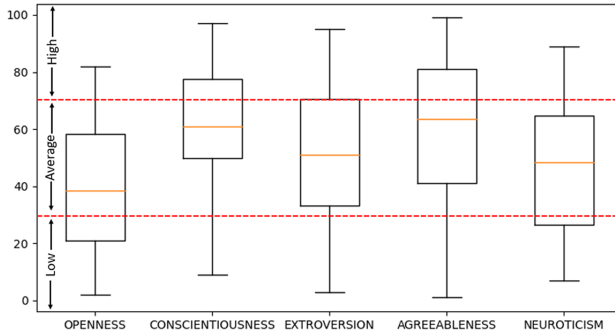


Fig. 1. Personality trait scores.

Agreeableness (average value is equal to 60.92) , and also well organized and determined, (average value for Conscientiousness is equal to 60.42).

The team climate score statistics are reported in Table 3, while we graphically summarize the distributions of the values for Vision, Participation Safety, Support for Innovation, and Task Orientation by the box-plots shown in Fig. 2. These boxplots show that the distributions are negatively skewed for Support for Innovation, Vision, and Participation Safety. As for Participation Safety, 50% of the scores is over 4.63 and $CV = 14.75\%$. This denotes that the values are concentrated around the mean. All the distributions are characterized by a low dispersion around the mean and a few outliers can be observed for Vision and Participation Safety (Fig. 2). The medians of Vision and Participation Safety were amongst the highest. However, median scores for the other two traits can be considered high as well. Descriptive statistics suggest that most team members had a clear vision of the team objectives and were able to safely participate in the team decisions.

We also computed the Individual Perceived Team Climate (IPTC) [23]. A person’s IPTC is computed by averaging his overall scores of the four team climate factors. We show in Fig. 3 the distribution of all the IPTC values in corresponding teams. We can observe that the Individual Perceived Team Climate scores of the teams is higher than 3, except for team 3, where one of the members scored 2.56.

Table 3. Distribution of team climate scores.

Team climate trait	Mean	Median	Std. Dev.	CV
Vision	4.12	4.36	0.72	17.39%
Participation Safety	4.38	4.63	0.65	14.75%
Support for Innovation	4.12	4.13	0.69	16.75%
Task Orientation	3.79	3.78	0.51	13.43%

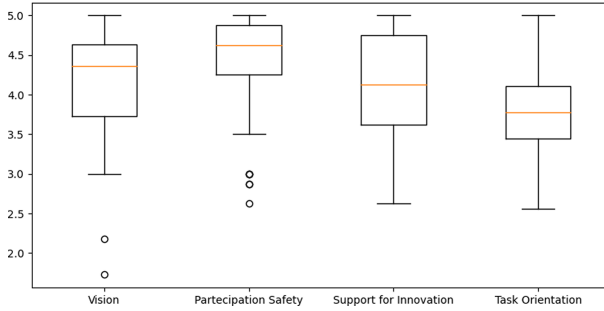


Fig. 2. Team climate overall scores.

4.2 Normality Test Results

The application of the Shapiro-Wilk test to the personality trait values revealed that only Extroversion ($p - value = 0.248$) was normally distributed, while Conscientiousness ($p - value = 0.041$), Agreeableness ($p - value = 0.032$), Neuroticism ($p - value = 0.014$) and Openness to Experience ($p - value = 0.020$) were not. In the case of team climate factors, only the values for Task Orientation ($p - value = 0.657$) were normally distributed.

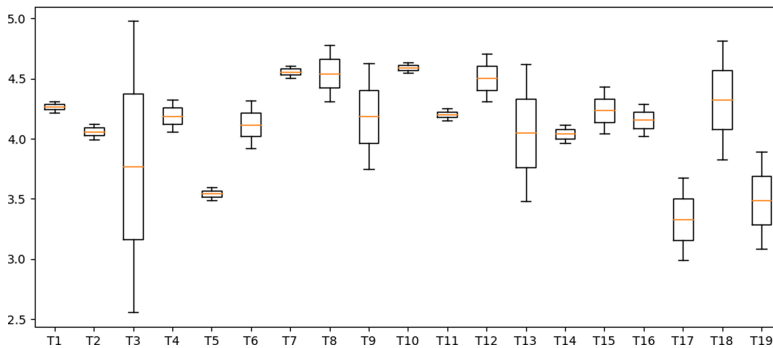


Fig. 3. IPTC team scores.

4.3 Correlation Analysis

In this section, we present the results of correlation analysis.

