The Effects of Neuroticism on Pair Programming: An Empirical Study in the Higher Education Context

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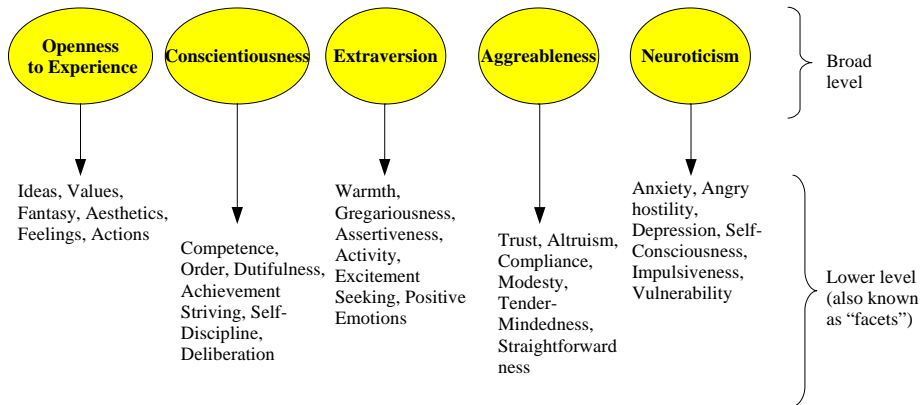John Grundy & Giles St.J. Burch

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Agenda

- Background & Motivation
- The Formal Experiment
- Results & Discussion
- Conclusions

Background & Motivation

- Motivation of study - to look at the effect of personality traits on PP using the Five-Factor Personality Model (FFM) given that it had not yet been previously investigated at length particularly in academic settings.

- Why FFM? It is widely accepted by personality psychologists as a robust taxonomy of personality and relevant to the educational context.

- Purpose of study: To investigate whether or not the personality trait neuroticism affects academic performance of students who pair programmed.

- Neuroticism indicates the level of emotional stability, reported to have a prominent role in learning and in educational contexts.

- Existing literature reports that neuroticism negatively affects academic success; but evidence from I/O psychology literature are mixed concerning neuroticism-team performance relationship.

The Five Factor Model (FFM)

"Big Five" traits

| Openness to Experience | Conscientiousness | Extraversion | Aggreableness | Neuroticism | Broad level |

Ideas, Values, Fantasy, Aesthetics, Feelings, Actions

Competence, Order, Dutifulness, Achievement Striving, Self-Discipline, Deliberation

Warmth, Gregariousness, Assertiveness, Activity, Excitement Seeking, Positive Emotions

Trust, Altruism, Compliance, Modesty, Tender-Mindedness, Straightforward ness

Anxiety, Angry hostility, Depression, Self-Consciousness, Impulsiveness, Vulnerability

Lower level (also known as "facets")

Formulation of Hypotheses

- Neuroticism is negatively related with students' academic performance due to the effects of anxiety and impulsiveness. But in certain conditions, evidence from I/O psychology showed that neuroticism may actually facilitate performance (Burch & Anderson, 2008).

- Teams comprising more emotionally stable members are likely to achieve higher performance than teams that consist of members who are emotionally unstable (Barrick et al, 1998).

- We predicted that levels of neuroticism may affect PP's effectiveness.

- Null hypotheses:
  Differences in levels of neuroticism do not affect the effectiveness of students who pair programmed.

- Alternative hypotheses:
  Differences in levels of neuroticism affect the effectiveness of students who pair programmed.

The Formal Experiment

- The formal experiment was conducted during semester 2, 2009 at The University of Auckland.
- Subjects: Undergraduate students enrolled in an introductory programming course
- Purpose: To improve the effectiveness of PP as a pedagogical tool in HE institutions.
- Focus: To investigate the influence of neuroticism factor towards the success of the PP practice in CS/SE courses/tasks.
- Obtained ethics approval - UAHPEC.

Variables & Design

- Independent variable: Level of neuroticism (low/medium/high).
- Dependent variables: academic performance (AP), satisfaction and confidence levels.
- AP was measured using tutorial exercises, assignments, a midterm test and final exam scores. Satisfaction and confidence were measured using a five-point likert-scale questionnaire.
- "Single factor between-group design" was the experimental design.

Research Settings & Instruments

- Participants were given an overview of the experiment during the course's first lecture.

- We gathered personality data early on in the semester using the online version of the IPIP-NEO.

- Pairs were allocated based on the scores on the neuroticism traits (between 0 and 99).

- Level of satisfaction/confidence when working in pairs - measured using a questionnaire.

| Scores	Lowest 40%	Middle 30%	Highest 30%
Level	Low	Medium	High

Experimental Setup

- Experiment was held in weekly compulsory tutorials.
- Every tutorial lasted for two hours - 45 minutes explanation, 75 minutes for exercises.
- After a "pair-jelling" period of 30 minutes, students swapped their roles.
- Before the end of each tutorial, students filled out a questionnaire to rate their feedback.
- Exercises given during all the tutorials taking place during a given week remained the same throughout that week.
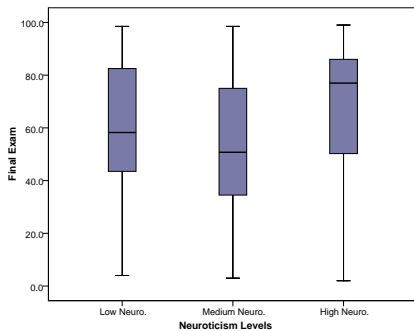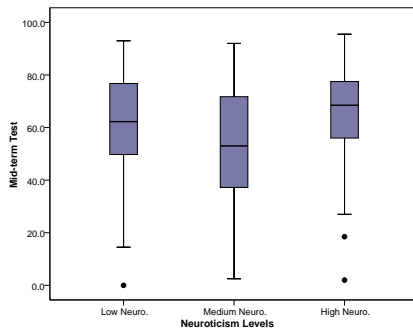
Results - Demographics

- Number of subjects enrolled: 270 first-year students.
- 202 (75%) male students; 68 (25%) female students.
- Age ranged from 19 - 47 years (mode age = 19 years).
- 79% had no work experience.
- Of 270, 118 (44%) students completed the personality test.