In Table 4, we show in bold the correlations having $p - value$ less than 0.05 (*i.e.*, statistically significant) for which the correlation—between Personality Traits and Perceived Team Climate—is significant and can be analyzed. On the basis of the results shown in Sect. 4.3, we used the Spearman non-parametric

Table 4. p-value correlation matrix for personality traits and team climate factors.

	Vision	Task orientation	Support for innovation	Participation safety
Extroversion	0.029	0.001	0.016	0.00031
Agreeableness	0.7	0.99	0.48	0.15
Conscientiousness	0.16	0.97	0.96	0.38
Neuroticism	0.21	0.28	0.26	0.16
Openness	0,71	0.72	0.37	0.94

test in all the cases with the only exception of Extroversion/Task Orientation, where we adopted the Pearson correlation test.

Concerning the correlation between Extroversion and Vision, the correlation result is $R = 0.3$. This denotes a weak positive correlation. This means that the increase in value of one of the variables generally corresponds to the increase of the other. Thus, extroverted individuals have in general a better clarity of the team objectives.

The correlation results for Extroversion and Task Orientation is depicted in Fig. 4. Also in this case, a (weak) positive correlation is shown ($R = 0.37$). This means that in general extroverted individuals are inclined to maximize the quality of task performance.

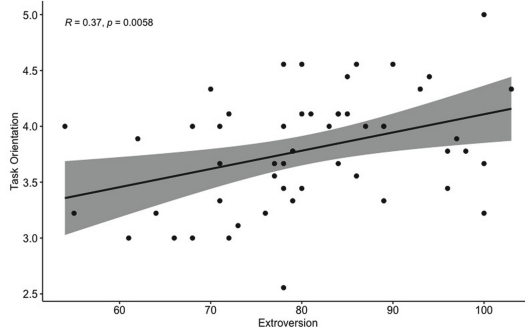


Fig. 4. Extroversion - task orientation.

Extroversion is also related to Support for Innovation by a (weak) significant positive correlation ($R = 0.33$). This means that extroverted individuals are also creative and promote new ideas.

Extroverted individuals seems also actively involved in group interactions with interpersonal and non-threatening relationships and favor a non-judgemental climate (Participation Safety) with $R = 0.48$. The correlation between Extroversion and Participation Safety can be considered moderate positive.

4.4 Regression Analysis

In this section, we study the contribution of Extroversion on Task Orientation, namely the only team climate factor that satisfied the normality assumption required to apply the linear regression analysis. In Table 5, we report the results of the test of the assumptions required to apply regression analysis. As shown, all the three assumptions are satisfied.

Table 5. Tests for validating regression assumptions.

Predictive model	Shapiro-Wilk	Durbin-Watson	Breush
Extroversion-Task Orientation	p-value = 0.6063	1.76439	0.8294

Table 6. Regression model description for predicting task orientation.

	Estimate	Stand. Error	t-value	p-value
Intercept	2.476705	0.461988	5.361	Signif level 0.00
Extroversion	0.016316	0.005671	2.877	Signif level 0.01
Residual Standard Error	0.4769 on 51 degrees of freedom			
R-squared	0.1396			
F-statistic	8.278 on 1 and 51 DF			Signif level 0.05

The regression model that predicts Task Orientation is summarized in Table 6. The intercept value is 2.48. It represents the expected value of Task Orientation variable when we consider the average of Extroversion computed on all the samples. Extroversion = 0.02 represents the slope of the line in Fig. 4. It means that when Extroversion increases by 1 the average score of Task Orientation increases by 0.02. R-squared is the percentage of the response variable variation that is explained by a linear model. In this case, R-squared is 13.96%. This means that 13.96% of Task Orientation is due to the Extroversion value. The percent error measures how close a value measured by the model is to a true value. It is given by the ratio between the residual standard error (0.477) and the expected value of Task Orientation variable (the intercept equal to 2.477), which is 19.25%. *p-values* < 0.01 for intercept and slope. This means that both individual variables are significant. Besides, *p-values* < 0.05 for F-statistic. We can conclude that R-squared is not equal to zero, and the correlation between the model and dependent variable is statistically significant.

5 Threats to Validity

In this section, we discuss the main threats that could affect the validity of the results of this study.

Internal Validity. Correlation studies prove associations, they do not demonstrate causation [3]. Therefore, this study can just prove that a correlation between some personality traits and team climate factors exists (as the defined research question asked). We also defined a regression model between a personality trait and a team climate factor. Also, the difference among the projects each team had to accomplish may be a threat that may influence the team climate.

Construct Validity. We considered a single variable for each construct studied in the study. Concerning social threats, we tried to prevent evaluation apprehension by informing participants that their data were anonymized and used in aggregated form. To mitigate the threat of violated assumptions of statistical tests, in case of not normally distributed data we adopted the Spearman's correlation test which does not require data normality. The strength of the associations between the variables in the case of Spearman's or Pearson's correlation index (*i.e.*, R) is the index itself, so any issue that affects the ability to draw the correct conclusion seems to have been handled. To deal with this threat we plan to replicate the study in different contexts with a larger number of participants.

Conclusion Validity. Two standard questionnaires were adopted to measure personality traits and team climate perception (Reliability of measures). Both the questionnaires are largely adopted in the literature. Nevertheless, participants may not have answered sincerely or carefully to the statements of both the questionnaires. To try to limit this threat we informed the participants in the study that their data were anonymized and that they could freely leave the study when they want.

External Validity. The study we conducted could not be generalized to the universe of the distributed smart-working development projects. Participants were master students. But they may be more skilled in the multi-platform technologies adopted for performing the software application because these are relatively new. They were in the second year of their master degree in Computer Science and coming to work soon. This may mitigate this threat. The number of developers and the number of teams might be considered limited. Each team is composed of at most three participants. This might threaten the validity of the results since teams in real projects could include a larger number of members.

6 Implications

Extrovert individuals like to deal with others and interact and communicate easily. The results of our study revealed that Extroversion has a positive correlation on all the team climate factors in our context (Computer Science students - Smart-working development). This factor may be particularly relevant in the

case of smart-working, because greater Extroversion may be needed when F2F contact is missing. It is also worth mentioning that it seems that Extroversion is related to software quality [2], and also with both team climate and team performance variables [22]. Vishnubhotla *et al.* [23] in the context of a Telecom company determined Agreeableness as related to team climate factors, no relationship was found for Extroversion. The researcher may be interested in determining the considered relationships to different kinds of users (*e.g.*, smart-working professionals) or specific development processes (*e.g.*, Agile context). In that respect, our results pose the basis for future research.

In the defined regression model Extroversion explained the 13.96% of Task Orientation. The judgment of the R-squared value depends on the context: in a quantitative environment these results may be modest, but in a social science context many variables intervene. Thus, low values as 10% may be accepted for studies in the field of arts, humanities, and social sciences because human behavior is difficult to predict [10]. This point may interest for the researcher: she may improve our results by considering a different and wider sample where TCI data are normally distributed and try to improve our model or get other prediction models for the other team climate factors. It is important to point out that this study is correlational, so no causal inference can be made (for example, we cannot say that adding an extrovert to the team will raise the climate level).

In our study, we cannot aggregate the data of the team climate and personality traits factors because data were not normally distributed. But we can consider the scores of the project works produced by the teams according to the teacher evaluation that assessed participation, system complexity, technological difficulty, usability, and presentation, with a score ranging from 1 to 5 and weight 25% of the total score for each factor. Results revealed that T3 obtained the worst score (score = 1), while T19 and T17 scored 2. The T3 team members had several discussions and the project risked being abandoned, see Fig. 3. The teacher intervention was required to solve the conflicts. This gives us the idea that different climate visions among the team members may be related to performances, but it is only an idea that should be better investigated.

7 Conclusion

In this paper, we presented the results of a preliminary investigation aiming at studying the relationships between personality traits and team climate in a distributed smart-working development context. Two largely adopted standard questionnaires were used for collecting data about the perceptions of 53 Computer Science students grouped in 19 teams. Results of the correlation analysis revealed that extrovert, out-going individuals in the current pandemic context when performing remote distributed work the Extroversion personality trait seems to be related to team climate. We also defined a regression model for predicting task Orientation scores by using the Extroversion personality trait. The value of our research concerns the improvement of our body of knowledge in the context of personality traits and team climate in a smart-working distributed development context.

To deal with external validity threats, we plan to replicate our study with a greater number of participants. Also, a different kind of them (*e.g.*, students vs. practitioners) could provide a better basis for the generalization of the results. We also plan to replicate our study when the Covid-19 pandemic will be concluded. We are going to execute replications—as similar as possible to the study presented in this paper—with the goal of showing differences in the results (original experiment vs. replications) and plan future work to understand the role of the Covid-19 pandemic on team climate. Future work will be also devoted to study the relationships with productivity and other project metrics as well as product software metrics.

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