Results - Data distributions
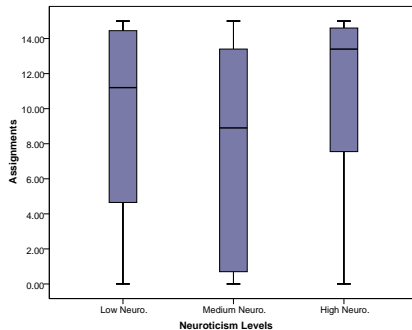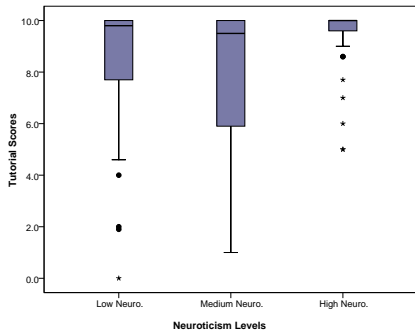
Results - Data distributions

Results - Correlations between FFM and performance

	Tut.	Assign.	Test	Exam	Extrav.	Agreea.	Consc.	Neuro.
Tut.	1							
Assign.	0.56**	1						
Test	0.36**	0.54**	1					
Exam	0.46**	0.68**	0.83**	1				
Extrav.	0.00	-0.01	0.05	-0.02	1			
Agreea.	-0.00	-0.02	0.09	-0.02	0.09	1		
Consc.	0.29**	0.19*	0.19*	0.15	0.28**	0.21*	1	
Neuro.	0.07	0.05	0.03	0.01	-0.24*	-0.15	-0.25**	1
Openn.	0.02	0.01	0.18	0.15	0.07	0.24**	0.01	0.21*

**. Correlation is significant at the 0.01 level (two-tailed).
*. Correlation is significant at the 0.05 level (two-tailed).

- No significant relationship between neuroticism and performance.
- The only trait that showed a significant relationship with academic performance was conscientiousness.

Results - Hypothesis Testing

- Hypotheses were tested using One-Way analysis of variance.
- Result showed no significant difference between the groups.
- Thus, we could not find strong support to reject the null hypothesis.

Performance Measures	Neuroticism Levels	N	Mean	SD	Sig.
Tutorials (range: 0 to 10)	Low Neuro.	40	8.75	2.03	0.07
	Medium Neuro.	45	8.11	2.65	
	High Neuro.	33	9.27	1.46	
	Total	118	8.65	2.19	
Assignments (range: 0 to 15)	Low Neuro.	40	10.14	5.13	0.05
	Medium Neuro.	45	8.21	5.65	
	High Neuro.	33	10.98	4.59	
	Total	118	9.64	5.28	
Test (range: 0 to 100)	Low Neuro.	40	59.85	21.57	0.07
	Medium Neuro.	43	52.20	23.71	
	High Neuro.	33	64.00	21.92	
	Total	116	58.19	22.82	
Final Exam (range: 0 to 100)	Low Neuro.	38	59.97	23.59	0.23
	Medium Neuro.	42	52.59	26.75	
	High Neuro.	31	63.06	31.32	
	Total	111	58.05	27.22	

Results - Satisfaction & Confidence

- On average 84% students were satisfied working with their partner.
- Ordinal variable "satisfaction" was measured using Kruskal-Wallis test; we found no differences in terms of satisfaction levels between groups (alpha 0.05).
- Results showed that the satisfaction level of paired students were not affected by levels of neuroticism.
- Confidence in solving the exercises was generally high among the low and medium neuroticism groups.

Discussion

- Paired students academic performance was not significantly affected by their level of neuroticism.
- Some studies report that neuroticism may not always prominent in affecting performance of students teams:
  - Effects may be absent due to the "'broad concept"' or wider impression represented by this traits. Peeters et al. (2006) proposed to study the effects at the facets level (e.g. self-consciousness, impulsiveness) to obtain a more genuine effect.
  - Moderator effects may influence the personality-performance relationship (e.g. complexity of task type).
  - Walle & Hannay (2009) investigated the nature of collaboration in PP and found some relationships between personality traits and the type of collaboration that may affect performance.

Conclusions

- Different levels of neuroticism do not appear to significantly impact academic performance when engaging in PP. PP group formation may ignore this trait for such introductory programming tasks.

- Positive correlation between conscientiousness in almost all performance measures; need further empirical evidence to confirm the cause-effect.

- Students' satisfaction and confidence level did not differ depending on the levels of neuroticism when pairing.

- Future work: i) to explore whether PP mitigates neuroticism for students engaging in PP tasks - would pairing help students better cope with anxiety or other negative aspects of neuroticism? ii) replicate the current study to see whether findings converge.

Thank You
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